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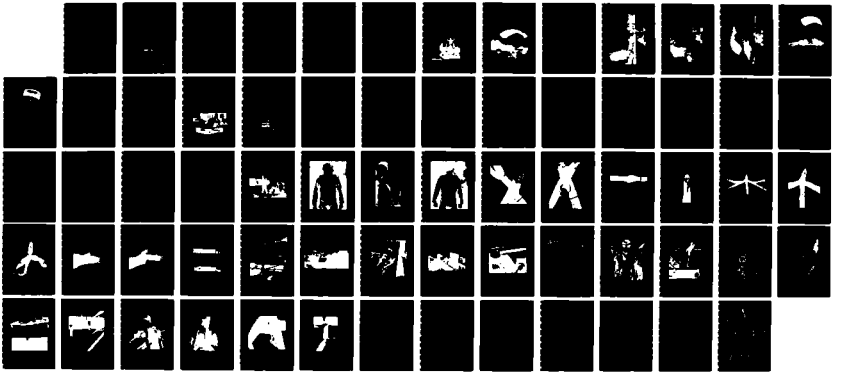

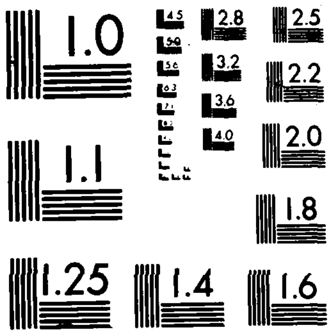

ROCOPY RESOLUTION TEST CHART

NWC TP 6728

12

Parascension Training Project

by
Manley C. Butler, Jr.
and
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Aerosystems Department

SEPTEMBER 1986

NAVAL WEAPONS CENTER
CHINA LAKE, CA 93555-6001

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Naval Weapons Center

FOREWORD

This report documents all phases of the parascension training project performed at the Naval Weapons Center from February 1985 to February 1986. The project began under the Aircrew Gliding Escape System (AGES) Program and is funded by the Naval Air Development Center, Warminster, PA.

The report has been reviewed for technical accuracy by LCdr. L. W. Schoenberg and J. R. Bates.

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26 August 1986

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(U) The Naval Weapons Center, China Lake, CA, has developed a safe, effective, and economical method of training aircrewmembers in the use of high-performance gliding parachutes. The use of a mobile launching platform, the parascension cart, for a trainee allows precise control of the launch conditions by the crew and allows training operations in light or variable winds that otherwise might cause difficulty in the launch. This report documents all phases of the parascension training project including the design and construction of the parascension cart; the towing bridles and associated rigging; the personal equipment used by the trainees; and the setup, checkout, and operational procedures used.

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INTRODUCTION

The term "parascension" was created from the words parachute and ascend; it is used to describe all types of lifting parachutes that are towed aloft from the ground. The impetus for the parascension training project at the Naval Weapons Center (NWC) arose in the Aircrew Gliding Escape System (AGES) Program.

The AGES Program is developing a high-performance, ram-air-inflated, gliding parachute wing for use in Navy ejection seat aircraft. This paper will present the method of parascension training developed under the AGES Program at NWC. The program, test results, and recommendations from the work done in the AGES Program from 1977 through 1986 are presented in References 1 and 2. The parascension cart and details of its construction are detailed in Appendix A; the various harnesses, rigging components, and details of the prelaunch assembly procedures are presented in Appendix B; and the Standard Operating Procedures (SOP) are given in Appendix C.

PARASCENSION TRAINING PROJECT

AGES PROGRAM

The most significant accomplishments in the AGES Program include the demonstration of acceptable deployment and opening characteristics at a pack opening speed of 300 knots indicated airspeed (KIAS) at 15,000 feet above mean sea level (MSL) with 300 pounds suspended weight; a successful in-flight ejection test initiated at 500 knots equivalent airspeed (KEAS) (pack opening occurred at approximately 225 KIAS); and the development of the parascension training project.

Although the technical problems of adapting a ram-air-inflated, gliding parachute wing to the ejection seat environment have been essentially solved and the solutions demonstrated, there remain several issues to be addressed. The most commonly asked questions regarding the use of this type of parachute are (1) How will we train the aircrewmembers in the use of this parachute; and (2) How will we avoid injuring an unconscious aircrewmember who is unable to control the parachute? This paper addresses the first question and documents the parascension training methods developed at the NWC. The second question, which is concerned with the acceptable biodynamic limits of personnel parachute landings, has not been fully answered. A simplified theoretical analysis of the injury potential encountered under various landing conditions is presented in Reference 2. Reference 3 addresses the problems of experimentally determining acceptable biodynamic limits for parachute performance. The experimental study of landing conditions is expected to be completed by the end of fiscal year 1986.

TRAINING

The purpose of parascension training in general is to enable potential users, particularly aircrewmembers, to become familiar with the flight characteristics of ram-air-inflated, gliding parachute wings without making an actual parachute jump, and to conduct this training under close supervision in a safe and non-threatening environment so that the maximum training benefit can accrue in the shortest possible time. The purpose of the parascension training project at NWC is to evaluate the training method and to determine its ability to fulfill these goals. If accepted, parascension training would be added to the standard emergency and survival training provided to all Navy aircrewmembers.

Several important advances in parascension training techniques were developed by Bureau of Land Management (BLM) smokejumpers at Fort Wainwright, AL as part of their conversion effort to ram-air canopies. The parascension project at NWC has depended heavily on the BLM group for guidance and initial training, and in April 1985 four BLM smokejumpers from Ft. Wainwright were detailed to NWC to assist in establishing the parascension project here.

The key development by the BLM group is the parascension cart (Figure 1). The trainee is held to the cart by the hold-down harness until the launch crew can inflate and stabilize the canopy. This eliminates the need, when parascending without the cart, for the trainee to run

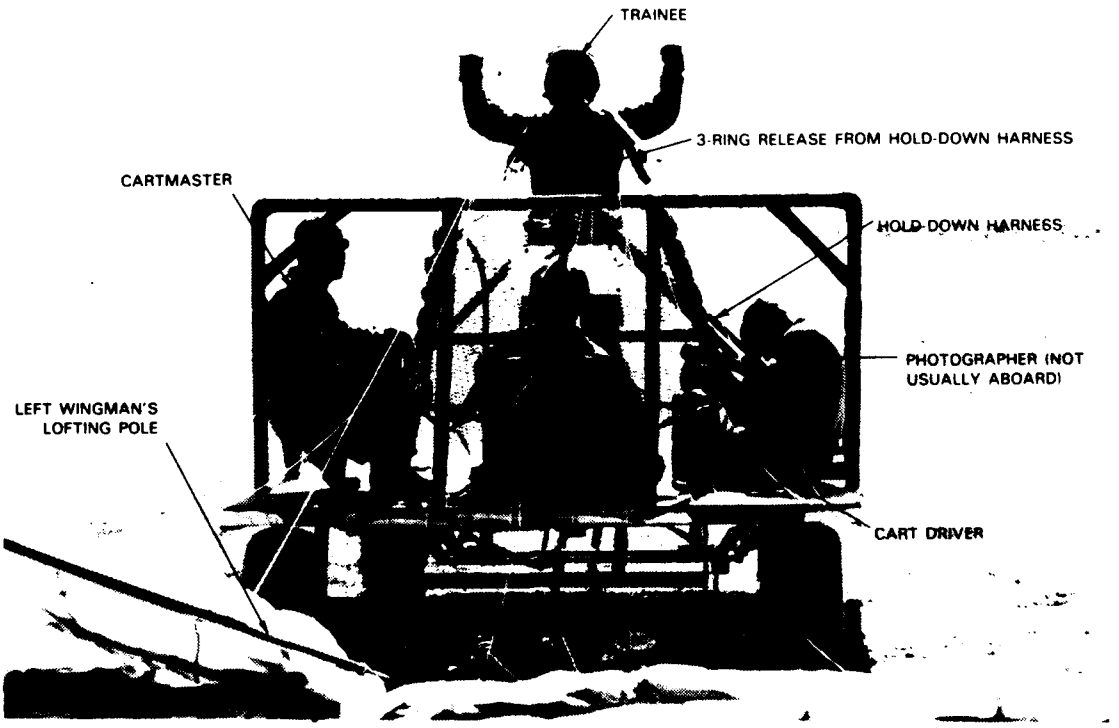


FIGURE 1. Parascension Cart Ready for Operation.

along the ground during inflation of the canopy, thus avoiding runway rash if the trainee were to fall.

Figure 1 also shows the canopy itself (lying on the ground); the parascension trainee; the cartmaster (kneeling on the left rear of the cart); the cart driver; and a photographer, who is not usually aboard the cart. Figure 2 shows the parascension cart in motion, after the canopy has inflated and stabilized above the trainee. Also shown are the tow rope and tow bridle, and the Y-bridle attached to the trainee. Note that both the trainee and the cart are attached to the tow rope; the cart is released from the tow rope by the same action that releases the trainee from the cart; and the trainee can self-release from the tow rope at the top of the climbout.

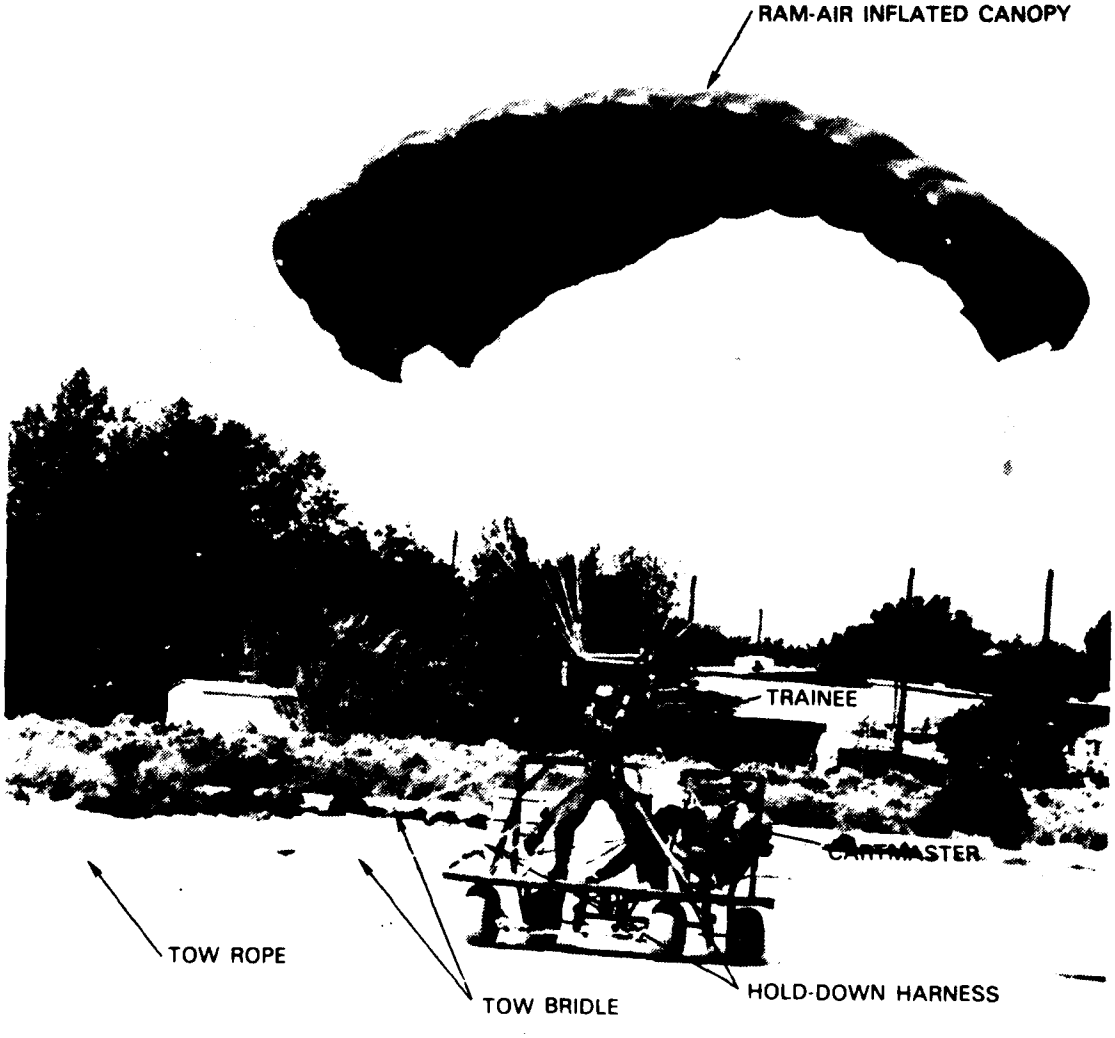


FIGURE 2. Parascension Cart With Canopy Inflated and Stabilized.

The following are descriptions of each parascension training crewmember and their tasks:

Cartmaster: is responsible for the overall safe conduct of the operation, and actually releases the trainee from the cart during the launch.

Cart driver: steers the cart under the direction of the cartmaster.

Wingmen (one on each side of the cart): help to inflate canopy during initial roll.

Tow Truck Driver: drives the tow truck under the direction of the cartmaster.

Safety Observer: rides in the back of the tow truck to ensure proper operating procedure; is capable of disconnecting the tow rope at the truck in an emergency.

Trainee: follows directions from the cartmaster prior to and during launch; follows directions given via radio from the ground controller while under the canopy during climbout and descent.

Landing Instructor/Ground Controller: directs the trainee via radio from launch through landing.

Roadguards: stand at both ends of the operating area if on a travelled roadway.

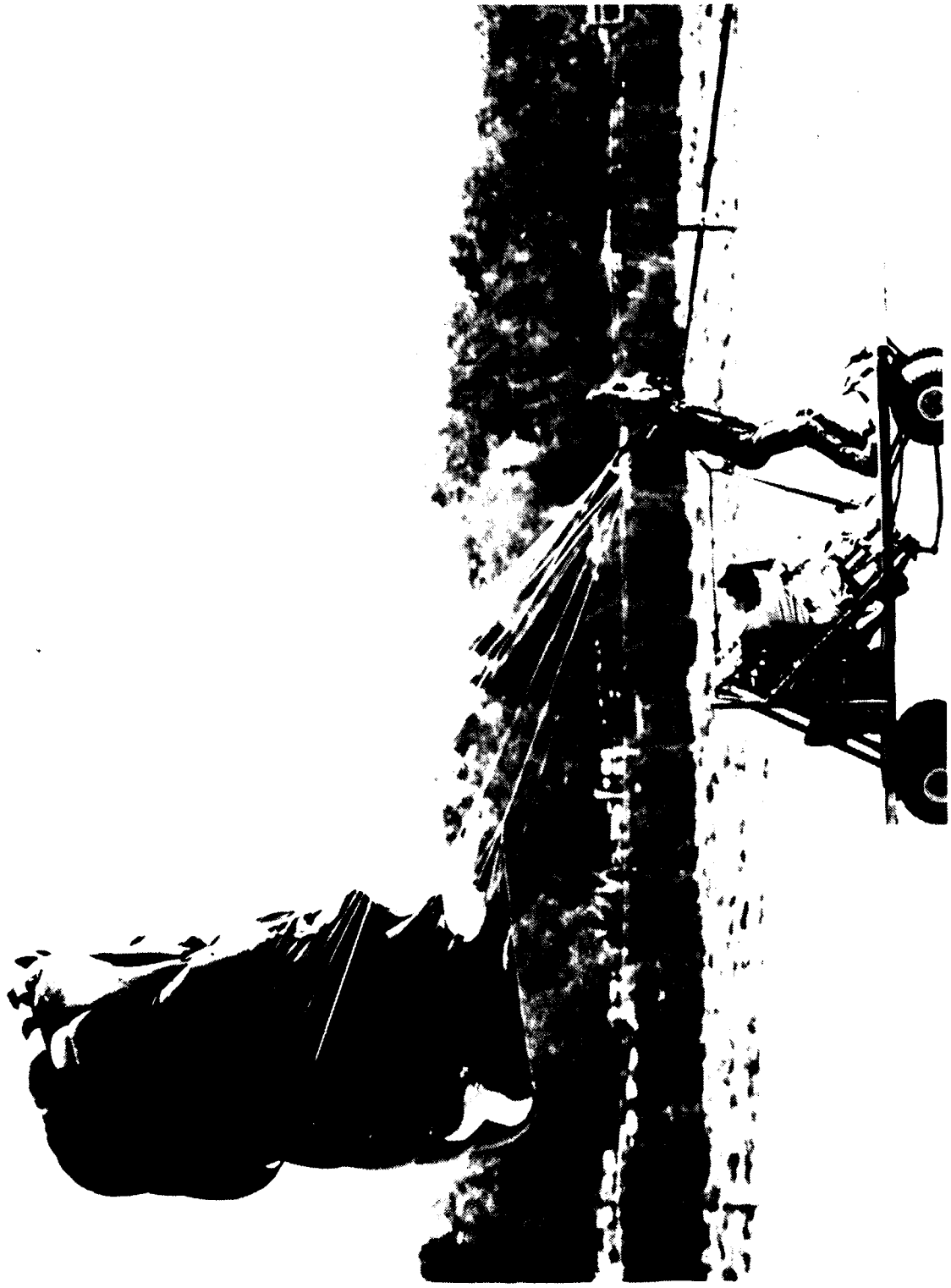
Medical Personnel: are EMT qualified and on hand during all operations.

TYPICAL FLIGHT SEQUENCE

A normal parascension training flight consists of the following stages:

Inflation: The canopy is laid out, straightened, and spread by the two wingmen, who hold the leading edge of the canopy aloft on the ends of the lofting poles. The "inflate" command is given by the cartmaster and the tow truck accelerates to about 10 miles per hour. The wingmen run alongside the cart, and as the canopy begins to fill with air it lifts off the poles and rises above the trainee. Figure 3(a) shows the canopy just after it has lifted off the lofting poles; it is very soft and mushy at this point. Figures 3(b) and 3(c) show the canopy as it fills then stabilizes above the trainee.

