Chapter 16

EMERGENCY EGRESS (AIRBORNE) FROM AIRCRAFT

As aviation has progressed, it has become apparent that greater effort must be expended in the development of safety devices used in escape from disabled aircraft. In 1920, a rule was established that required fliers to carry and use parachutes. This was the beginning of positive measures undertaken to increase the aircrew's chance of survival.

Now, supersonic speed, coupled with very high altitudes, has greatly multiplied the problems of escape. The epochal jump from 40,200 feet made by Colonel Randolph Lovelace, MC, 24 June 1943, served to reveal many of the dangers associated with bailout from extreme altitudes. Coincident with the opening of his parachute at high altitude, he became unconscious and lost the glove from his left hand. When he regained consciousness, he was suffering from shock, a sprained back, and frostbite injury to his left hand. The thin nylon glove remaining on his right hand was sufficient to protect it from frostbite. Oxygen was supplied by several H-2 bailout bottles during his descent.

In July of the same year, Major P. J. Ritchie made a successful 32,000-foot emergency jump without oxygen, holding his breath during the long free fall. He did not pull his ripcord until he felt himself on the threshold of unconsciousness. Nevertheless, he suffered injuries from the severe opening shock at 27,000 feet.

In 1944, a series of high-altitude dummy drops provided information which showed that opening shock was greater at high altitude than at lower levels. However, it was not until the summer of 1950, when a series of jumps demonstrated the feasibility of high-altitude bailout, that reliable information was obtained at and below the level of 42,000 feet, with recordings of pulse rate (ECG), respiration, skin temperature (nape of neck and dorsum of hands and feet), time, and altitude.

On the other hand, bailout at very low altitude has been the greatest cause of loss of life. The problem here has always been one of getting the flight crew out of the airplane in sufficient time to get their chutes open before they hit the ground.

PARACHUTE EQUIPMENT

There are three main parts to any parachute assembly: the pack, the harness, and the canopy. The Air Force uses three basic parachute packs (back, seat, and attachable chest), and there is no difference in their operating reliability.

One type of personnel parachute canopy is used throughout the Air Force for both emergency bailouts and ejections, that is, the C-9. The canopy is fabricated from mildew-proof nylon and is 28 feet in diameter. (*Exception:* F-4 aircraft employs 24-foot canopy.) It has a high coefficient of drag and is sufficiently stable for most applications.

The requirement for a seat or chest style parachute is dictated by the emergency escape exit, seat configuration, and the operational requirement. TO 14D1-1-1 directs the style of parachute to be worn on a given aircraft by a crewmember or passenger. Some generalizations are furnished in the interpretation of TO 14D1-1-1.

Back Parachute

The back parachute is preferable for general use. The harness is readily adjustable and allows slack for comfort during flight, yet can be quickly tightened prior to bailout.

Crewmembers of all Air Force fighter aircraft except the F-111 use an automatic back parachute. The F-111 has a separable crew escape compartment which is lowered to the surface by its own 70-foot diameter chute. The F-4C aircrewman uses a back parachute which is an integral part of the seat. The crewmember is required to wear a special harness which he attaches to the stowed parachute.

Crewmembers of Air Force helicopters are required to use nonautomatic, back-style parachutes.

Seat Parachute

The seat-style parachute is in limited use, being used chiefly in training aircraft. When worn with a survival kit or life raft, the seat parachute assembly is quite bulky and heavy, making movement to and through emergency exits difficult. Due to its location on the body, this assembly does not adapt well with other accessories and thus, has limited usefulness. Usually, it hinders escape more than does either the chest or back-style parachute. Because of these limitations, the seat parachute is used only on the A-1E, B-57, T-28, and T-33 aircraft.

Attachable Chest Parachute

The attachable chest parachute is used only when there is no provision for either a back or seat parachute. The harness can be worn separately from the parachute pack for comfort. The faults of this chute, however, outweigh the advantages. Crewmen have been unable to reach stowed parachutes in time for bailout because of high G forces, fires, explosions, and their movement to distant locations within the aircraft during the emergency. During the high emotional tension of an emergency, men have forgotten to fasten the pack to the harness prior to bailout.

This type of chute is worn by passengers on the following aircraft: WB-50F, HC-47D, KC-97G, C-118, C-121G, C-131A, C-135F, VC-118, VC-137B, VC-137C, T-29A, CT-29A, VT-29C, U-3A, U-3B, HU-16A, and HU-16B.

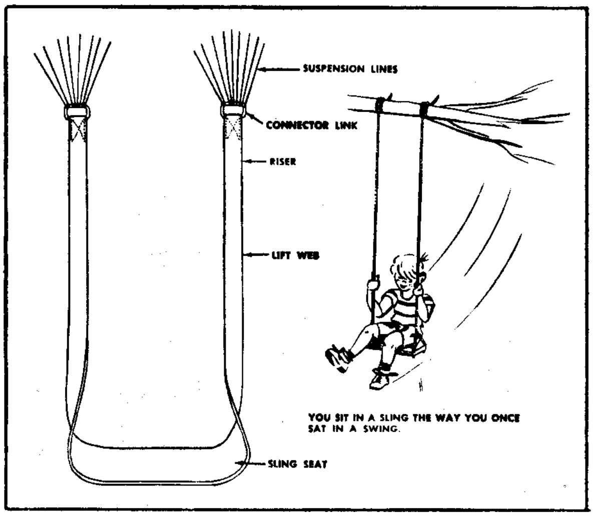


Figure 16-1. Basic Harness Sling.