Launch: After the canopy is inflated and stabilized above the trainee, the "launch" command is given, whereupon the cartmaster activates the handle that simultaneously releases the trainee from the cart and the cart from the tow rope. The cart is then brought to a stop by the driver. Figure 4 shows the canopy immediately after launch; notice that the cart section of the tow bridle has released and is trailing below the tow rope/tow bridle junction. Also note that the hold-down harness has dropped back onto the cart after the trainee was released.



(a) Canopy just after it has lifted off the lofting poles.

FIGURE 3. Canopy Filling and Lifting Off Lofting Poles.

(b) Canopy filling.

FIGURE 3. (Contd.)

(c) Canopy stabilizing above the trainee.

FIGURE 3. (Contd.)

FIGURE 4. Canopy Immediately After Launch

Lift: During the lift phase the trainee responds to commands from the ground controller; occasionally a crosswind will require continuous corrections to keep the rope over the roadway during climbout. Figure 5 shows a typical lift phase; again notice the rope in trail.

Tow Release: At the top of the climbout or when the end of the available tow area is reached the tow truck comes to a stop, which allows the tow rope to go slack. As soon as the rope is slack, the trainee is given the command "release tow," after which the trainee is in free gliding flight just as if a parachute jump had been made from an

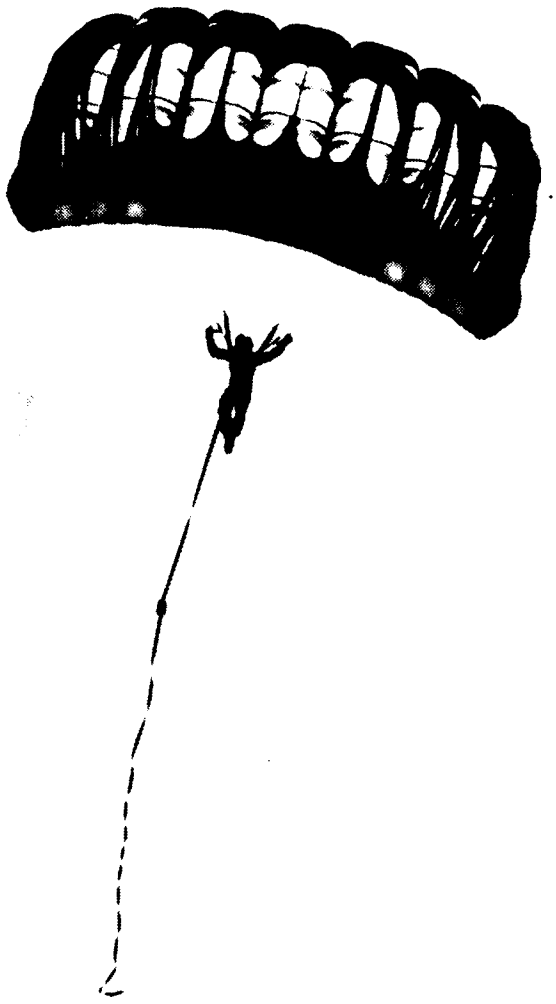


FIGURE 5. Trainee in Lift Phase of Operation.

airplane. The actual release mechanism is located on the forward end of the Y-bridle about 3 feet in front of the trainee; the Y-bridle is the only part of the towing assembly that stays on the trainee after the release.

Flight Maneuvers: Most training flights will consist of a pre-planned set of flight maneuvers that may be executed by the trainee either independently or under the direction of the ground controller.

Landing: The landing is conducted under the direction of the ground controller until the trainee is able to perform the landing without guidance. The primary objective of

the landing instruction is to teach the trainee to land safely and in the general area chosen by the trainee.

Flared Landings: Proper technique is taught to trainees. Because an improperly executed flared landing can result in a much harder impact, trainees are taught to land at half brakes to minimize the chance of trainee error causing an injury on landing.

SUMMARY

The parascension training project at NWC has successfully demonstrated its ability to aid in teaching aircrewmembers the use of ram-air-inflated, gliding parachute wings. Further developments in the training program and equipment are expected to make this training technique the method of choice for training aircrewmembers when the AGES parachute enters the Fleet in 1990.

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3. David C. Johansen and Kurt E. Wittendorfer. "Biodynamics of Personnel Parachute Landings: A Fresh Look at Parachute Descent Rates," in Proceedings of the 23rd Annual SAFE Symposium. SAFE Association, Las Vegas, NV, 1-5 December 1985. 326 pp.

Appendix A

PARASCENSION CART DESIGN AND CONSTRUCTION DETAILS

Figures A-1 through A-8 show construction details of the parascension cart used at NWC. This particular cart was designed by NWC personnel using guidance from the BLM smokejumpers. The dimensions shown, as well as the particular parts used, were selected for convenience and ease of construction. Should one desire to construct a similar cart, one should use the information contained herein as a guide only.

The parascension cart came into service in early 1985 and has had only minor problems. The roll bar padding and the plywood decking were replaced after 9 months because of degradation caused by outside storage. The original rear axle assembly, which was taken from a golfcart-sized vehicle, was replaced with the assembly shown here. The original assembly had inadequate load capability (training crewmembers tend to ride the cart to the operating area) and excessive brake fade. The wheel adaptors shown have a support shoulder that actually carries the load from the wheel into the axle. Before manufacturing similar parts one must determine the exact requirements of the particular parts to be used.

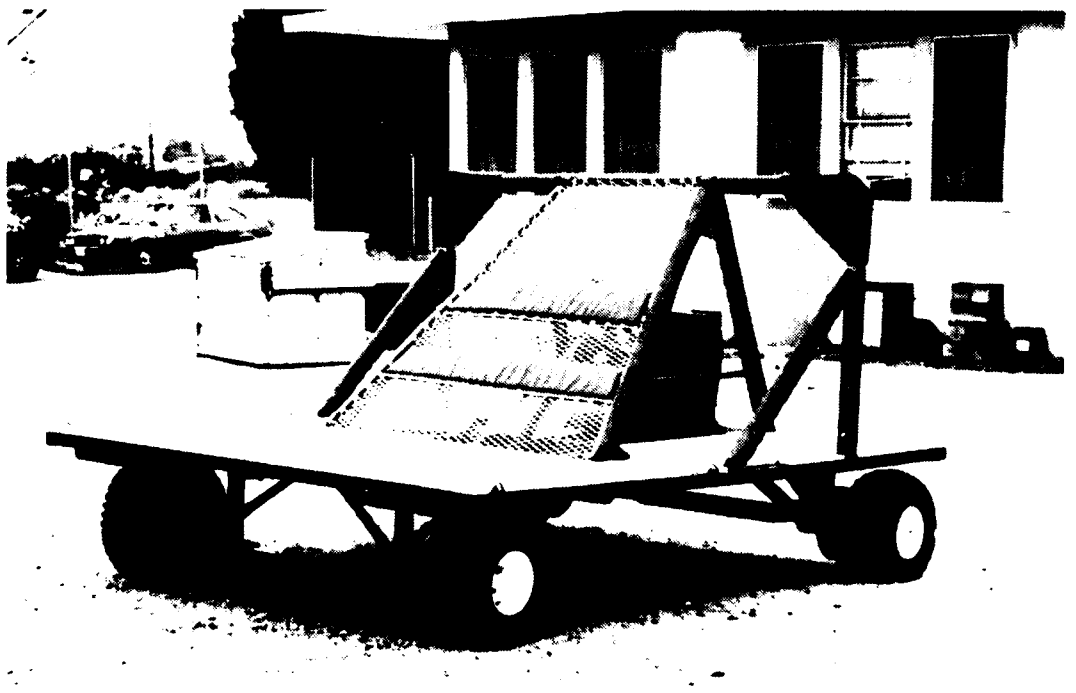


FIGURE A-1. Parascension Cart, Overall View.

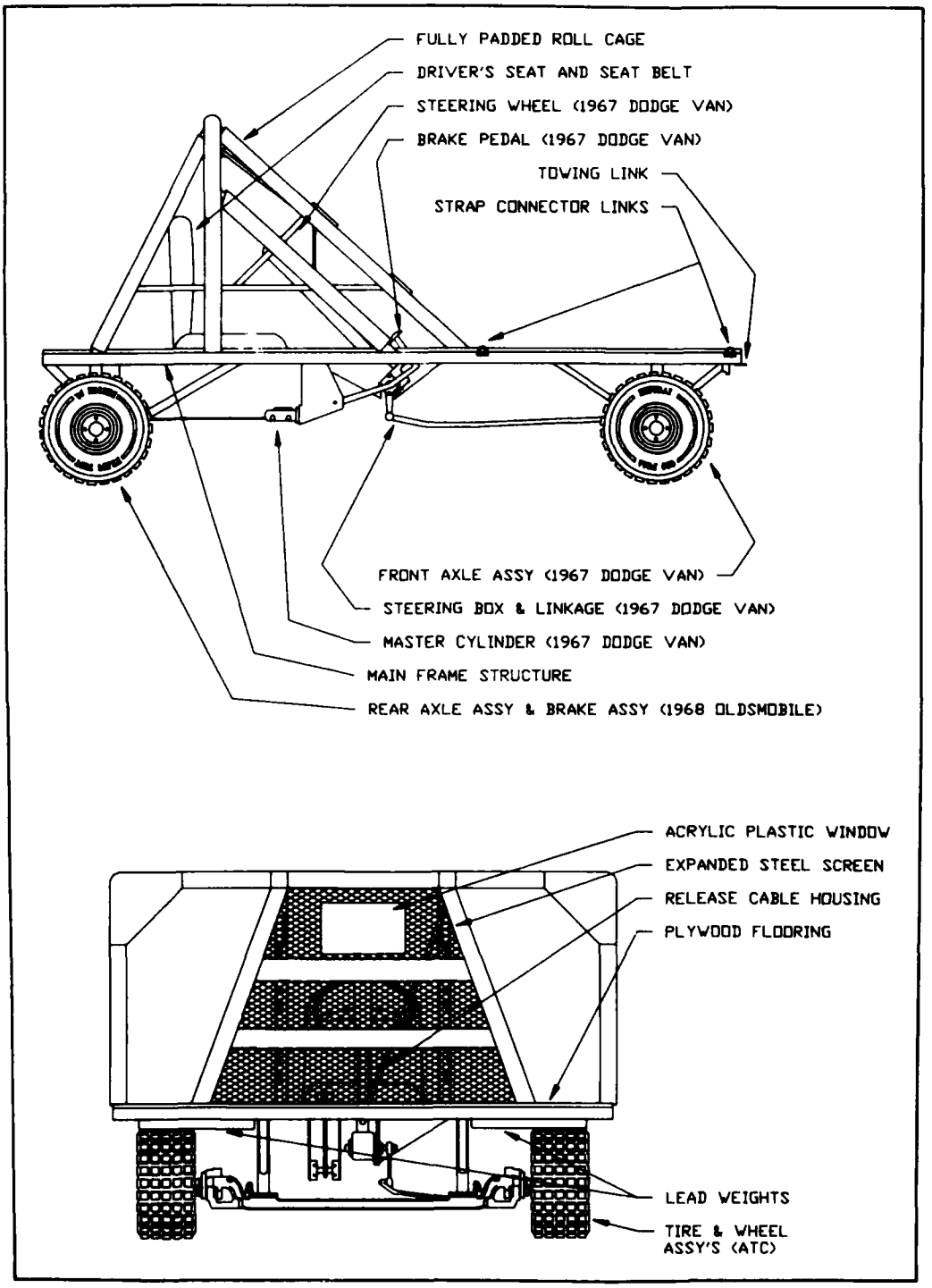


FIGURE A-2. Parascension Cart, Front and Side Views.

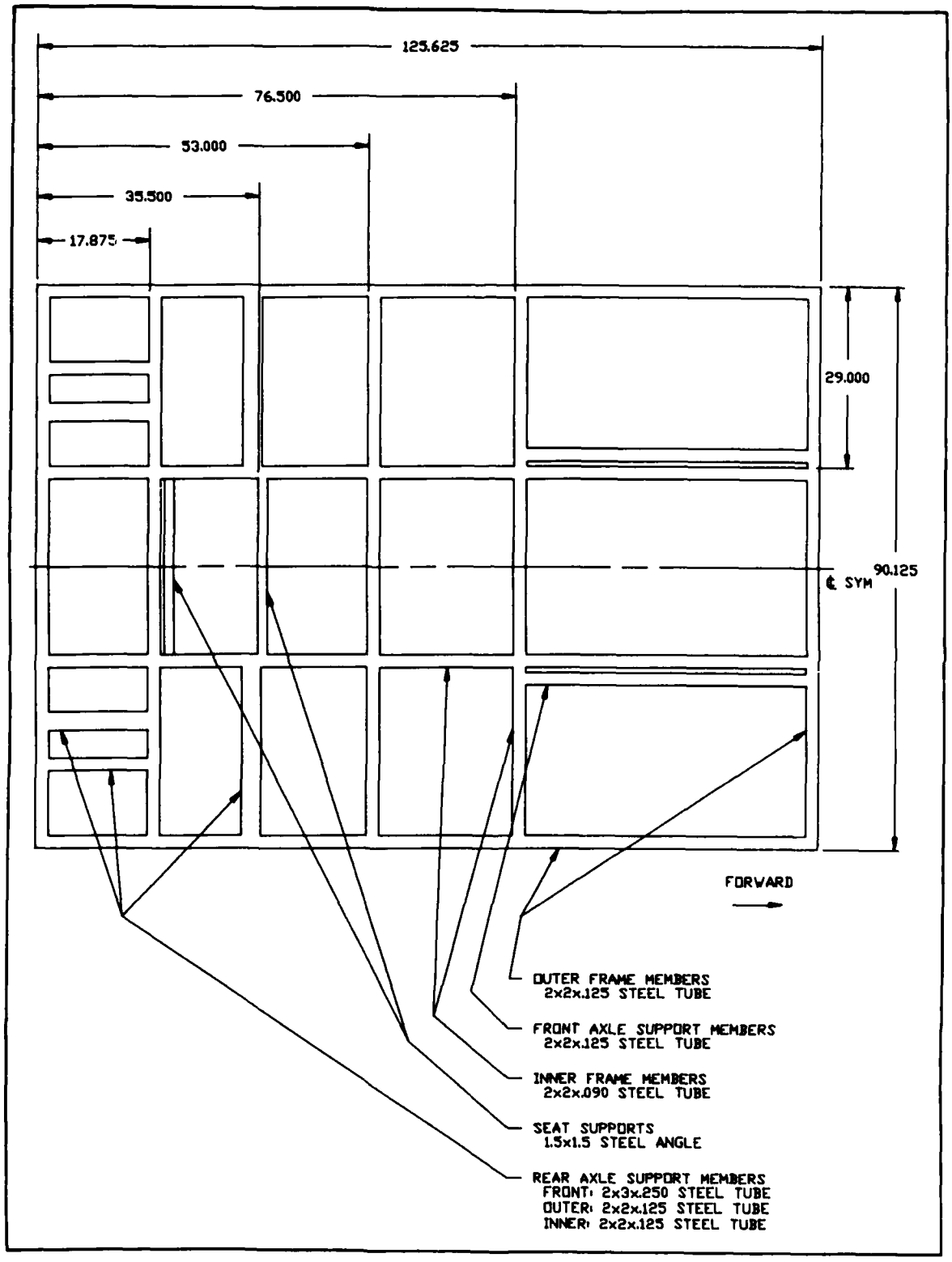


FIGURE A-3. Parascension Cart, Frame Details.

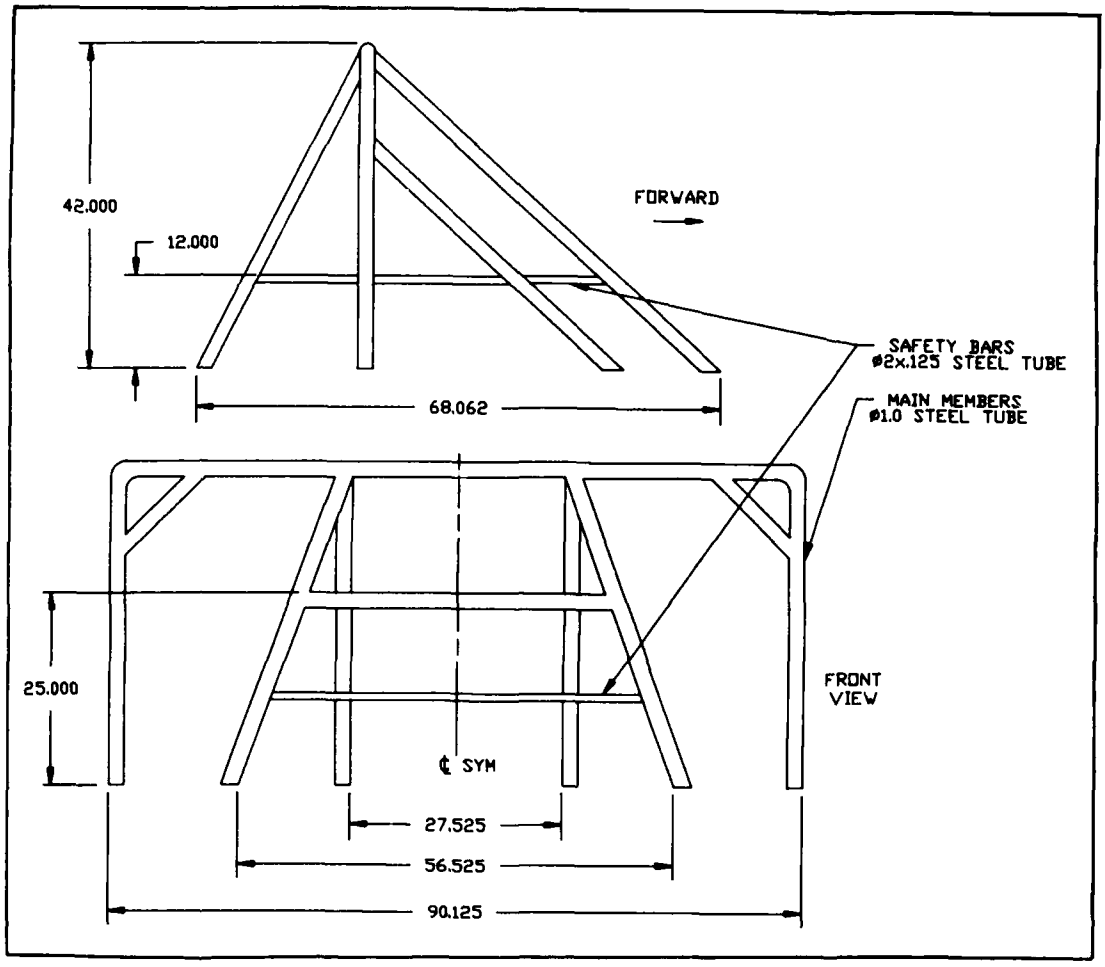


FIGURE A-4. Parascension Cart, Roll Cage Details.