Harness

There are two general harness configurations used throughout the Air Force for emergency bailouts: Class III and Class IV. Though construction details differ, either class can be adjusted if one understands the basic system of harness construction.

Every harness starts as a loop of webbing called the "sling." (See figure 16-1.) This loop is just like a child's swing and works in the same way. Both ends of the swing are attached to the parachute suspension lines, much the same as a swing is attached to a tree.

The sling is designed to take the largest part of the parachute-opening force. If the body position during bailout could always be controlled, only the sling portion of the harness would be needed for a safe jump. Since the sling will not stay in a fixed position by itself, leg, back, and chest straps are added to the harness to keep the parachutist from falling out of the sling.

Figure 16-2, *View A*, shows a harness sling and the added straps. For clarity, no hardware is shown. *View B* illustrates the same harness assembled with hardware. On Class III harnesses, the length of the main sling may be changed by moving the sling webbings through the mainsling adjuster. On Class IV harnesses, taking up the adjustable leg strap results in tightening of the sectional main sling and integrated back straps. (See TO 14D1-2-1 for sizing and adjustment procedures.)

Automatic Safety Belt

The ejection seat is equipped with a Type MA-6 automatic opening safety belt (figure 16-3) which, in conjunction with the ejection seat and automatic parachute, comprises an automatic escape system, extending the maximum and minimum altitudes at which escape may be successfully accomplished. In a low-altitude ejection, use of the automatic system greatly reduces the time required for separation from the seat and deployment of the parachute, and consequently, reduces the altitude required for safe ejection. The automatic safety belt has been thoroughly tested and is completely reliable. No matter how fast a pilot's reactions, he cannot beat the automatic operation. The belt is cartridge-operated for automatic opening during seat ejection. Automatic operation is accomplished during seat ejection by gas pressure from a separate, automatically controlled initiator which supplies pressure through a length of high-pressure hose that actuates a piston inside the belt, retracting the latch tongue, and releasing the belt swivel link. The link accommodates an anchor on a lanyard leading to the parachute automatic timer. When the belt is manually opened, the anchor is released automatically so that the inadvertent actuation of the automatic parachute will not occur.

In some aircraft, the ejection seat is equipped with a seat-man separator that operates automatically as part of the seat ejection sequence and requires no additional effort on the part of the pilot. The system consists of a web strap assembly shaped like an inverted "Y," and a cartridge-operated actuator. Two straps attached to the forward edge of the bucket seat are routed under the survival kit to the yoke from which a single strap is routed up the face of the seat, back to the actuator behind the headrest. When the seat is ejected, a trigger on the seat is tripped, causing an actuator to fire. This action causes the web strap assembly to be drawn taut, effectively displacing the survival kit and separating the pilot from the seat. Upon separation from the seat, the parachute lanyard, still attached to the open safety belt, actuates the parachute timer, or pulls the ripcord grip directly if the zero-delay lanyard is connected. The zero-delay lanyard is discussed in more detail later on in this chapter.

METHODS OF EGRESS AND EGRESS SYSTEMS

For the pilot flying at subsonic speeds, the problem of escape has been satisfactorily answered by open-seat ejection. The seat is ejected from the aircraft in an upward or downward direction by a catapult of appropriate design. The rocket-type catapult per-

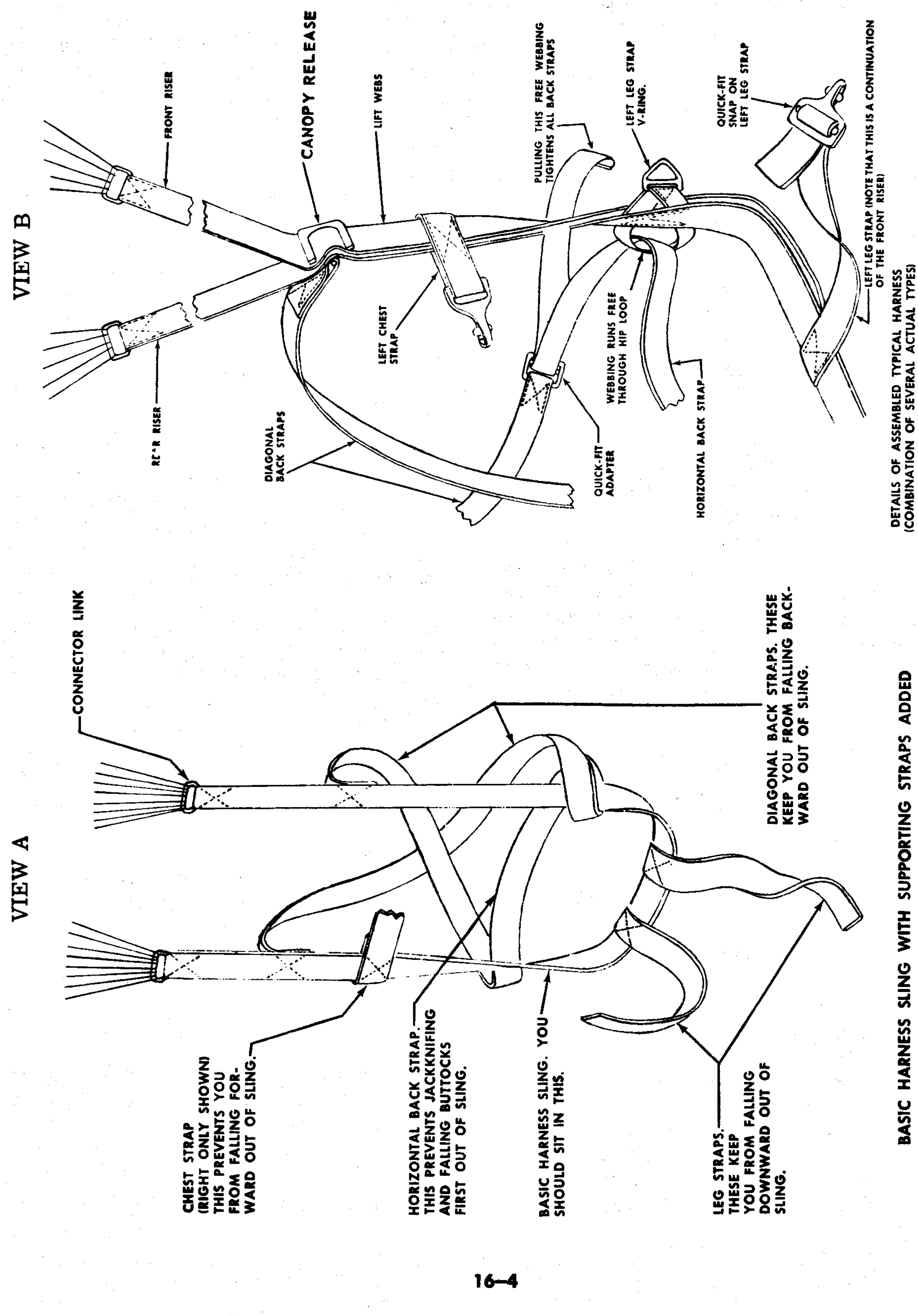
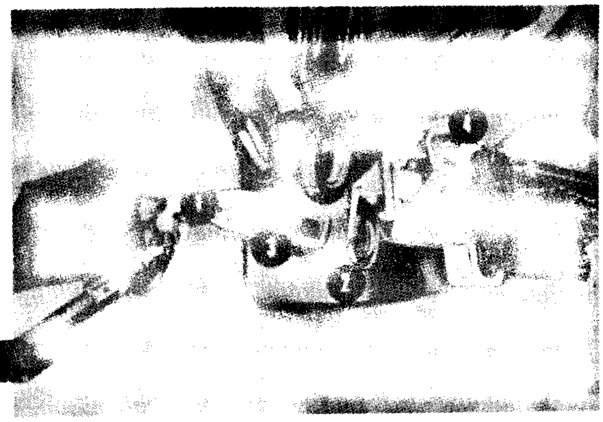
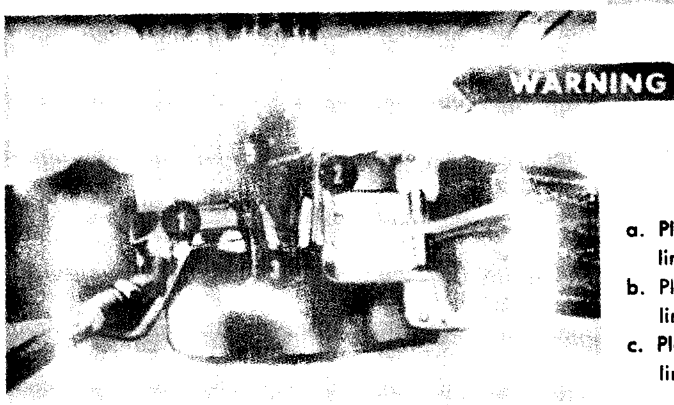


Figure 16–2. Harness Construction.

1. Automatic Release
2. Parachute Lanyard Anchor
3. Swivel Link
4. Manual Release
5. Shoulder Harness Loops





WARNING

Failure to install the shoulder harness loops and parachute lanyard anchor in correct sequence will prevent separation from the seat after ejection.

a. Place right shoulder harness loop on safety belt swivel link.
b. Place left shoulder harness loop on safety belt swivel link.
c. Place parachute lanyard anchor on safety belt swivel link and fasten safety belt.

Swivel link 3 released from right side of belt.
Shoulder harness loops 5 released from swivel link 3
Parachute lanyard anchor 2 retained by shoulder on swivel link 3
Manual release lever 4 locked, holding swivel link to left side of belt.