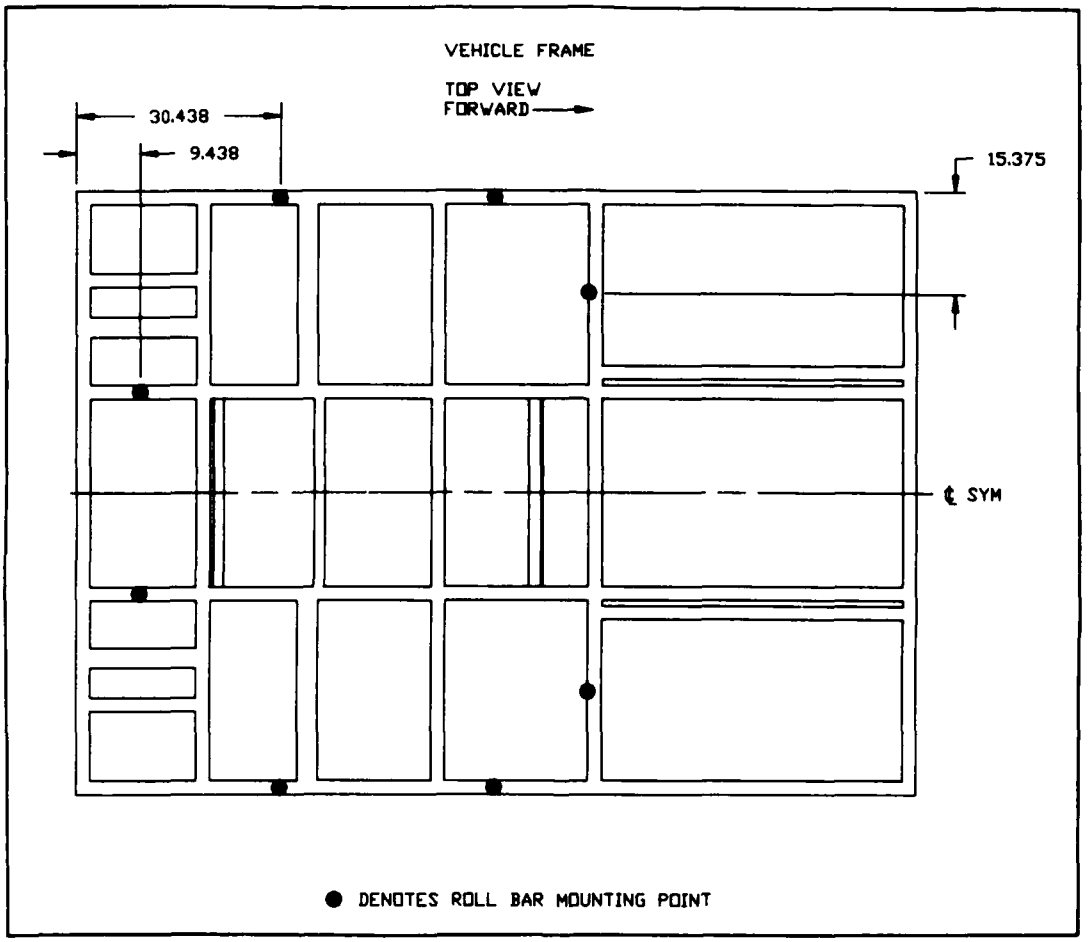


FIGURE A-5. Parascension Cart, Roll Cage Mounting Points.

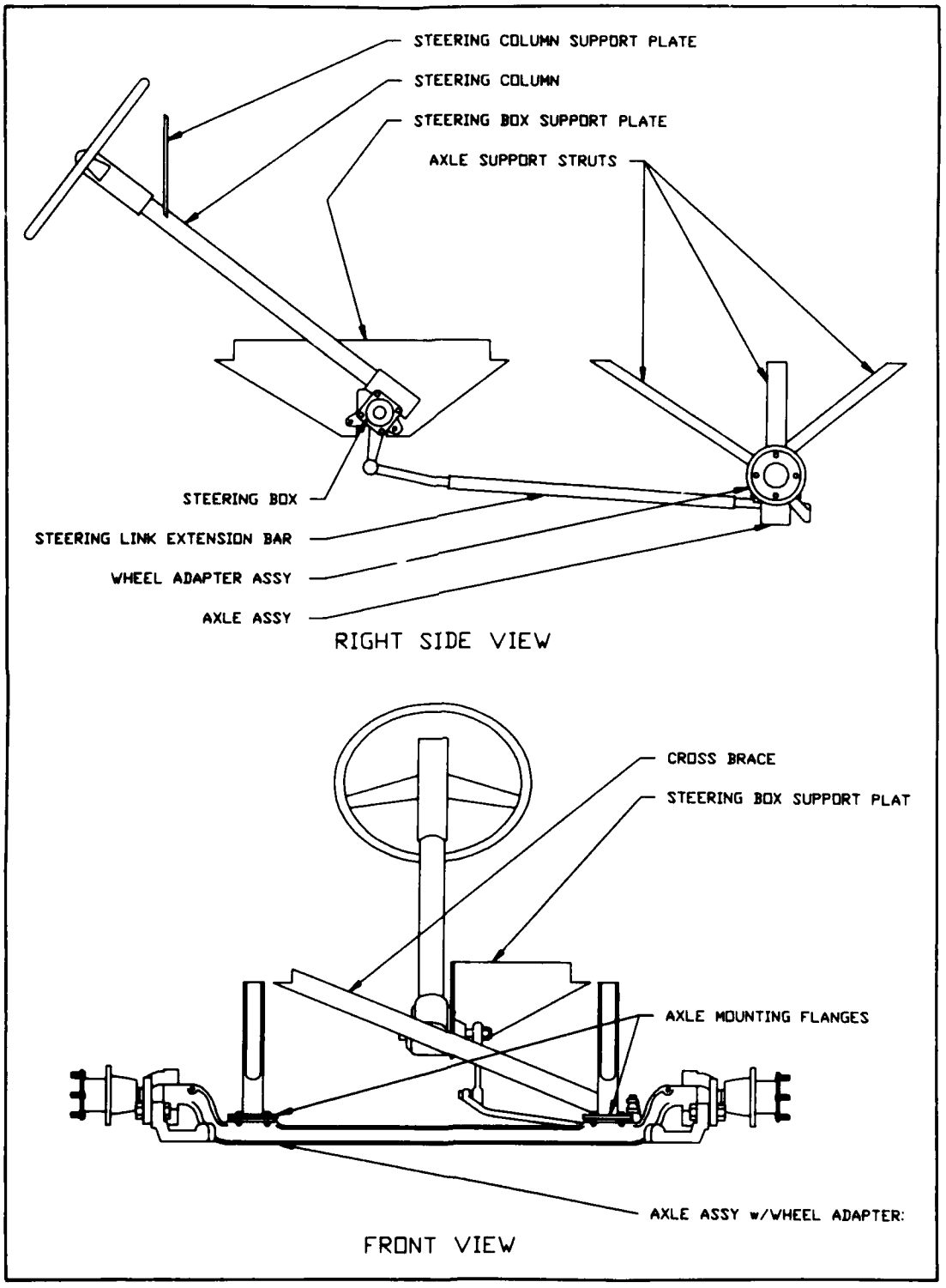


FIGURE A-6. Parascension Cart, Front Axle Views.

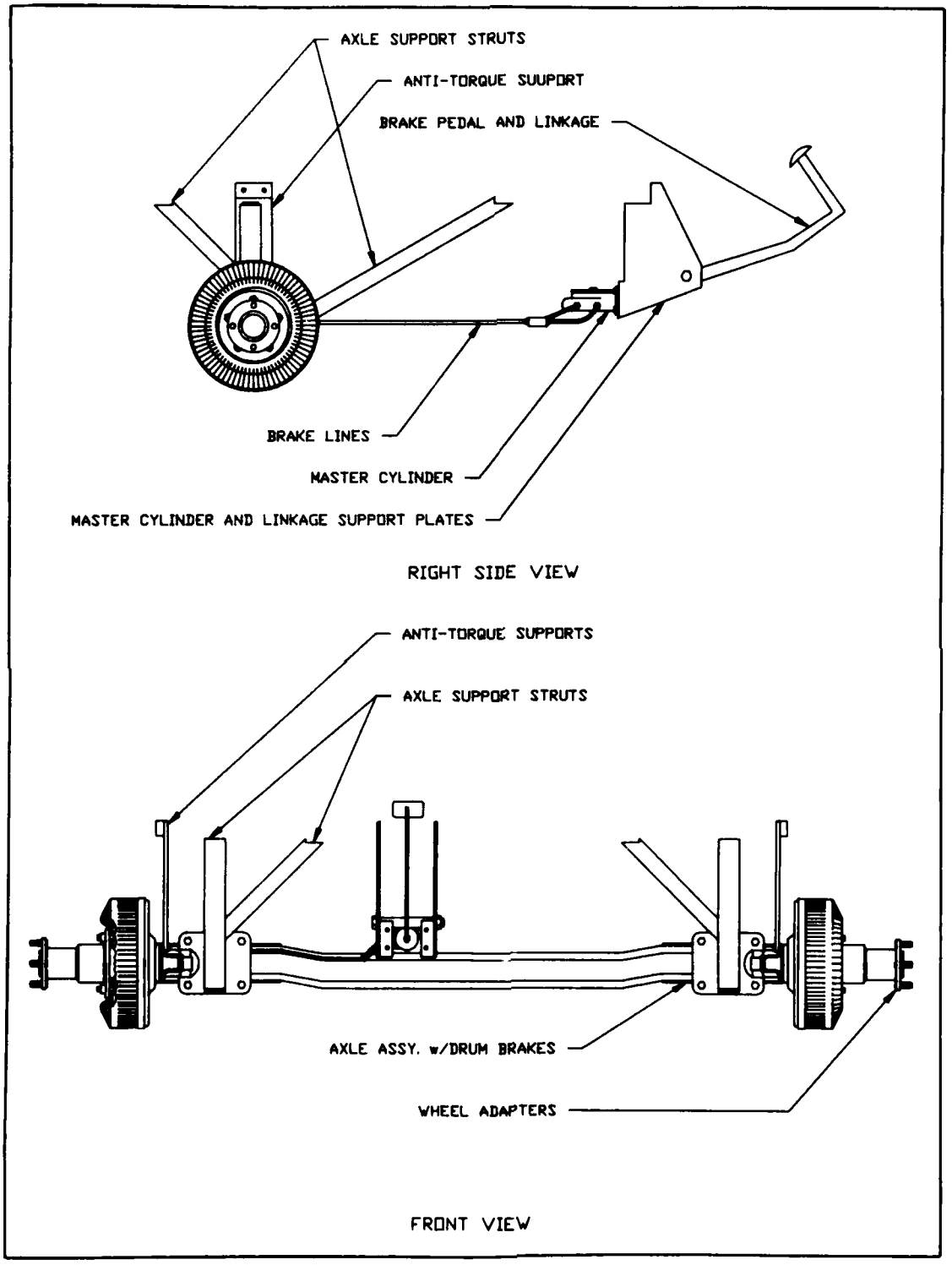


FIGURE A-7. Parascension Cart, Rear Axle Views.

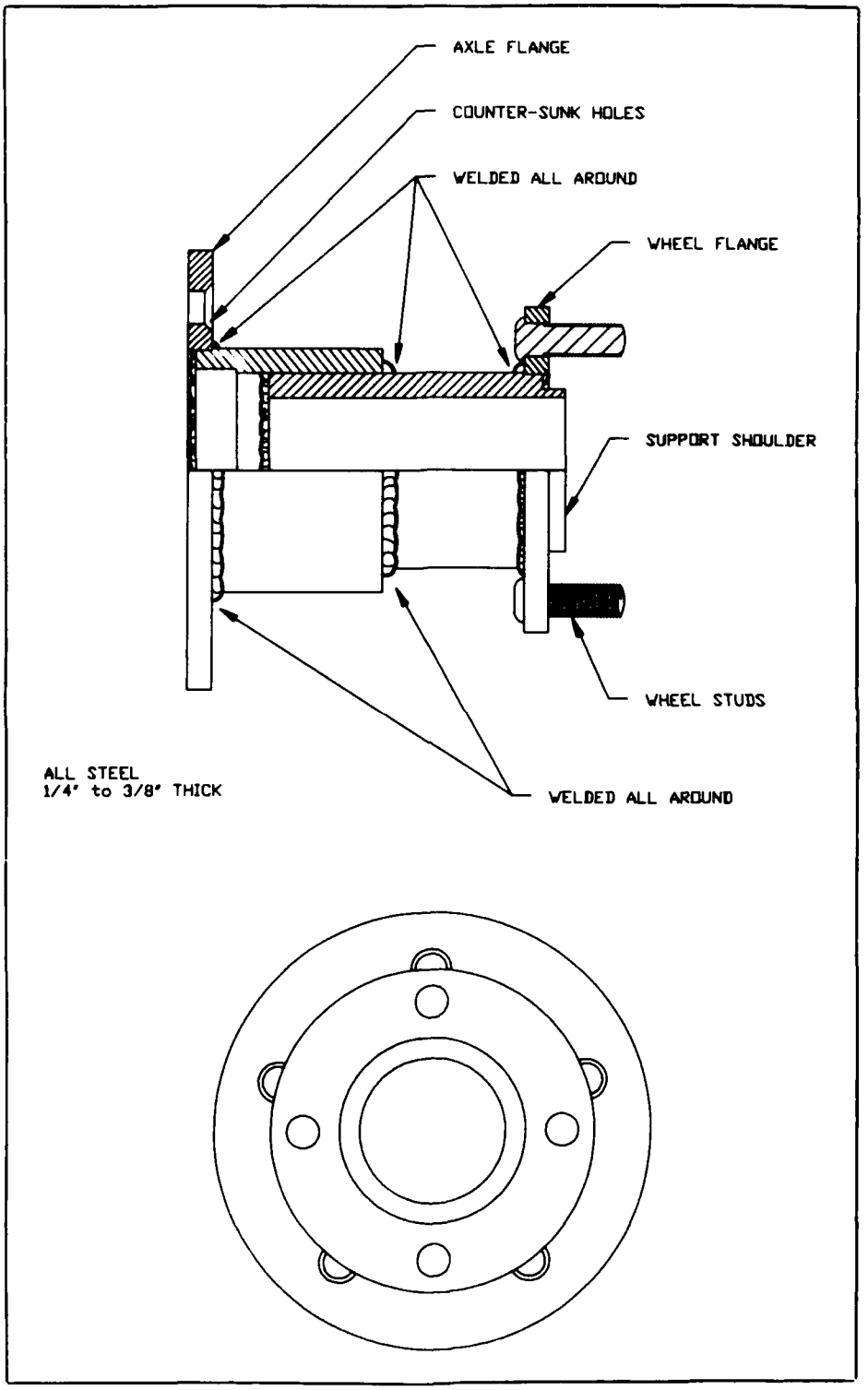


FIGURE A-8. Parascension Cart, Wheel Hub Adapter.

A suggested maintenance schedule for the parascension cart is included at the end of this appendix.

MAINTENANCE SCHEDULE

Before each day of operation:

Check tire inflation
Check tire condition
Check condition of roll bar padding
Check condition of brake lines
Check condition of plywood panels
Check condition of driver's window

Every fifth day of operation or every month (whichever comes first):

Check brake fluid level
Lubricate grease fittings
Check frame welds
Check steering box condition

Every thirtieth day of operation or every 6 months (whichever comes first):

Check brakes
Check steering box fluid level
Check vehicle for over-stress damage

Every sixtieth day of operation or every 12 months (whichever comes first):

Repack wheel bearings
Check front end alignment

MAINTENANCE ITEMS

Tires

Tire inflation should be kept at 10 psi. The tires need to be checked for wear, road damage, and weather damage. They should be replaced if tread height at any area on the tread is less than 1/16 inch or if there is sufficient road or weather damage (cracking, chunks missing, etc.) to present a safety hazard. Replacement tires should be the knobby type. Sand paddle tires are not recommended.

Brakes

The brake lines and fittings should be visually checked for leakage. The flexible lines also need to be checked for cracking and other damage and should be replaced if damage is

evident. The fluid level in the master cylinder should be kept 1/4 inch under the top edge of the reservoir. Any DOT 3 brake fluid suitable for use in a passenger car can be used in this system. Brake shoes must be replaced if any of the lining is worn within 1/32 inch of any rivet. The brake shoes and drums should be checked for wear if they begin to make any unusual noises as well as at the specified intervals.