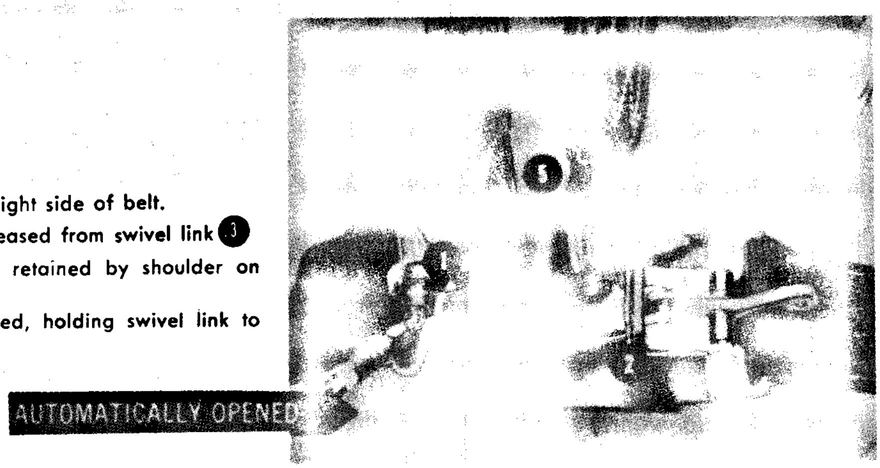


Figure 16–3. Automatic Safety Belt, Type MA–6.

mits higher ejection velocity without exceeding the maximum permissible acceleration and "jolt," because such catapults have no inherently limited "stroke length."

At a given altitude, the force exerted by windblast on a given area increases as the square of the true airspeed. Windblast problems become acute beyond 500 knots indicated air speed (IAS), and at 660 knots (Mach 1 at sea level) become quite critical.

At this speed, windblast exerts over 9 psi, or a total of 3½ tons over the surface of the body. This pressure is not, *per se*, injurious to tissue, but makes retention of personal equipment exceedingly difficult. It can cause extreme flailing of limbs and head, and hence, secondary injury.

However, ejections at indicated airspeeds above 500 knots are quite rare. In general, pilots using currently standard Air Force equipment, and using it in the proper manner, can expect to bail out uninjured.

Separation From the Seat and Parachute Opening

One of the first considerations after ejection is separation from the seat. It is advisable for the subject to release his safety belt and shoulder harness and kick clear from the seat as soon as possible after ejection. There are reports on record of cases in which the pilot ejected himself from the plane, but was still fastened in the seat by the safety belt at the time it crashed into the ground. In these cases, the seat chute failed to deploy when the ripcord was pulled because of the restriction imposed by the seat.

When the seat leaves the aircraft, the lap belt initiator is armed, and, following a one-second delay, the lap belt is blown apart. In the event of a malfunction, the belt may be manually opened. However, if this occurs, the automatic parachute release is bypassed and the ripcord will have to be operated manually.

When the F–1B automatic parachute release (figure 16–4) is installed in the parachute pack, one need have no fear of delayed opening or entanglement of the chute on the aircraft structure. The automatic parachute release aneroid is set at 14,000 feet, and the time setting is 1 second when used with an automatic lap belt. When used in a nonejection-seat aircraft, the timer is set at 5 seconds. This provides a sufficient time interval to avoid the aircraft and to approach terminal velocity. The automatic release can be overridden in an emergency, but under no circumstances should the chute be operated before a one-second delay.

It should be pointed out that altitude may be difficult to judge when one is over water or desert terrain. Having the aid of the F–1B, there is no reason for opening the chute at high altitude, and very little reason to use the manual release.

Manual Parachute Release. When it is necessary to pull the ripcord manually, the jumper should first look at the "D" ring. If a back or seat-style parachute is being used, the thumb of the left hand should be hooked into the ring and the assembly rotated outward from the body. The right hand then should grasp the "D" ring which is then pulled with both hands away from the body with a hard and fast motion. When a chest-

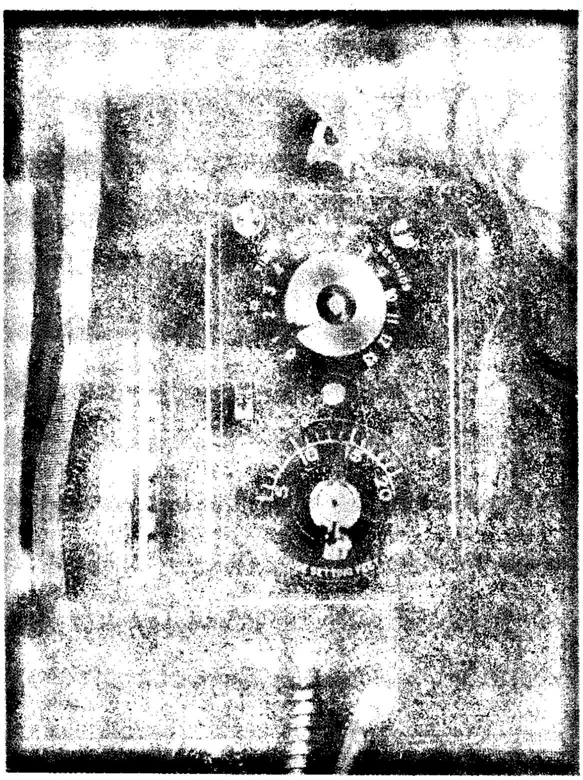


Figure 16–4. F–1B Automatic Parachute Ripcord Release, in the Latest Back Type Parachute.

The release consists of an anaeroid and time setting. An anaeroid setting of 14,000 feet will be maintained at all times. A one second time setting will be used when used in an ejection seat. For use in aircraft with conventional seats, a five second time setting will be used.

type parachute is used, the bottom of the pack is held with the left hand, and the right hand pulls the "D" ring with a hard, fast jerk.

Low Altitude Escape

Most fatal ejection attempts are from low rather than very high altitudes. In an attempt to lower the minimum safe ejection altitude, a timing system has been developed which causes immediate chute deployment when the pilot leaves the seat. This is called the "one and zero" system, meaning seat separation one second after ejection and chute deployment at that time. This system has been found to give ground level escape capability, using certain catapults and traveling above a certain airspeed.

This is accomplished by a very simple arrangement (figure 16-5). While flying at altitudes below 2,000 feet, the lanyard, which ordinarily arms the timer when the pilot leaves the seat, is snapped directly to the "D" ring.

Before the takeoff, the pilot inserts the automatic parachute lap belt key into the seat belt, in accordance with standard procedures. The snap ring is then attached to the parachute "D" ring. Upon reaching a reasonable flight altitude (2,000 feet), the snap ring is disengaged. No further action is necessary since the automatic parachute release arming knob is never disengaged from attachment to the seat belt. Prior to landing and during low altitude flights, the pilot again attaches the snap hook to the "D" ring. Zero-delay lanyard engagement requirements and method of attachment are shown in figures 16-6 and 16-7, respectively.

High Altitude Escape

As altitude increases, several problems of escape become more acute. These include (1) bailout oxygen supply, (2) cold exposure, (3) decompression, and (4) parachute opening shock.

The problems of escape at high altitude virtually dictate that the crewman free-fall to a pressure altitude of 15,000 feet before his parachute is deployed. Seat separation, free-fall, and chute deployment are accomplished by a group of automatic devices designed to provide a dependable means of getting the crewmember to a lower altitude safely. The free-fall technique of high-altitude ejection seat escape becomes less satisfactory at altitudes above 40,000 feet since dangerous rates of spin are encountered at these altitudes. Nevertheless, the use of this technique and reliance on the parachute timer offer the greatest measure of safety.

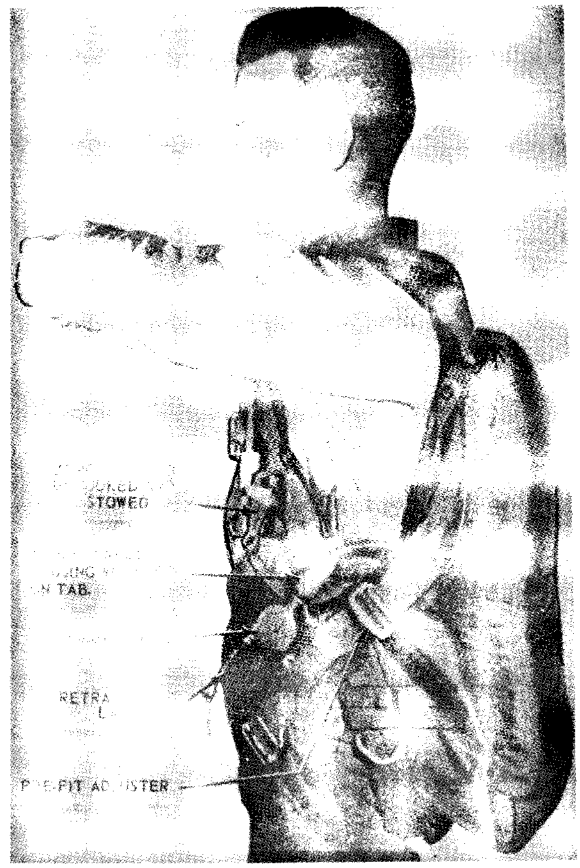


Figure 16-5. Arrangement of Arming Accessories, Automatic Back Parachute.

Bailout Oxygen Supply. To combat hypoxia, the standard bailout aid, usually used in the Air Force for oxygen masks, is a small, high-pressure (1,800 psi) oxygen bottle (H-2) (see figure 16-8). Pilots of fighter-type aircraft should carry the bailout bottle on flights above 25,000 feet to provide oxygen in cases of egress. This bottle is located on the parachute and is attached to the oxygen mask with a hose and bayonet fitting via a