Chassis Lubrication

The grease fittings and steering stops (Figure A-9) can be lubricated with any automotive chassis grease. The wheel bearings (front and rear) can be packed with any heavy-duty automotive wheel bearing grease. The wheel bearing grease seals need to be replaced every time the bearings are packed.

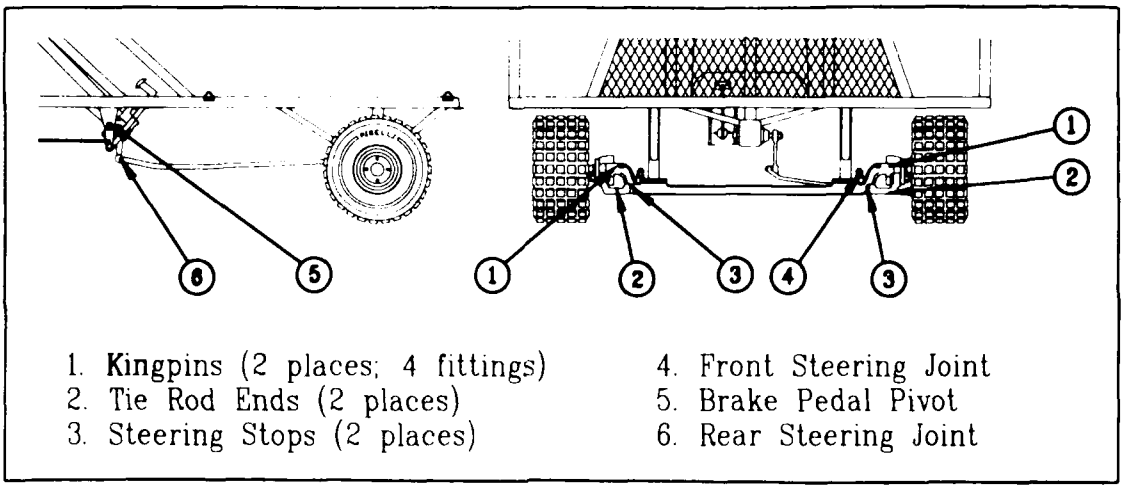


FIGURE A-9. Chassis Lubrication.

Vehicle Frame and Stress Areas

The vehicle should be visually checked for stress breakage. The following are some of the areas to be checked (Figure A-10):

A. Frame welds. All areas where frame members and axle struts are welded together.

B. Wheels. The area where the wheel bolts to the vehicle.

C. Steering mounts. Bolts and welds where the steering box mounts to its supports and where those supports mount on the vehicle frame.

D. Master cylinder mounts. Bolts and welds where the brake master cylinder mounts to its supports and where the supports mount to the frame.

E. Axle bolts. Bolts holding the axle to the axle struts (front and rear).

F. Wheel adapters. Welds and bolts on all wheel adapters.

G. Harness rings. Where the harness and tow rings are welded to the vehicle.

Breakage at any of these areas presents a serious safety hazard and must be repaired before the next vehicle operation.

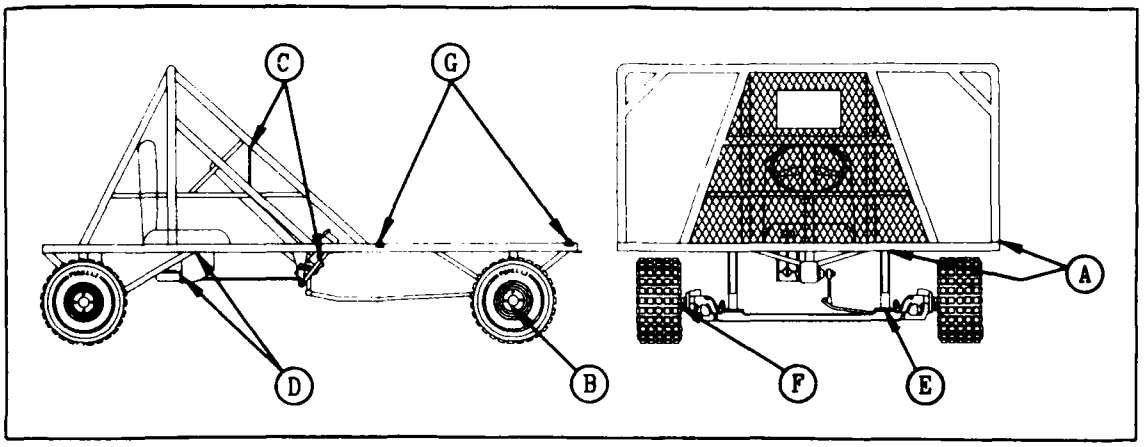


FIGURE A-10. Stress Areas.

Steering

The steering box can be visually checked for leakage. The steering fluid level should be kept just under the top of the filler hole. Any 90W automotive gear oil is suitable for refilling the steering box.

Driver's Window

The driver's window is subject to weather damage and should be replaced if it is cracked, pitted, yellowed or otherwise damaged so as to interfere with the driver's visability or ability to drive the vehicle safely.

Plywood Panels

The plywood floor panels are also subject to wear and weather damage. A panel should be replaced if it is cracked or splintered to the point where it could break, cause an injury, or otherwise present a safety hazard.

Roll Bar Padding

The roll bar padding should be visually checked for tears, cracks, and other signs of wear. Small damage areas should be immediately repaired. Padding sections should be replaced if there is sufficient damage to cause the roll bar to become an obvious safety hazard. The padding is only expected to last a year because of storing the vehicle outdoors. Covering the vehicle may delay the degradation somewhat, but it is reasonable to expect to replace the padding every year.

VEHICLE COMPONENTS

The following are the components acquired or fabricated to construct the parascension cart:

Front axle and steering assembly
Source: 1967 Dodge A-100 1/2 ton van

Brake master cylinder
Source: 1967 Dodge A-100 1/2 ton van

Parking brake handle and linkage
Source: 1967 Dodge A-100 1/2 ton van

Rear axle and brake assembly
Source: 1968 Oldsmobile Toronado
Drum size: 11 inches

Tires and wheels
Source: Nondescript three wheel all-terrain vehicles
Size: 21x12-8
Maximum inflation: 10 psi

Wheel adapters
Fabricated at NWC

Frame, roll bar, and axle supports
Fabricated at NWC

Roll bar padding
Fabricated at NWC

Maintenance procedures for components not fabricated at NWC are the same as for the vehicles originally equipped with them.

Appendix B

PARASCENSION HARNESS AND RIGGING DETAILS

Figures B-1 through B-32 show details of all the rigging and hookups required to perform parascension training using NWC equipment. The particular dimensions and components were selected for convenience, availability, and ease of manufacture. The most commonly used canopy is the Birdwing by ParaFlite, Inc., Pennsauken, NJ; however, almost any modern ram-air-inflated gliding parachute that is sized to give a wing loading of .5 lb/ft^2 (or less) could be used with careful handling.

The tensiometer assembly is a ParaFlite product, although a similar unit could be made by any hydraulics parts house. The cylinder is arranged so that tension on the tow rope acts to compress the fluid in the cylinder. As the cylinder has an effective surface area of 1 in^2, gauge readings in psi are also equal to pounds-force (tension) in the tow rope.

The harness shown (Figures B-2 through B-4) is one of several that have been built and used for parascension, none of which are significantly different than any other type of sport parachute harness. Care should be taken to ensure that the harness fits each trainee properly. The construction details of the harness are shown here for information only (Figures B-5 through B-15); there are hundreds of methods that could be used to build a satisfactory harness.

Figure B-16 shows the overall view of the truck set up for towing. The bungee legs of the tow truck towing bridle are used to prevent the hydraulic cylinder of the tensiometer assembly from bouncing up and down in the truck bed as the tow rope is alternately loaded and unloaded. The tension legs of the tow truck bridle assembly actually carry the towing load. The hydraulic hose leads to the tensionmeter gauge mounted on the dashboard. The carabiner hook connects the tow rope to the safety observer's emergency tow release mechanism. The loose end of the flexible cable that is visible near the cylinder is used to actuate the 3-ring mechanism for emergency release. The flexible cable housing on the left-side tension leg is used to route the actuation cable to the safety observer's emergency release handle. The safety observer is seated in the chair mounted in the truck bed; from there the safety observer can communicate with the driver and operate the launch signal lights through the light control switches on the panel. The safety observer can also communicate with the rest of the launch crew via two-way radio.

Note that the canopy is attached to the harness with connector links to preclude an accidental release of the trainee from the canopy (Figure B-22). The Y-bridle is also attached to the trainee with connector links.

Several of the 3-ring release mechanisms shown in Figures B-24 through B-26 were adapted from ready-made parachute risers. The release mechanisms could also be made as an integral part of the Y-bridle, hold-down harness, and other features. Again, none of the specific details shown are absolute, they are intended as a guide only.

Appendix C comprises the parascension Standard Operating Procedures for additional details on the use of the items covered here.

The Booth 3-Ring Canopy Release System

The Three Ring Release is a new device.* It would be foolish to think that everything there is to be known about it is already known. Therefore, please consider yourself a test jumper.

However, as of this writing (October 1976), we have over 3500 jumps on the system, including 15 premeditated breakaways, 6 actual emergency breakaways, and literally thousands of suspended harness tests. . . all with perfect function, no accidental release, and no structural deterioration.

Here is a list of maybe's to look out for:

1. Assemble as the diagrams show. Be sure that the nylon cord loop on the risers passes over only the small ring. Do not pass the loop over the middle ring also.

2. Do not construct any sort of cover for the rings. They will not operate if covered, and there is no reason for a cover anyway.

3. Do not wet and then refreeze the nylon cord loop. If it is rigidly frozen, the rings may not release a low drag malfunction such as a bag lock or streamer.

4. Periodically inspect the system for wear. Check
   - nylon cord loops
   - breakaway ripcord
   - cable housing endings
   - riser grommets

5. Avoid prolonged exposure to sunlight. Nylon will lose strength rapidly in sunlight, without apparent visual damage.

HOW THE SYSTEM WORKS

The riser rings are actually ten to one levers. When interlocked, their mechanical advantages multiply to equal 100 to 1. The nylon cord loop acts as a two to one pulley, yielding a total mechanical advantage of 200 to 1 per riser, or 400 to 1 for both.

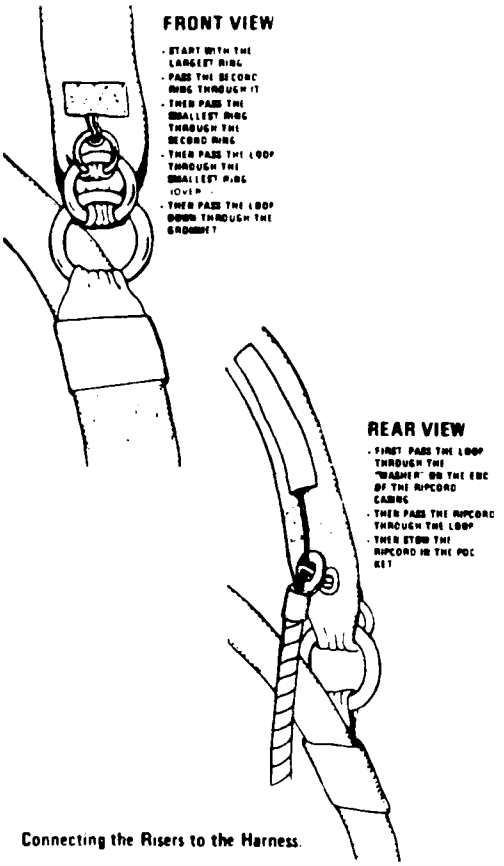
In other words, if the whole system were loaded to 2,000 lbs. (roughly equivalent to opening an unreefed ram-air at terminal), the force the nylon loop/cable locking system would be exposed to would be only *five* pounds. Or, to release a 200 pound jumper from his canopy, the cable activator need only move against a one-half pound load from each nylon loop.

BREAKAWAY PROCEDURES

Familiarize yourself with the system by practicing breakaways from a suspended harness, *before* actually jumping it.

For maximum ease of operation, the soft breakaway handle (which is velcroed in place) should be peeled away from the main lift web, *then* pulled downward about 8" to effect release. If the handle is just pulled straight down, considerably more force will be required to release the handle from the main lift web velcro.

IF you pull the breakaway ripcord cable completely out of its housing during a breakaway, throw it away before pulling the reserve ripcord.



Connecting the Risers to the Harness.

We would appreciate user comments that relate to safety, operation and maintenance of the three ring release. Please share your experiences with us so we may all learn from them.

*At the time this manual is being reprinted (May, 1978), the Three Ring Release has been installed on nearly 2,000 rigs and has earned worldwide acceptance.

3-Ring Release System Required Periodic Maintenance

The Booth 3-Ring Release System has been in use for three years, with excellent results. Although the system is at least as durable as the rest of the harness/container assembly, it requires periodic maintenance and inspection to insure proper operation.

Feedback from riggers and some of the thousands of users has made it possible to publish this set of maintenance and inspection instructions. It must be followed exactly.

Generally, it is NOT recommended that the risers be attached to the harness when new and "forgotten." Like all skydiving gear, the 3-Ring Release should be carefully inspected and cycled (operated) on a regular basis.

Specifically, the procedures below should be done at least every month. This is especially important if the rig has not been used for a month or more (such as during the winter). Immediate inspection is required if it has been subjected to some abuse such as a drag across the runway, a water landing, or exposure to a lot of dust or sand.

1. **Every month operate the 3-Ring Release System** on the ground. Extract the release cable completely from the housings and disconnect the risers.

2. While the system is disassembled, **closely inspect it for wear.**
   - **Check the white locking loops** (the ones that pass over the smallest ring and through the grommet) to be sure they aren't frayed.
   - **Check the Velcro** on the release handle and main lift web to insure that it adequately holds the handle.
   - **Check the stitching**, including that which holds the large ring to the main lift web and the hand tacking that prevents the release housings from sliding through its keeper. (This keeper is located a few inches above the padded release handle.)

3. **Take each riser and vigorously twist and flex the webbing near where it passes through each ring.** The idea is to remove any set or deformation in the webbing. Failure to do this might make the release hesitate when activated in response to a low-drag malfunction such as a streamer.

4. **Check the inside of the release housing** for gravel or other obstructions. Use the cable to do this. Inspect the housing for dents or other damage (this is very unlikely unless the rig was smashed in a car door or suffered similar abuse).

5. **Clean and lubricate the release cable** with a light oil such as "3-in-1." Put a few drops on a paper towel and firmly wipe the cable a few times. A THIN invisible film should remain — too much will attract grit and dirt. Failure to do this could require a higher-than-normal force to extract the cable during a breakaway.

6. **Inspect each release housing and assembly.** There are two kinds: an older hand-tacked one (with a flexible grommet) and a newer swedged version. It is recommended that the older type be replaced. Kits are available from the Relative Workshop at $5 a set.

7. **Re-assemble the system properly,** insuring that it is done in accordance with the *Owner's Manual*. Double check it. Make sure the risers aren't reversed.

8. **If any wear is found, consult the manufacturer or a rigger immediately.**

— **The Relative Workshop**
1050 Fliteline Blvd
DeLand, FL 32720
(904) 736-7589

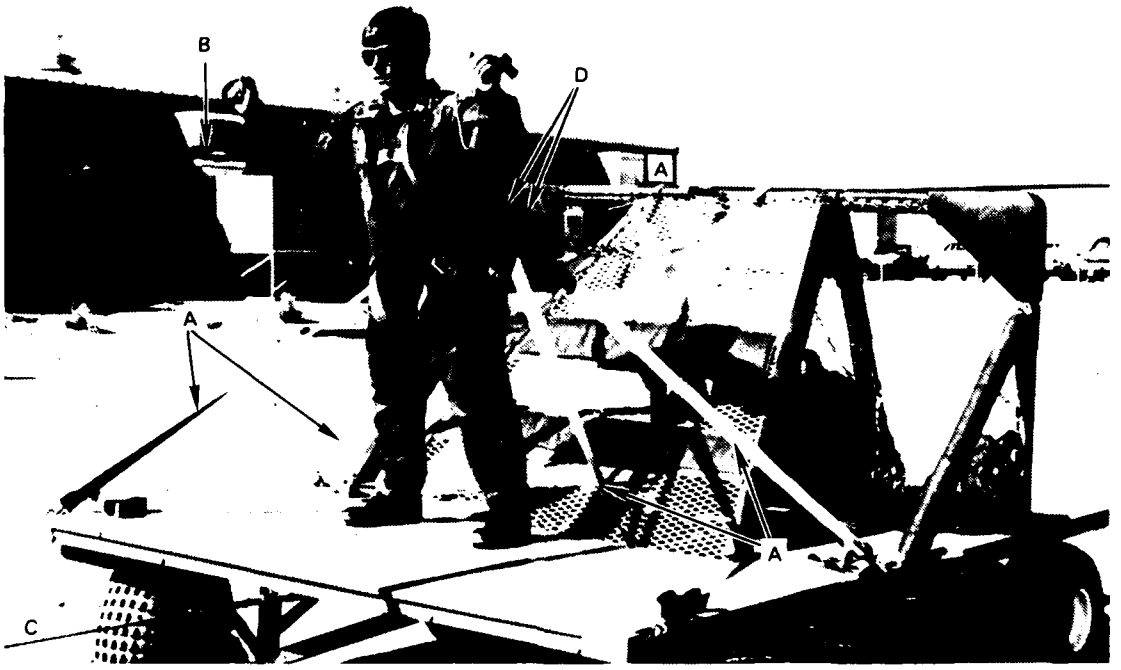


FIGURE B-1. Overall View of Trainee on Cart. (A) Hold-down harness legs properly adjusted, (B) upper and (C) lower legs of tow bridle under tension, (D) parachute risers are attached but canopy is not yet spread for launch.