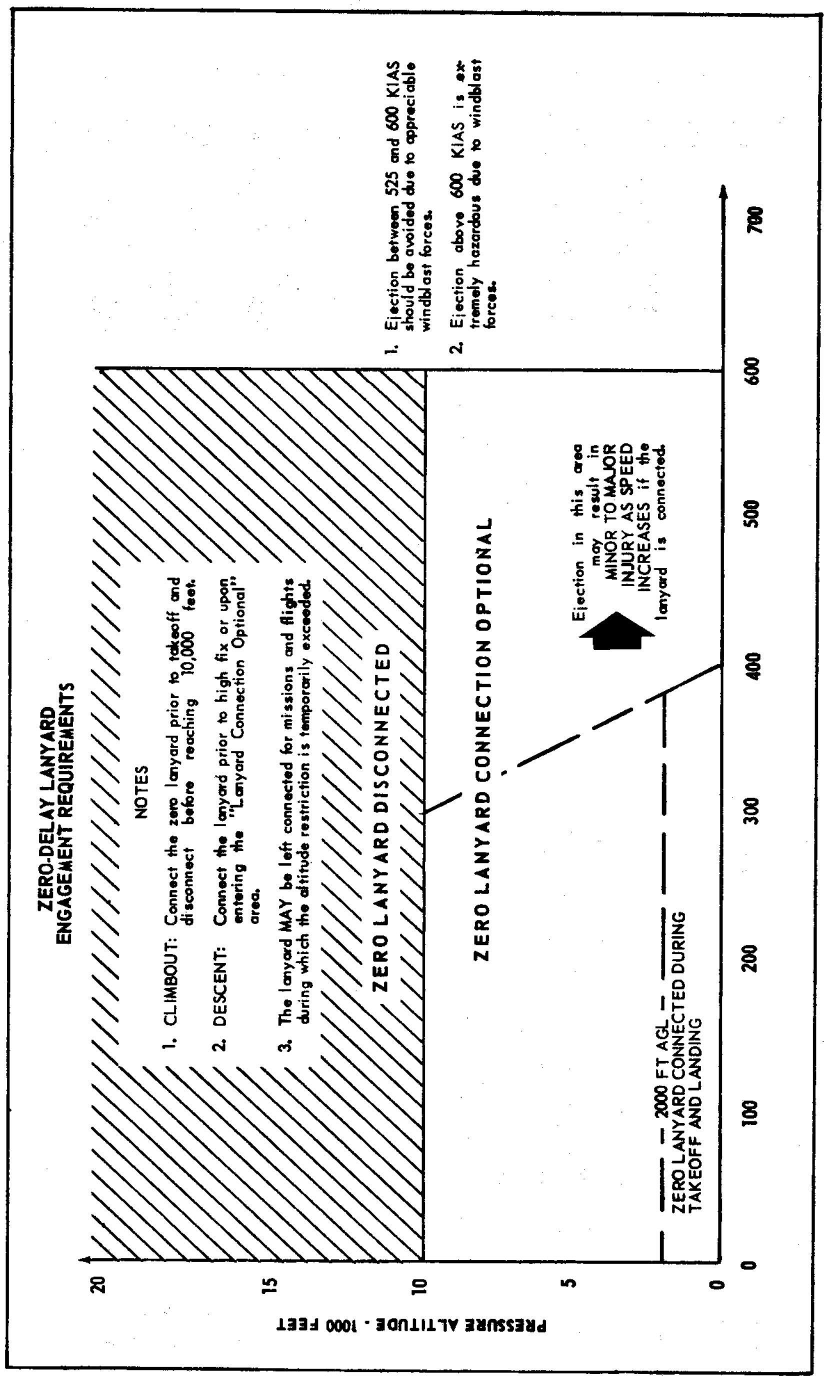


Figure 16–6. Velocity—KIAS.

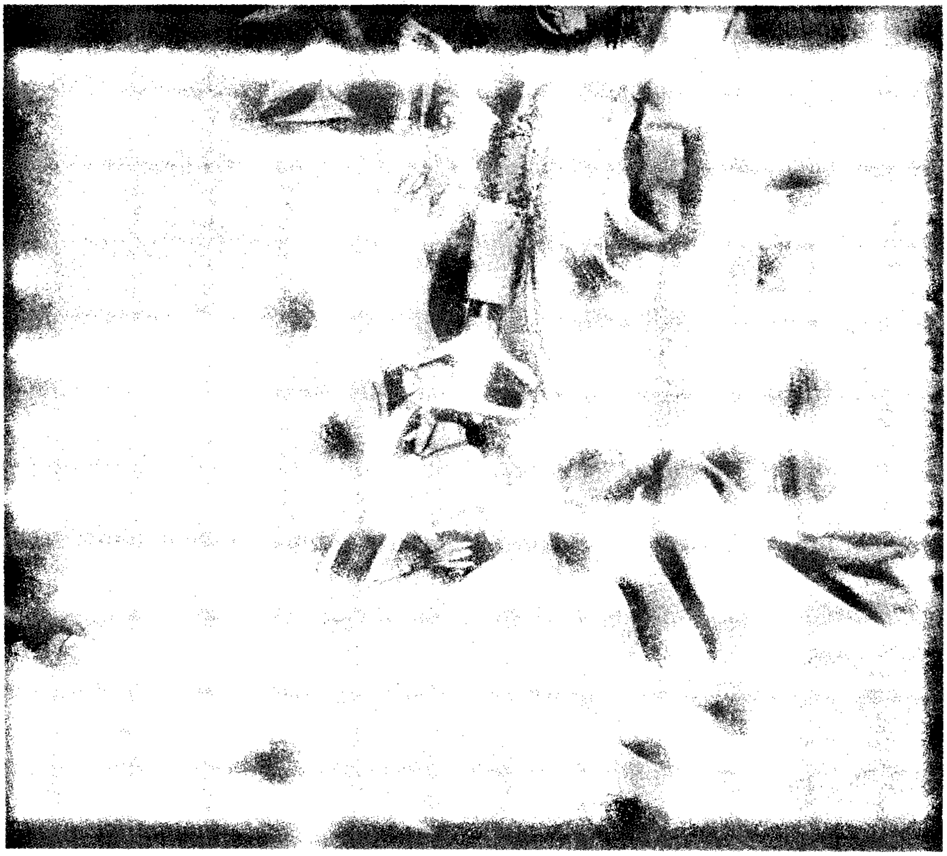


Figure 16-7. Method of Attaching Lanyard Hook to Ripcord Grip.

connector (CRU-60). Certain aircraft (F-4, F-106) carry the emergency oxygen in the survival container. It will supply a continuous flow of oxygen for approximately ten minutes.

With the H-2 system, the flow rates (at 25° C, 760 mm Hg) will vary from ten liters per minute during the first minute to one liter per minute at the end of a 10-minute period. Free fall descents from a maximum altitude of 40,000 feet can be accomplished when using demand masks (MBU-4), and from 50,000 feet when using pressure breathing masks (MBU-5) in conjunction with the CRU-60 connector. Even from these altitudes, the bailout bottle is not expected to supply oxygen for a long open-parachute descent, but is intended to carry the free-falling parachutist to lower altitudes safely and without danger of unconsciousness from hypoxia. Altitudes above 50,000 feet require bottles of larger capacity to supply the oxygen under pressure to the high-altitude pressure suit and mask. Fighter pilots bailing out with the Type H-2 assembly must actuate the valve of the bailout bottle, disconnect the oxygen-mask hose, release the canopy, and fire the ejection seat. In certain aircraft (F-4, F-106), actuation of the bailout assembly is accomplished automatically by the motion of the ejection seat as it leaves the aircraft.

It has been proven that the H-2 bailout bottle provides a satisfactory supply of emergency oxygen. However, in escape above the 20,000-foot level, the oxygen contained in the bailout bottle would probably be insufficient for some bomber crewmen, considering the time required to reach and open escape hatches and still provide for the increased

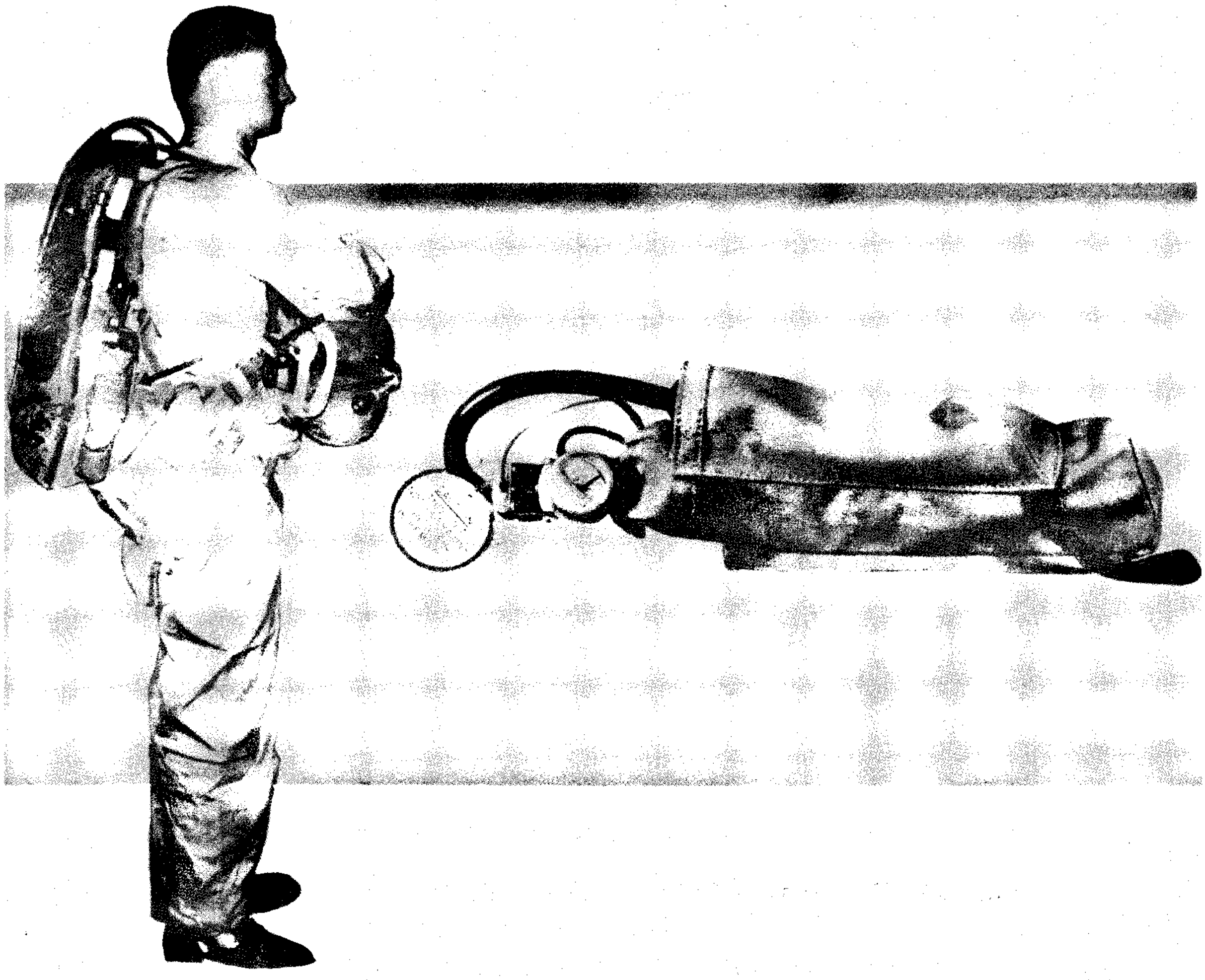


Figure 16–8. The H–2 Bailout Bottle and Canvas Container.