FIGURE B-2. Front View of Trainee in Harness. Y-bridle and risers have been omitted for clarity. (A) Connector links on (B) main lift web show the location of the load point on the harness.

FIGURE B-3. Side View of Trainee in Harness. Harness is constructed from MIL-W-4088H Type 7 webbing. (A) Leg strap adjuster is MS-22040-1; (B) solid link in diagonal back strap is MS-70108; (C) connector links are MS-22021; (D) main lift web is 20 inches from bottom of leg strap junction to top of load loop. Exact dimensions are not critical as long as harness is symmetrical and fits the trainee properly.

FIGURE B-4. Rear View of Trainee in Harness. (A) Large ring in center of back is the connection point to the hold-down harness.

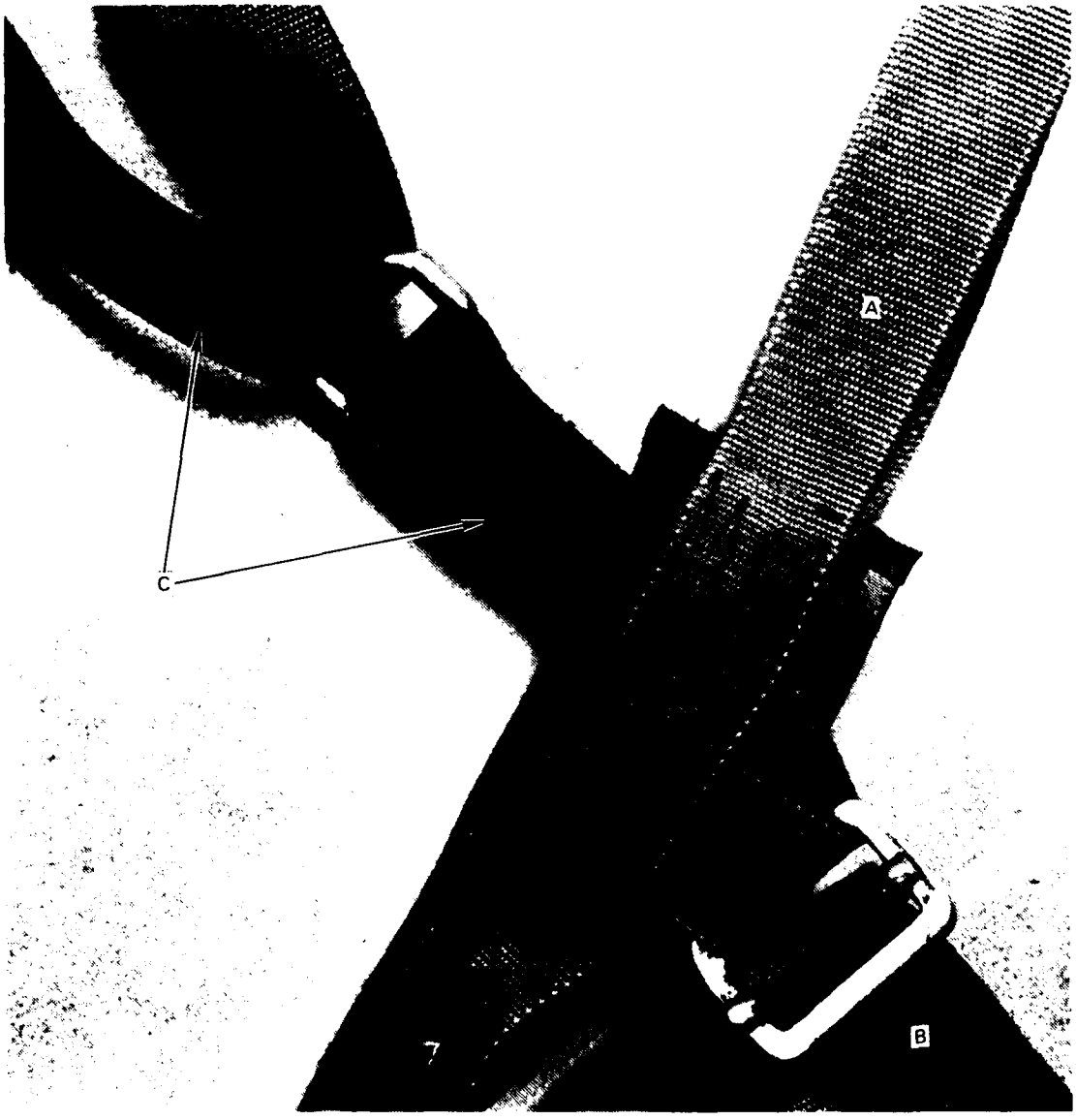


FIGURE B-5. Detail of Junction of (A) Main Lift Web, (B) Leg Strap, and (C) Back Strap. Exact construction details are not critical; use best commercial practice.

FIGURE B-6. Detail View of (A) Diagonal Back Strap Intersection and Attachment of (B) the Hold-down Ring. (C) Webbing on the hold-down ring is MIL-W-4088H Type 8. (D) The adjuster is MS-22040.

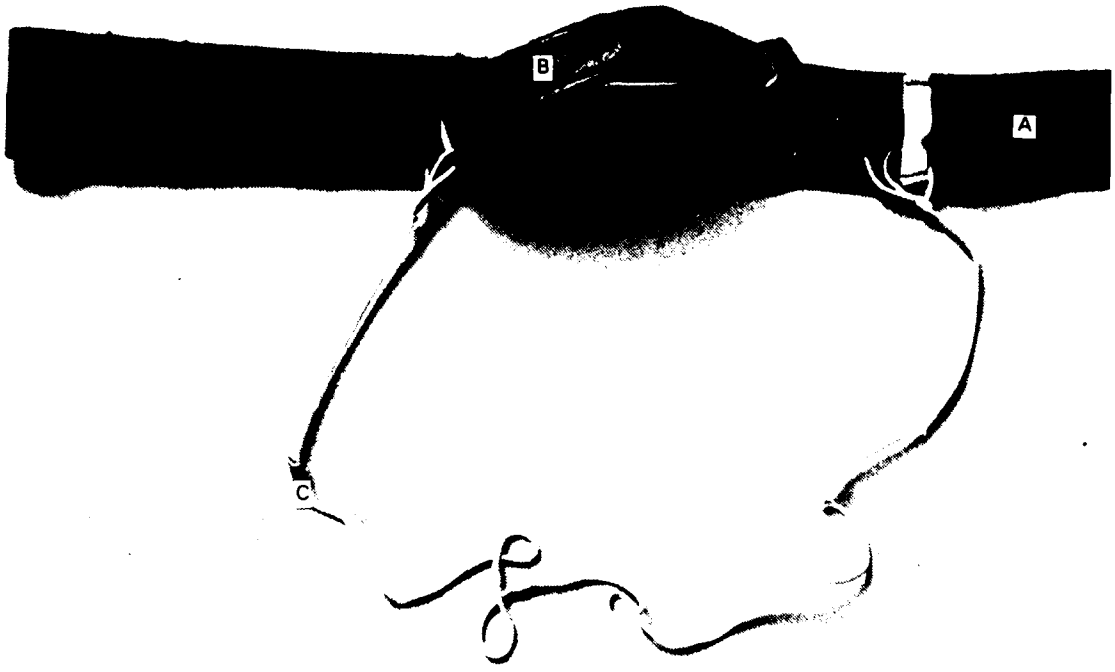


FIGURE B-7. Y-Bridle. (A) Aft end of right side of Y-bridle. (B) trainee's tow-release handle with (C) handle retention lanyard.

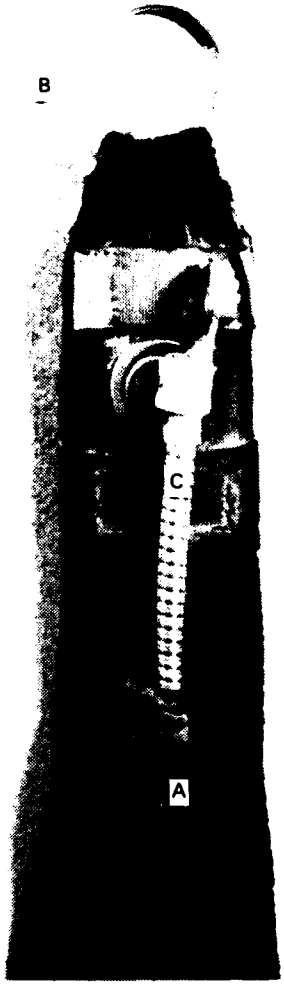


FIGURE B-8. Forward End of (A) Y-Bridle Showing the Backside of (B) 3-Ring Release Mechanism and (C) Cable Housing for Release Cable (From Handle Shown in Figure B-7(B)).

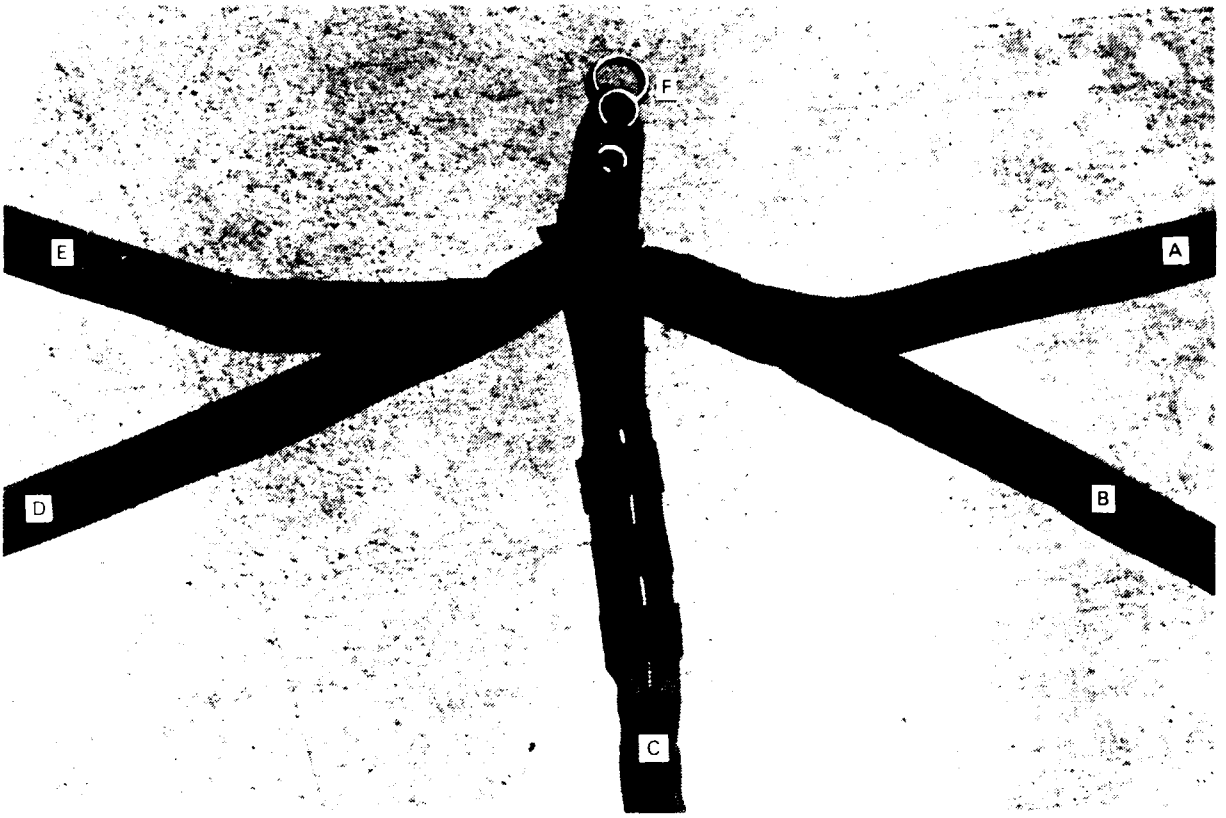


FIGURE B-9. Overall View of Hold-down Harness. Each leg is 8 feet long and has an adjustable snap on the end (not visible in photo). Snaps are 48B7047 or MS 22018 or equivalent. Snaps are used to attach the legs to the cart using V-rings welded onto the cart frame. (A) Right front leg, (B) right rear leg, (C) rear center leg, (D) left rear leg, (E) left front leg, (F) V-ring release mechanism.

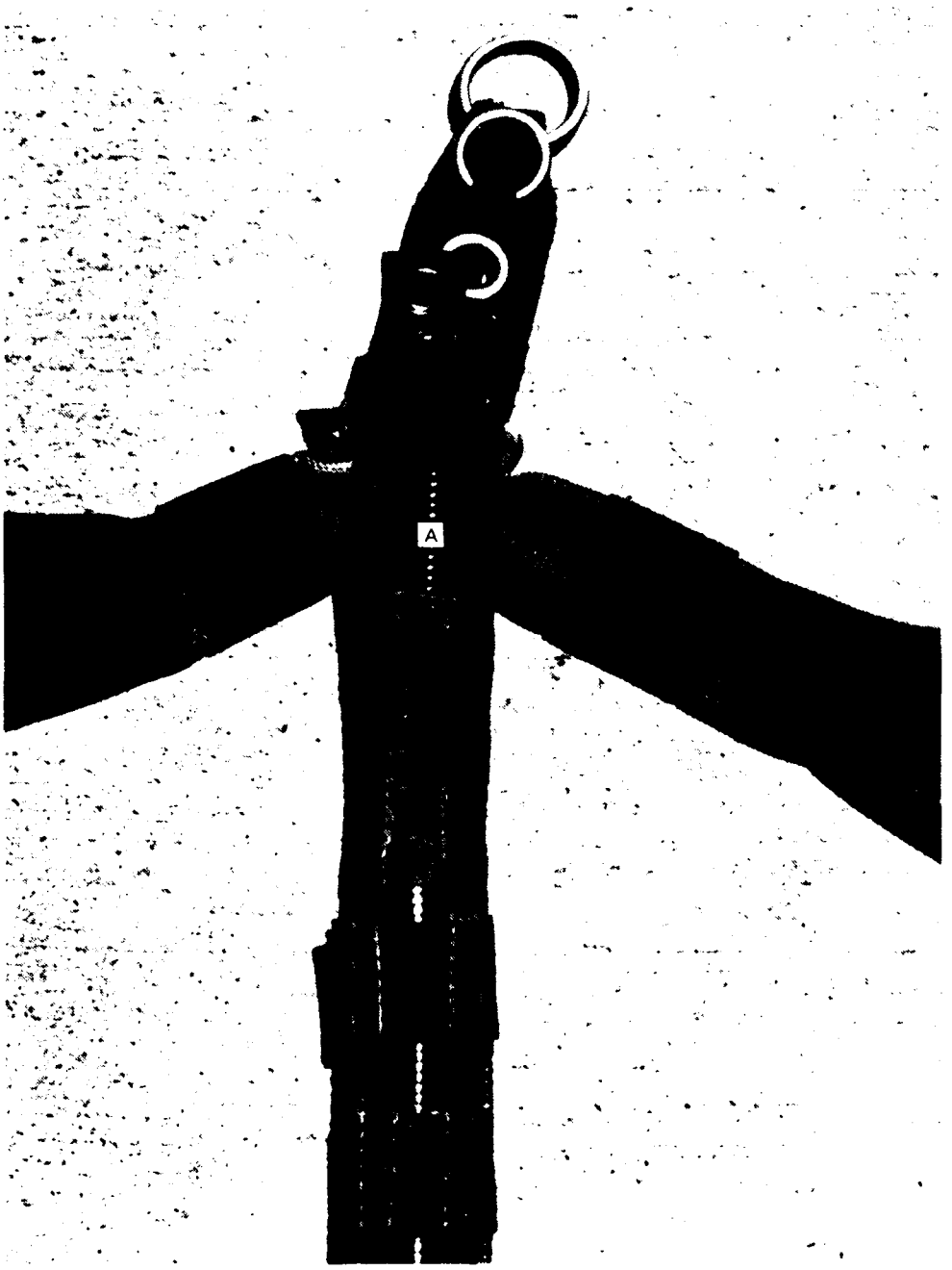


FIGURE B-10. Detail View of Hold-down Harness Junction. (A) The release cable housing extends along the rear center leg approximately 5 feet

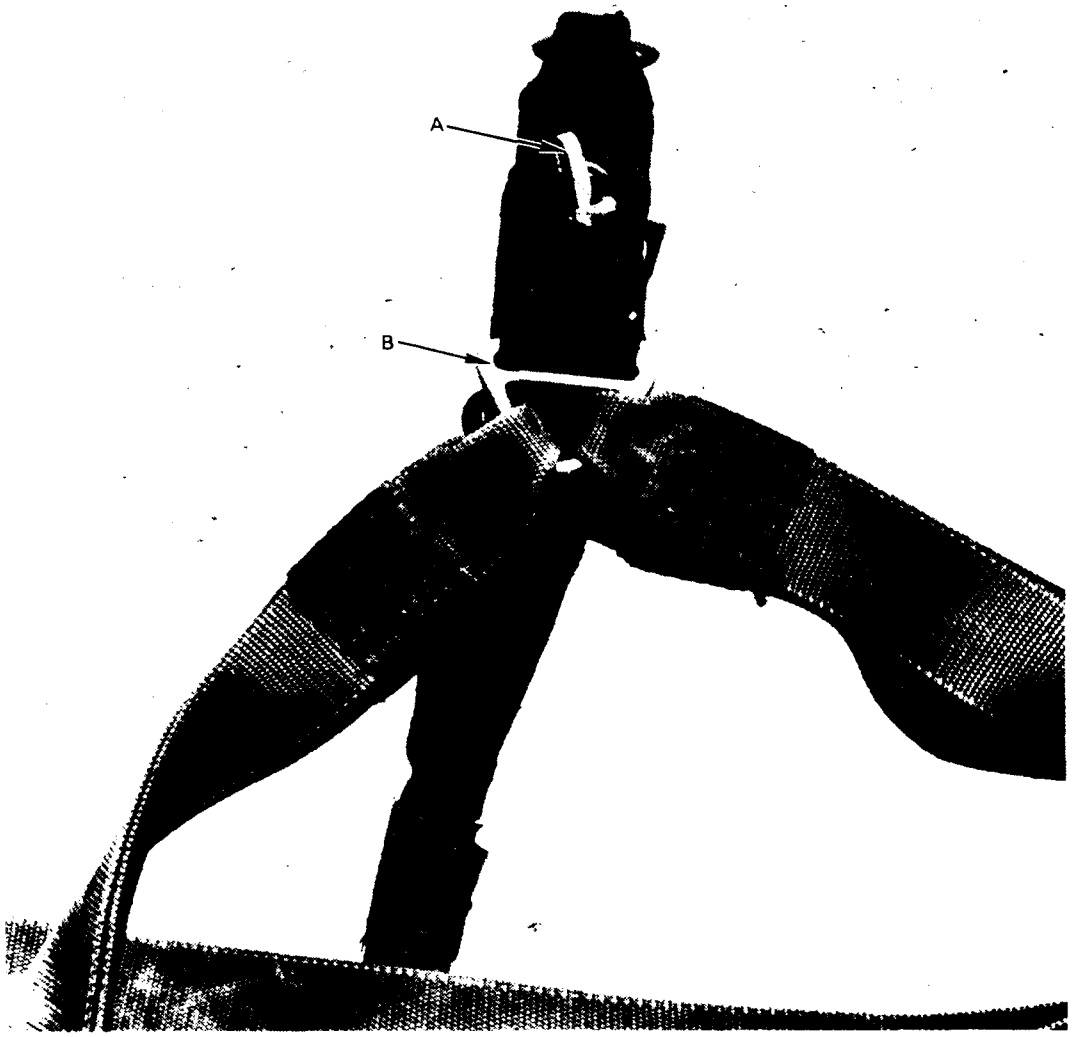


FIGURE B-11. Detail Back View of Hold-down Harness Junction. (A) Replaceable loop, (B) V-ring is MS-22020-1.

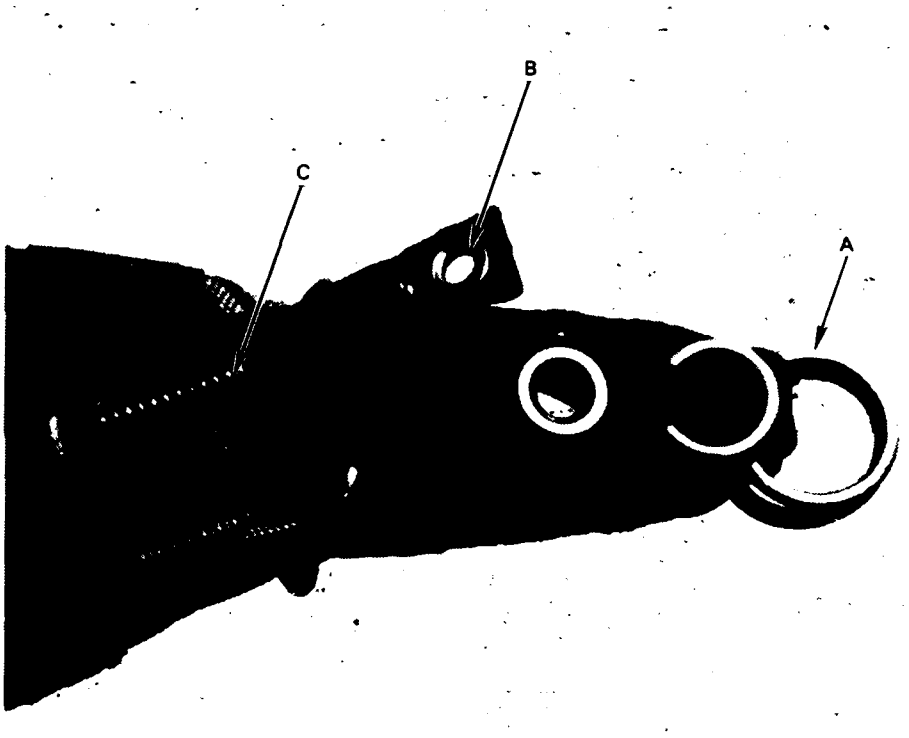


FIGURE B-12. Detail Front View of Hold-down Harness Junction and (A) 3-Ring Release Mechanism. (B) Cable guide and (C) cable housing.

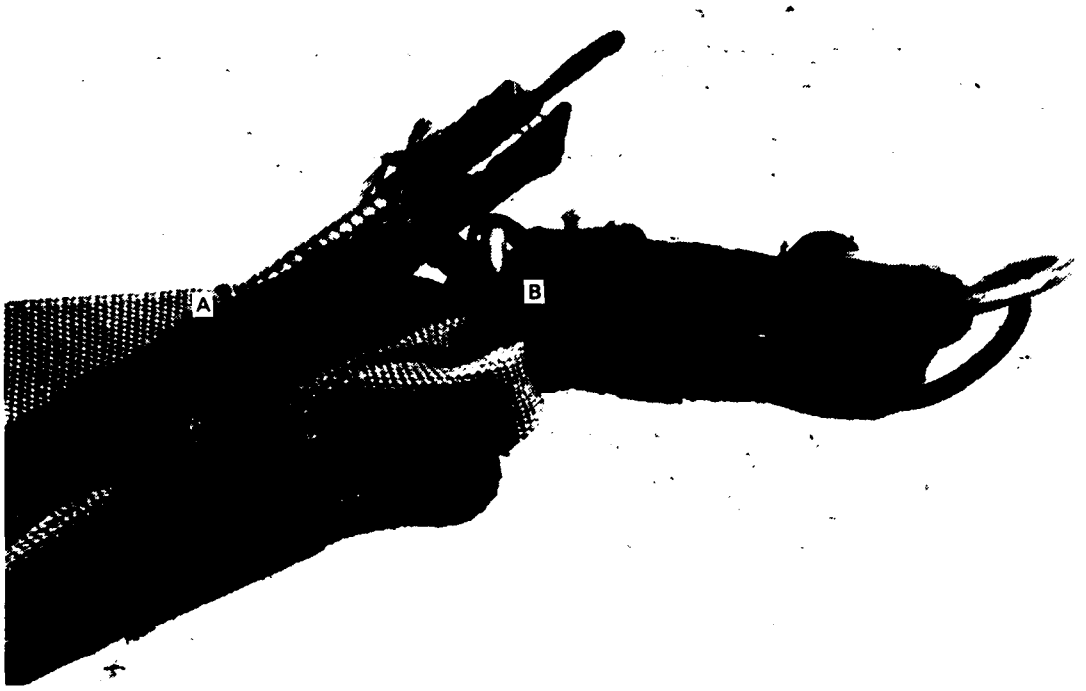
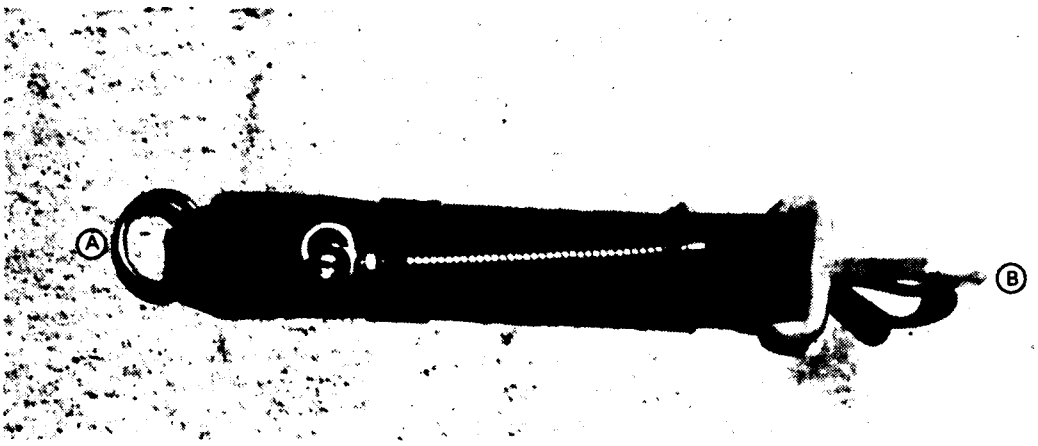
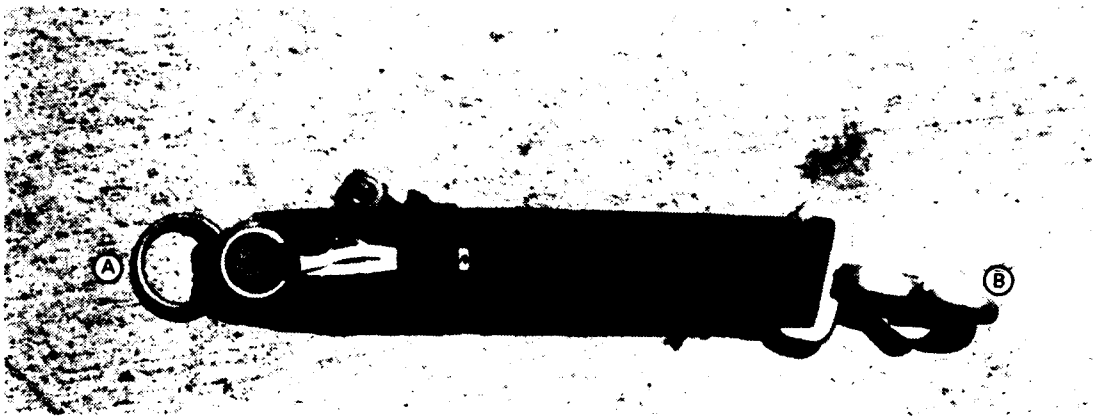


FIGURE B-13. Detail Side View of Hold-down Harness Junction. Note that (A) the rear center leg of the hold-down harness passes through the slot in (B) the V-ring.



(a)



(b)

FIGURE B-14. Cart/Tow Bridle Connector Strap. (a) Top view. (b) Bottom view. (A) 3-ring release mechanism with replaceable loop, (B) Snap is MS-22042-1.

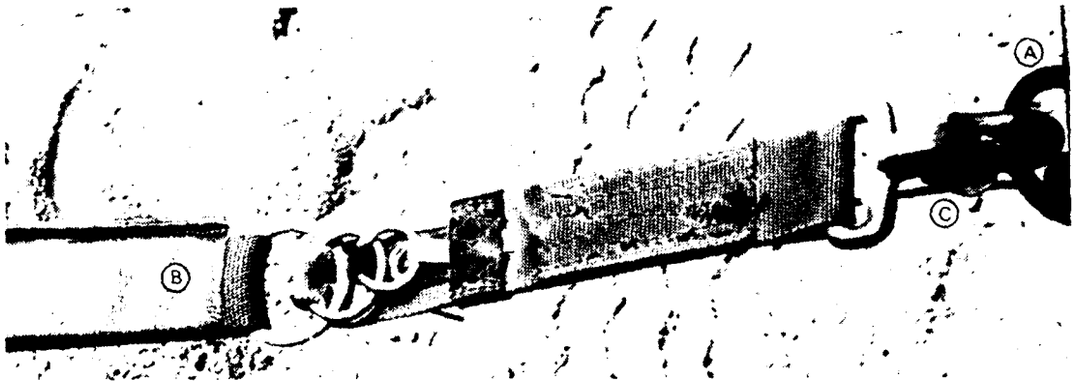


FIGURE B-15. View Showing Hookup of (A) Cart Tow Ring to (B) the Lower Leg of the Tow Bridle. Notice (C) release cable under the snap on the right side.

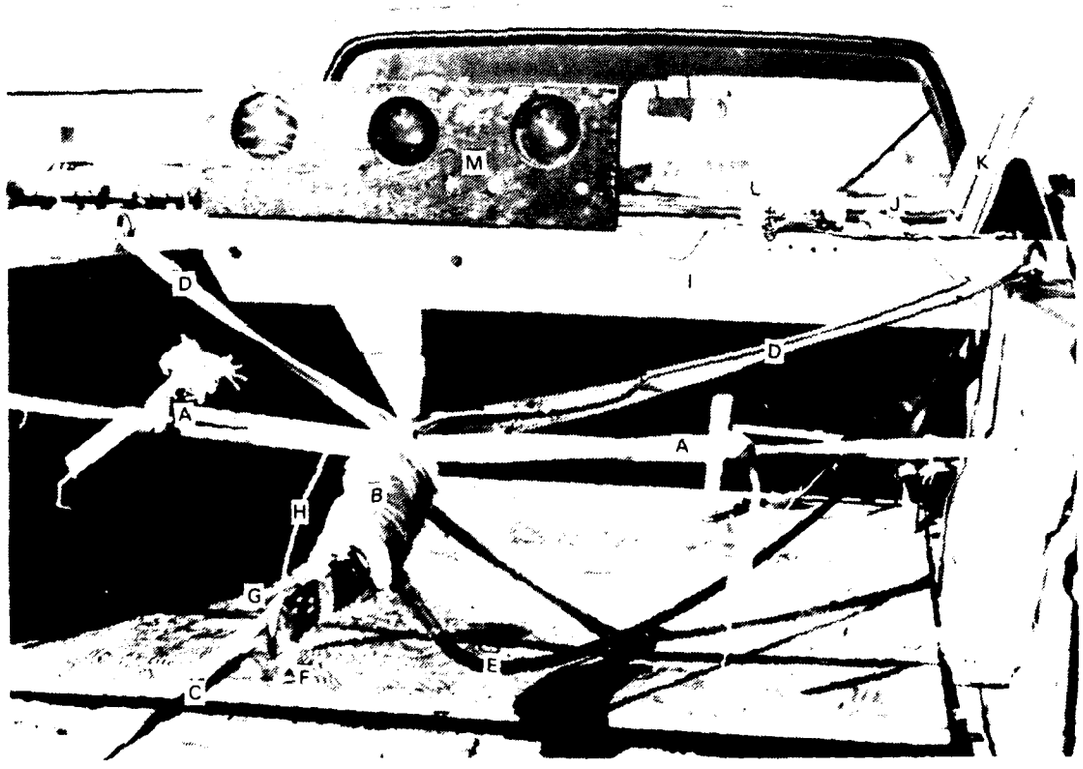


FIGURE B-16. Overall View of Truck Setup for Towing. (A) Bungee legs of the tow truck towing bridle, (B) hydraulic cylinder of the tensiometer assembly, (C) tow rope, (D) tension legs of the tow truck bridle assembly, (E) hydraulic hose, (F) carabiner hook, (G) safety observer's emergency tow-release mechanism, (H) loose end of the flexible cable, (I) flexible cable housing on the left-side tension leg, (J) safety observer's emergency release handle, (K) safety observer's chair, (L) launch signal lights, (M) panel of light control switches.

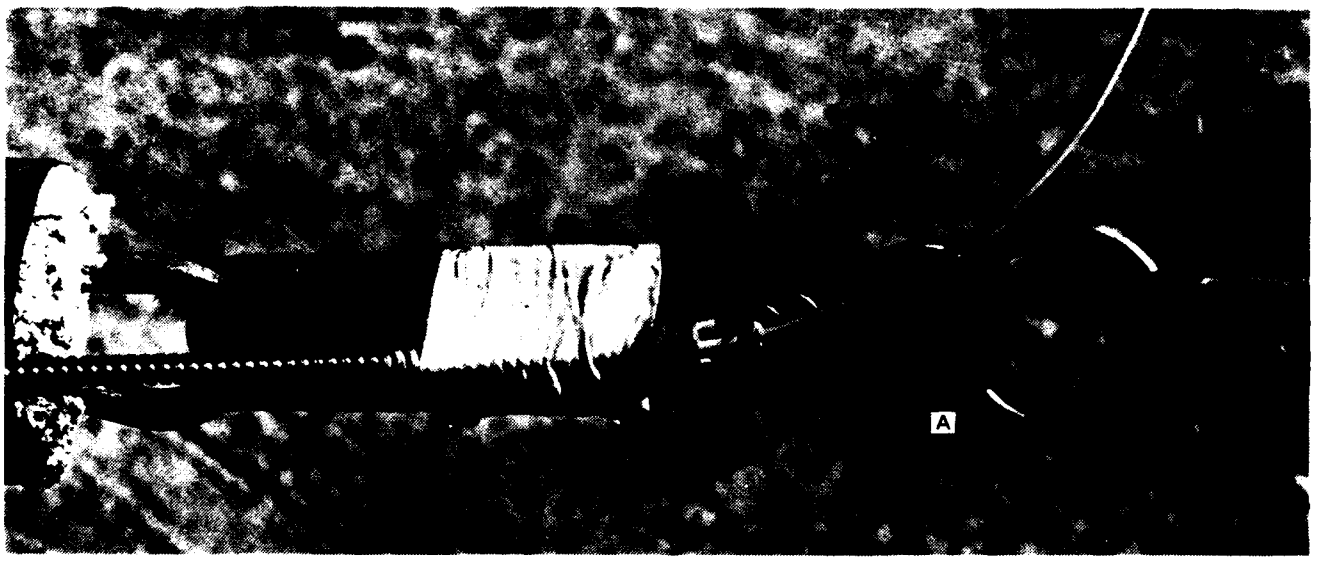


FIGURE B-17. Safety Observer's Emergency Release Mechanism Rigged for Use. (A) Release mechanism.

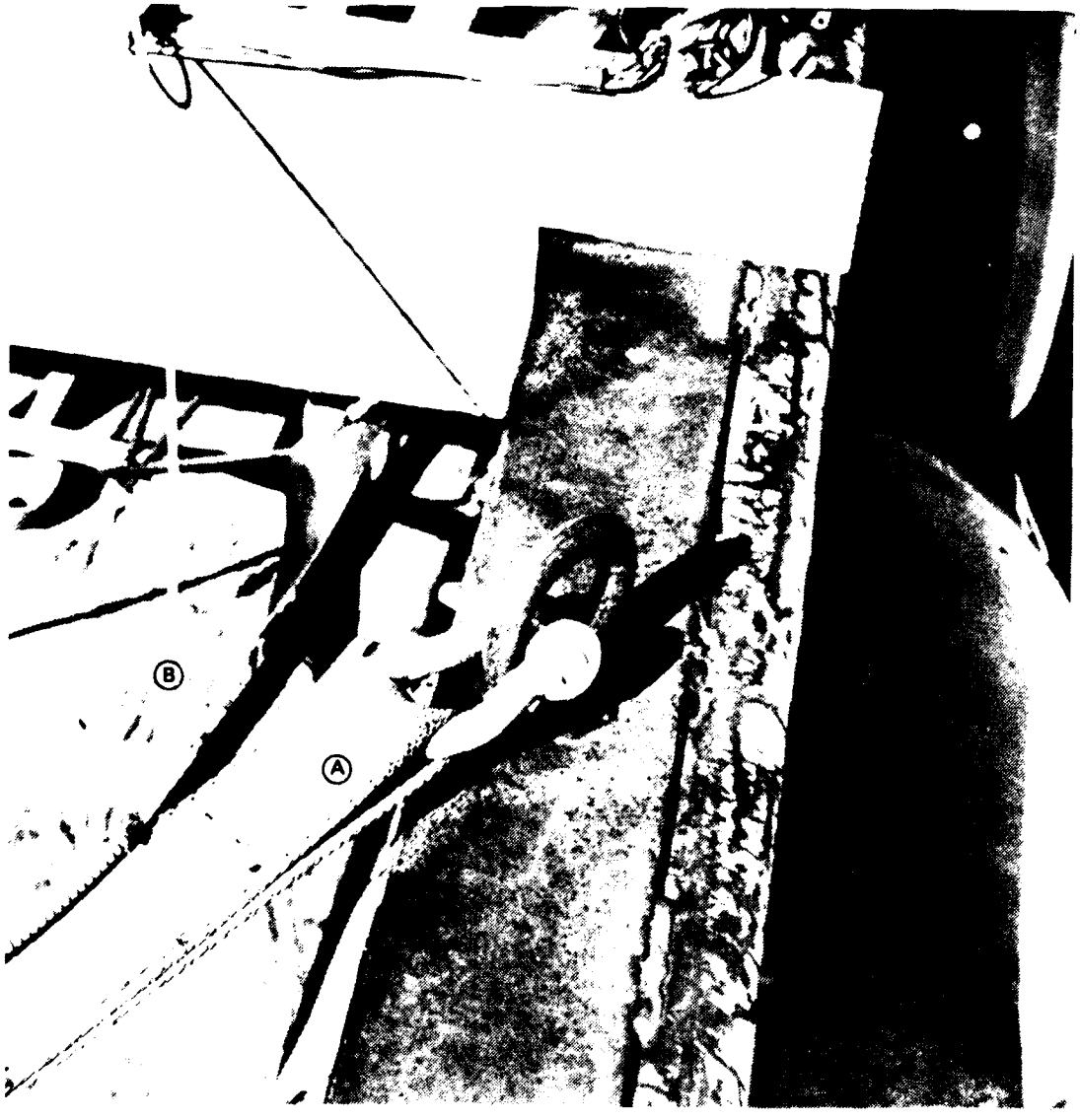


FIGURE B-18. Hookup of (A) Tension Leg of Truck Bridle to the Truck Body. Note the routing of (B) the safety observer's emergency release cable.

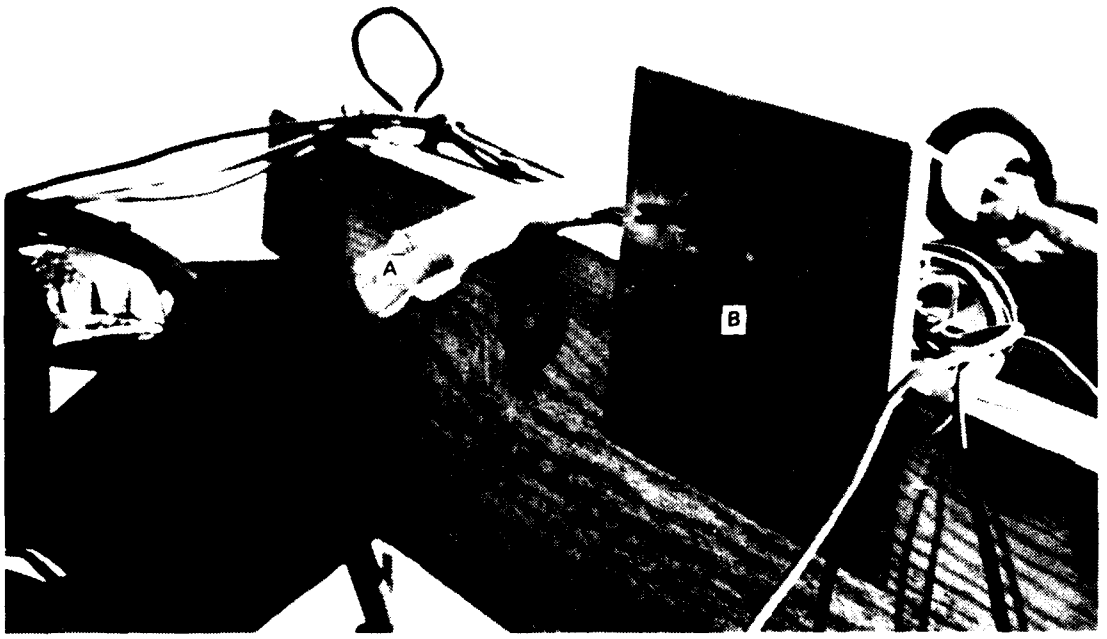


FIGURE B-19. Safety Observer's Position. (A) Emergency tow release handle and (B) signal light control panel.

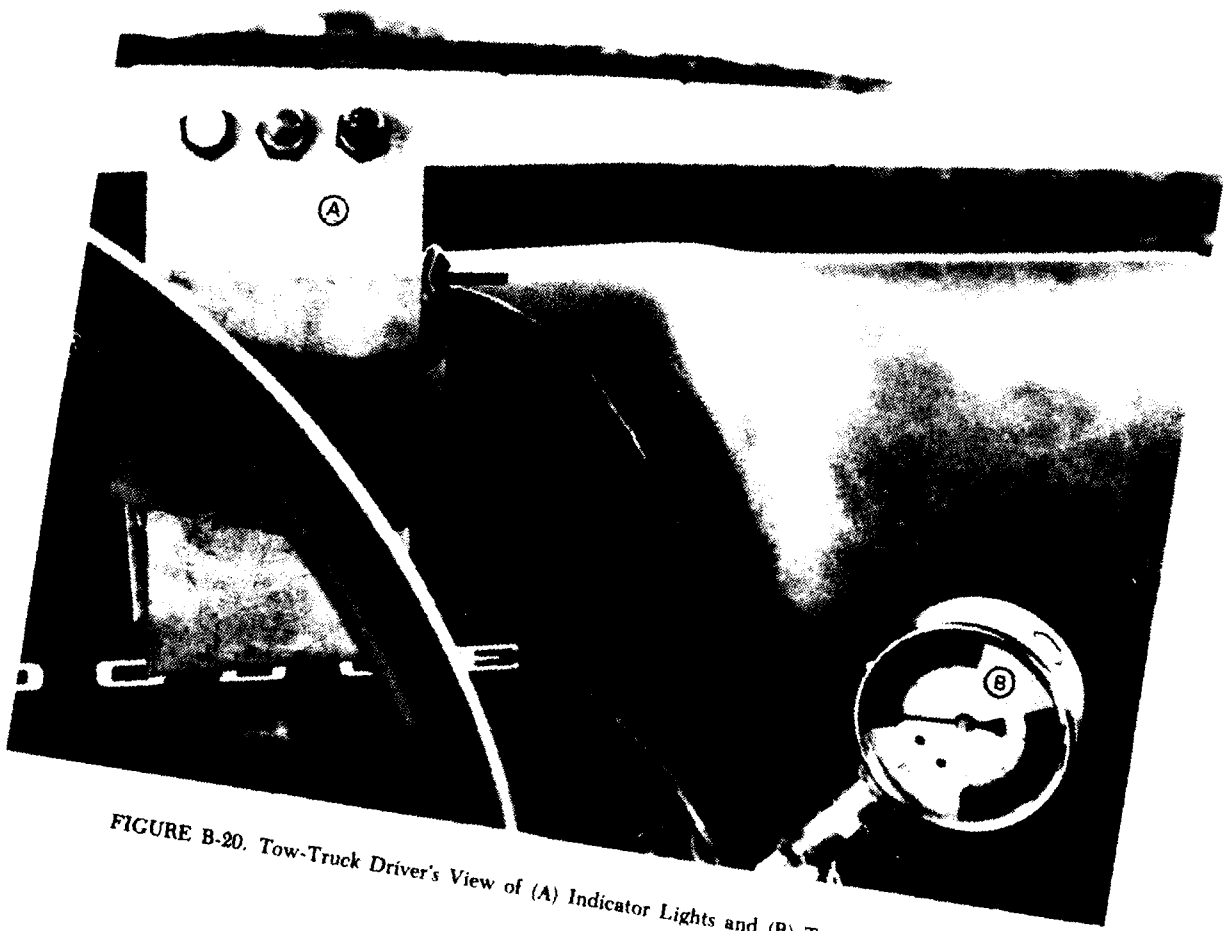


FIGURE B-20. Tow-Truck Driver's View of (A) Indicator Lights and (B) Tensiometer Gauge.

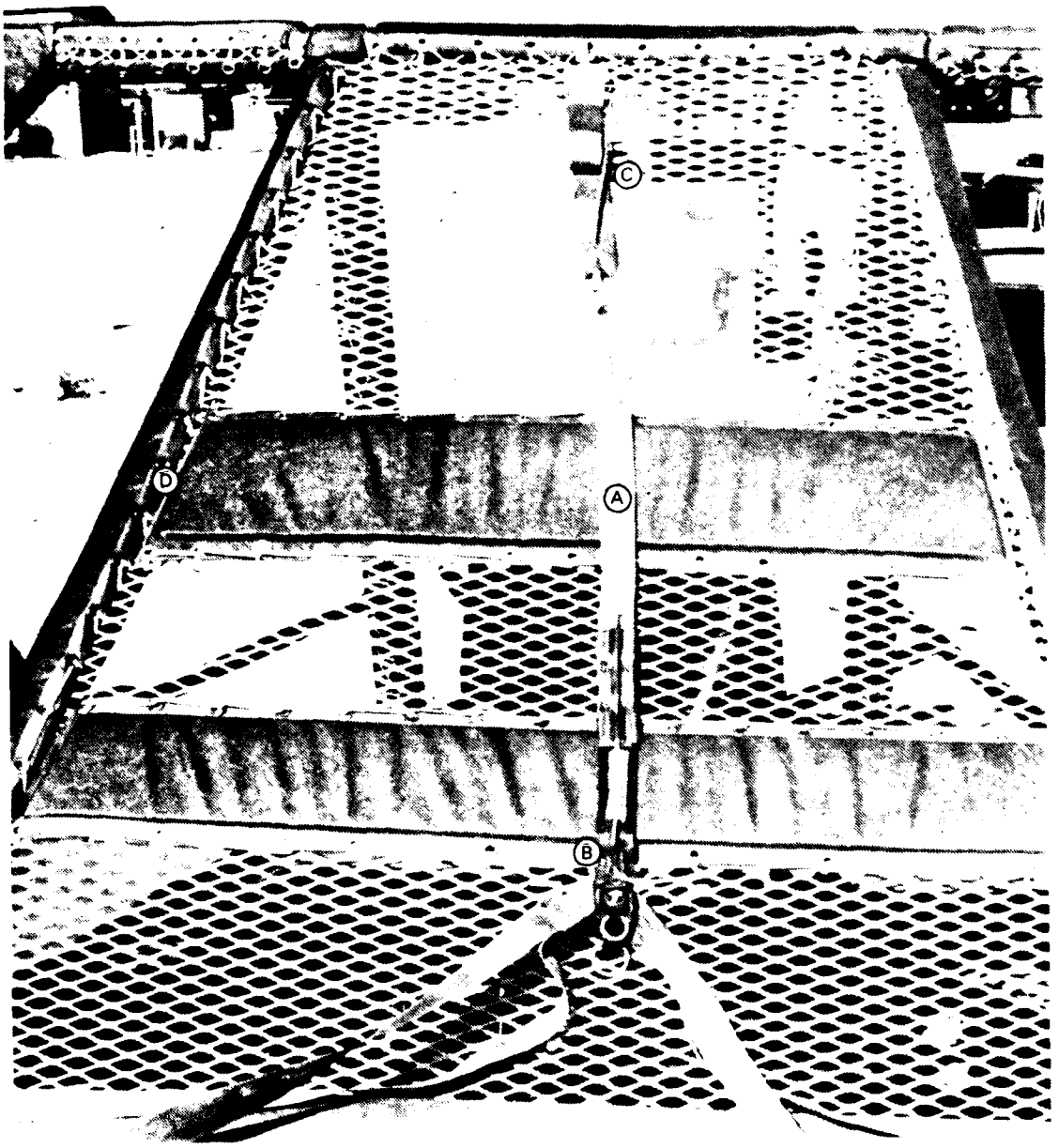


FIGURE B-21. Overall View of Hold-down Harness Attached to the Cart, Ready for the Trainee to Hook Up. (A) Rear center leg of the hold-down harness, (B) junction, (C) section of cable housing, (D) padding on the roll cage.

FIGURE B-22. Overall View of Trainee in Harness Ready to Step Up to Platform. (A) Y-bridle, (B) parachute risers, (C) trainee's tow release handle.

FIGURE B-23. Overall View Showing Proper Adjustment of Hold-down Harness. The trainee has limited movement in all directions and can not fall off the cart.

FIGURE B-24. Rear View of (A) Trainee Harness Hooked to (B) Hold-down Harness.

FIGURE B-25. Detail Front View of Properly Assembled 3 Ring Release at the Connection to the Hold-down Harness.

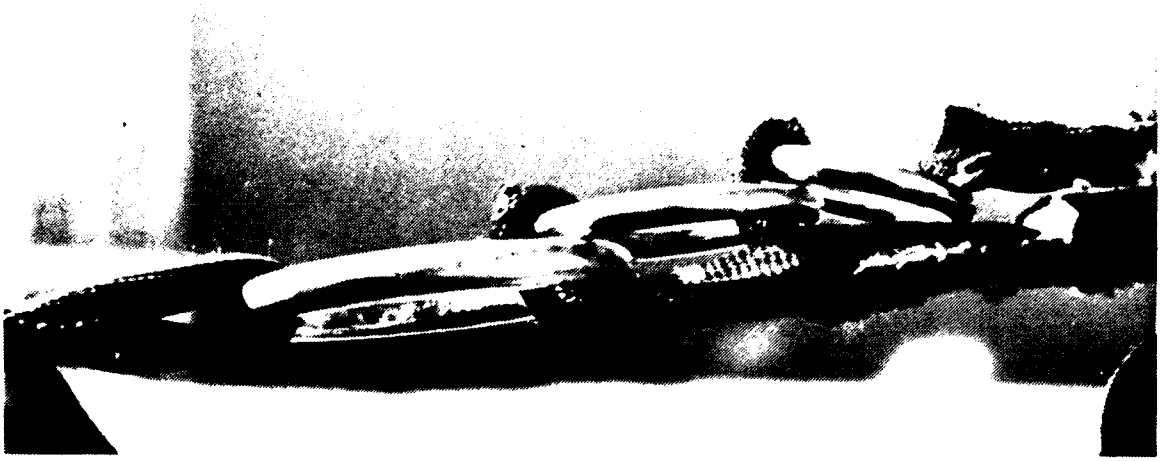


FIGURE B-26. Detail Side View of Properly Assembled 3-Ring Release at the Connection to the Hold-down Harness.

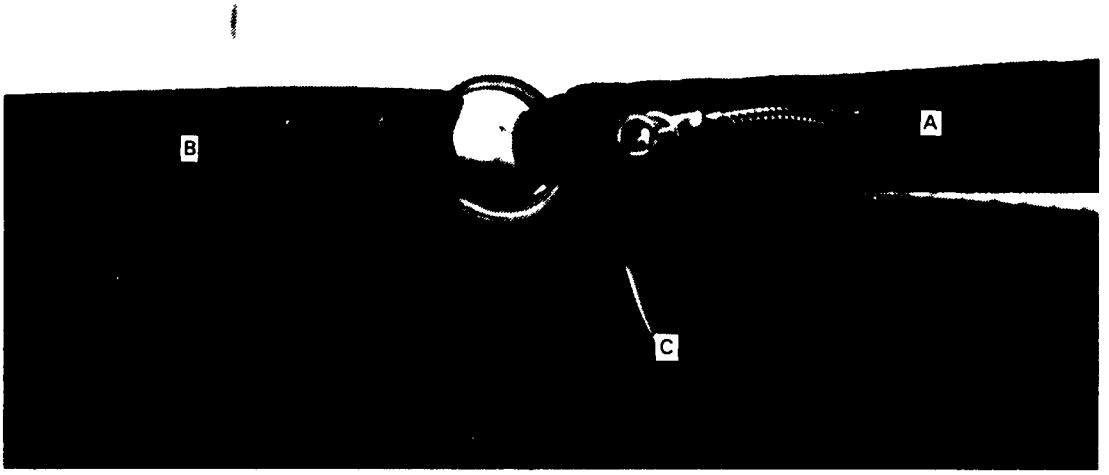


FIGURE B-27. Junction of (A) the Y-Bridle and (B) the Upper Leg of the Tow Bridle. Note (C) the excess release cable used to prevent accidental release from the tow bridle. Trainee must pull the cable approximately 1 foot to release from the tow bridle.

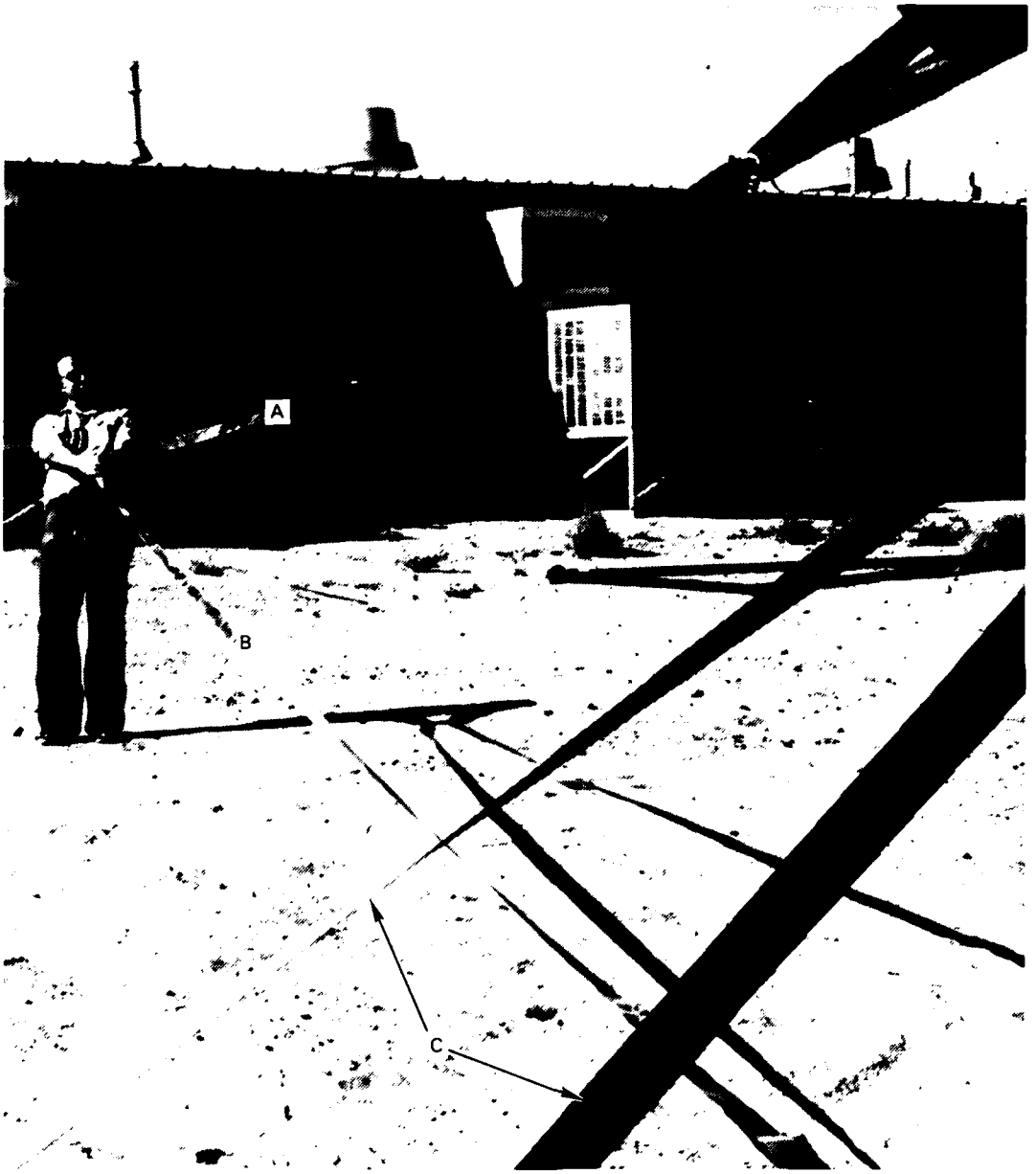


FIGURE B-28. Cartmaster's View Toward the Tow Truck (Person in Photograph is Simulating the Tension Created When the Tow Truck is Pulling the Cart). Tow bridle is approximately 25 feet long; (A) the upper leg, which goes to the trainee, has an adjuster to compensate for stretch in the webbing and trainees of different heights. (B) The lower leg of the tow bridle is marked with a red flag to aid in rigging the tow bridle. The straps in the foreground are (C) the left side legs of the hold-down harness.

FIGURE B-29. Cartmaster's View of Trainee. Note the length of (A) the release cable extending from the cable housing at the hold-down junction. This cable and the cart tow-release cable must be adjusted so that the cart is released from the tow bridle at exactly the same time that the trainee is released from the hold-down harness.

FIGURE B-30. Cart Driver's View of Trainee.

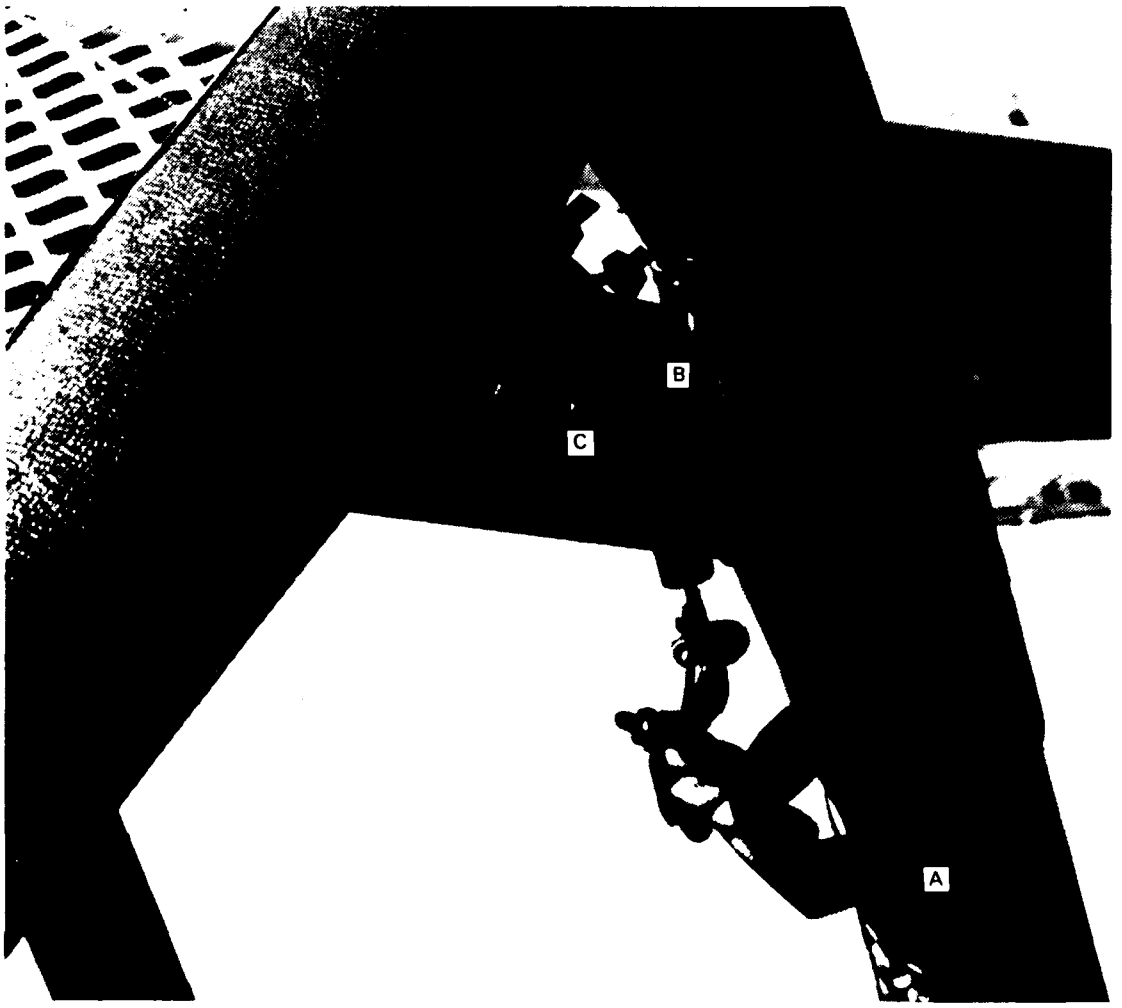


FIGURE B-31. Cartmaster's Launch Release Handle (A). The cable that runs through (B) the metal conduit releases the cart from the lower leg of the tow bridle. The other cable running through (C) the flexible housing is used to release the trainee from the hold-down harness.

FIGURE B-32. Trainee's View Toward the Tow Truck.

Appendix C

PARASCENSION STANDARD OPERATING PROCEDURES

I. PURPOSE

A. To familiarize people with ram air canopy flight characteristics without the need to make an actual parachute jump. To conduct this training under close supervision in a safe and non-threatening environment so that the maximum training benefit can accrue in the minimum possible time.

NOTE: Site selection must be based on safety and operating limitations of the parascension training devices. In general, the site must be free of obstacles such as powerlines, large buildings, rough terrain, etc. Straight paved roads, runways, taxiways, smooth dirt roads, smooth grass field, etc. have all been used successfully in the past. The tow site should allow for as much variation in tow direction as possible. The cartmaster is responsible for the selection. Wind limitations are 15 knots total with a maximum cross wind component of 5 knots measured at the launch site.

II. POSITIONS AND RESPONSIBILITIES

A. Cartmaster - responsible for overall safe conduct of Parascension Operations.

1. Assembles all personnel and equipment required for the operation, conducts the "preflight" inspection of all equipment and the "preflight" briefing of all personnel.

2. Responsible for site selection and inspection for each operation.

3. Rides on the tow cart and directs all phases of the tow/launch operations.

a. Duties

(1) Inspects all rigging and hook-ups at tow cart prior to each tow/launch.

(2) Briefs pilot on launch procedures.

(3) Insures pilot is properly dressed - flight suit, boots gloves, helmet, radio (optional).

(4) Insures wind indicator is in place.

(5) Insures operating area is clear of potential hazards, e.g., aircraft, vehicles, observers, etc.

(6) Receives "READY" confirmation from all positions prior to initiating tow/launch phase.

(7) Initiates tow/launch phase.

(8) Aborts inflate/launch phase at his discretion.

(9) Initiates new sequence in same manner.

B. Cart Driver - drives the tow cart under the Cartmaster's direction.

1. Responsible for conducting a thorough inspection of the cart to ensure it is operational and safe for use.

2. Responsible for a conditional inspection of the tow rope and tow harness assembly prior to each hook-up.

a. Duties

(1) Hooks-up pilot to cart and tow rope.

(2) Follows direction of the cartmaster for tow/launch phase.

(3) Aborts inflate phase at his discretion.

NOTE: May not abort during launch phase.

(4) Makes appropriate entries in log book upon completion of each launch.

C. Wingman (2 ea.) - assists in the launch operations by holding the leading edge of the parachute aloft so that the canopy can inflate quickly and evenly.

1. Responsible for conducting a thorough inspection of the parachute assembly for damage prior to each launch.

a. Duties

(1) Lays out canopy and checks lines for continuity, assists in hooking-up pilot to cart and tow rope.

(2) Insures launching poles are in good condition.

(3) Inserts launching poles into grommets, prepares to spread the canopy on command.

(4) Spreads and inflates the canopy on command.

(5) Assists in returning cart to starting position after launch is completed.

(6) Aborts inflate phase at his discretion.

NOTE: May not abort during launch phase.

D. Tow Truck Driver - drives the tow truck which pulls the cart; operates under the Cartmaster's direction.

1. Responsible for conducting thorough inspection of the tow truck to ensure it is operational and safe for use.

2. Responsible for ensuring the operating area remains clear of potential ground hazards, e.g., aircraft, vehicles, observers, etc.

a. Duties

(1) Inspects all rigging and hook-ups at tow truck prior to each tow/launch.

(2) Coordinates initial inflate speed with safety observer prior to each tow/launch.

(3) Monitors speedometer, tension on tensiometer (100 lbs.), dashboard mounted signal lights.

(4) Responds to commands of the cartmaster and safety observer.

(5) Aborts inflate phase at his discretion.

E. Safety Observer - rides in the back of the tow truck, ensure proper procedures are adhered to during each tow/launch operation.

1. Responsible for conducting a thorough inspection of the lighting system, the emergency release system, and the tensiometer.

a. Duties

(1) Coordinates events between cartmaster and tow truck driver.

(2) Coordinates various speed settings with tow truck driver prior to each tow/launch.

(3) Monitors wind velocity and adjusts tow speeds accordingly.

(4) Maintains immediate access to lighting system controls and emergency release handle (in hand) during tow phase.

(5) Aborts through tow release phase at his discretion.

(6) Monitors activities of rope and pilot recovery vehicle.

(7) Provides maneuvering and landing instruction to the pilot in the absence of a landing instructor (optional).

F. Pilot - is the trainee wearing the parascension harness and is to be towed to an altitude normally not to exceed 1,000 ft AGL prior to release.

1. Responsible for following all instruction given by:

a. The cartmaster prior to launch.

b. The safety observer after launch.

c. The landing instructor after release (optional).

(1) Duties

(a) Responds to any questions asked by key personnel, e.g., radio check, ready, etc.

(b) Ask questions if any doubt as to procedures, responsibilities, etc.

(c) Aborts any phase at his discretion.

G. Landing Instructor - instructs the pilot after tow release has been accomplished (optional).

H. Roadguards - (if required) stage at each end of the operating area to monitor/divert traffic.

I. Medical Personnel - provides any onsite medical services as required.

NOTE: No operations will be conducted without a qualified EMT present. Any incident occurring which the medical personnel believe requires examination by them shall require that those involved cease operations until given clearance by the medical personnel for continued participation. The decision of the medical personnel shall not be overridden.

III. PHASE

A. Inflate

1. The objective of the inflate phase is to achieve a stable canopy over the pilot's head. The cartmaster will not give the command to leave the inflate phase until this objective is achieved.

2. To initiate the inflate phase, the slack is taken up on the tow rope. The cartmaster asks each member in the cart crew if they are ready. Then the cartmaster asks the pilot if he is ready. Next the cartmaster asks, "Truck, are you ready and is it clear?" On receiving confirmation, the cartmaster gives the commands "Spread the canopy and inflate". "Spread the canopy" is a command to the wingmen to spread the canopy. "Inflate" signifies the tow truck should move to inflate speed. Inflate speed is a set speed predetermined by the safety man and tow truck driver.

B. Launch

1. The objective of the launch phase is to safely launch the pilot from the cart.

2. The launch phase begins once the cartmaster has determined the inflation phase has been reached. The cartmaster initiates the launch phase by giving the command "Launch speed", which directs the tow truck driver to accelerate from inflate speed. It is the cartmaster's duty to determine when there is sufficient lift to safely release the pilot. At this time, the cartmaster pulls the release mechanism which simultaneously releases the pilot

from the cart and the cart from the truck.

C. Lift

1. The objective of the lift phase is to get the pilot to altitude and release point (normally not to exceed 1,000 ft AGL).

2. The lift phase begins when the pilot is released from the cart. At this time the tow truck driver accelerates smoothly while monitoring the tensiometer. The safety man monitors the status of the pilot and is prepared to take appropriate action to correct any difficulties.

D. Tow Release

1. The objective of the tow release phase is to safely disconnect the pilot from the tow rope.

2. When the truck approaches the release point, the safety man gives the command "Slow down and come to a stop" to the truck driver. When the tension on the rope is reduced, the safety man gives the pilot the command "Tow release". The pilot should not release until this command is given. In the event radio contact is lost between the safety observer and the pilot the pilot will have been briefed to release himself when the tow truck has come to a stop and slack in the tow rope becomes obvious. At this time, the pilot is under the direction of the landing instructor (optional).

E. Landing

1. The objective of the landing phase is to get the pilot safely on the ground.

2. On the initial flight, it is not recommended that the pilot attempts a flared landing. A properly executed flared landing requires not only good altitude assessment and good timing, but a feel of the canopy gained only with experience.

3. Under the direction of the landing instructor, the student pilot can safely land without flaring. On final approach, the student pilot simply flies the canopy at 50-75% brakes, with final braking increased immediately prior to landing. (All ram air canopy landings are made into the wind.)

F. Flared Landings

1. The landing should be a carefully controlled dynamic stall, timed so that touchdown occurs during the exact moment of high lift yield during the artificial change in angle of attack. This is just prior to the stall, and the jumper should be extremely careful not to stall too high.

2. Flared landings, like all ram air parachute landings, are made into the wind and should start at an altitude of 10-20 feet, with plenty of room ahead.

3. At about 10-20 feet off the ground, slowly depress both toggles downwards, timing the movement to coincide the 100% brakes position at touchdown. The flared landing, when properly executed, practically eliminates

both horizontal and vertical velocities for a short period.

CAUTION: Never release the toggles completely or let them up abruptly. If the toggles are released in such a manner, the ram air canopy will surge forward.

G. Emergency Procedures

1. In the event that the canopy becomes unstable before the launch command is issued, the canopy can be flown back to the proper position or the operation halted and restarted.

2. In the event that the canopy "locks out" during ascent, the tow truck is immediately slowed until canopy control is regained.

3. In the event that radio contact is lost between a pilot and the ground controller, the pilot shall select the best available landing area and land normally.

4. In the event the tow rope breaks during tow, the cartmaster will abort the launch.

5. In the event the tow rope breaks after launch, the safety observer will abort the lift phase, the pilot will land straight ahead.

6. All emergencies not covered here shall be handled at the discretion of the cartmaster.

END

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