The figure at the left shows one method of attaching the bailout bottle (H–2) to the parachute pack (arrow).

metabolism from excitement and exercise. In such situations, crewmembers should use the walk-around bottle to reach the escape hatch and then transfer to the bailout bottle.

Cold Exposure. A body falling freely through space is not unduly influenced by the cold windblast. The extremely low temperatures at high altitudes affect the parachutist for such a short time that there is no reason to fear frostbite. During a free fall, the individual may experience some degree of frostbite unless all parts of the body are fully covered with clothing approximating 2 *clo* value. (The *clo* is defined as that amount of insulation which will maintain normal skin temperatures when heat production is 50 kilocalories per square meter of body surface per hour, air temperature is 70° F, and air movement is 20 ft per min.) (See chapter on "Effects of Temperature.")

Decompression. (The effects of decompression are discussed in the chapter entitled, "Effects of Decreased Barometric Pressure —Dysbarism.")

Parachute Opening Shock:

Opening shock in terminal free fall at 5,000 feet is 5 to 8 Gs peak acceleration. The opening shock at high altitudes is more severe; the rate of opening of the parachute canopy is much faster since the lighter air

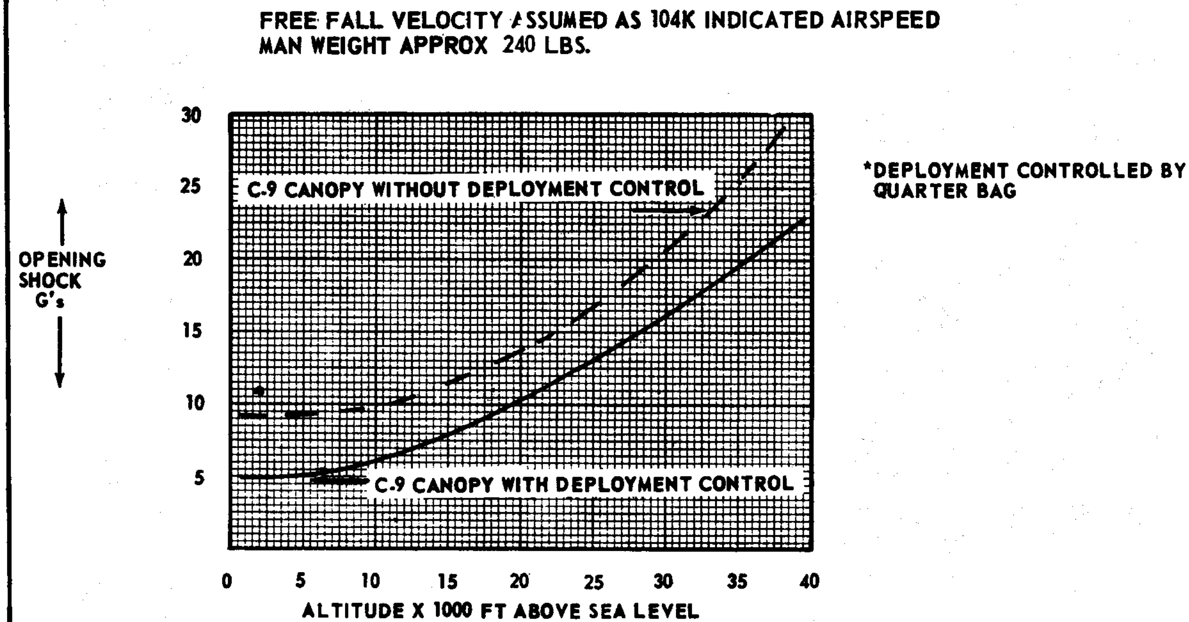


Figure 16–9. Average Opening Shock 28 Foot Parachutes at Various Altitudes at Terminal Velocity of Average Crewman.

at high altitudes offers less resistance to the expanding skirt of the canopy. This allows complete deployment and opening in a very short time. (See figure 16–9.)

The effects of increased terminal velocity are obvious since velocity actually doubles at an altitude of 40,000 feet when compared to that at sea level. As one ascends, the increase in terminal velocity is responsible for an increase in the magnitude of deceleration at higher altitude. Higher terminal velocity is attained as air density decreases. Approximate values are as follows:

40,000 feet terminal velocity—243 mph
30,000 feet terminal velocity—196 mph
10,000 feet terminal velocity—140 mph
SL feet terminal velocity—120 mph

Parachute packs used on aircraft having ejection seats have their canopy packed in a "quarter deployment bag" (figure 16–10). This bag encases approximately one-fourth of the folded canopy. Suspension lines are stowed in channels (flutes) on the outside of this bag. Parachutes packed in this manner are restricted from use in slower helicopters and liaison aircraft. The quarter deployment bag facilitates the orderly deployment of suspension lines and canopy, and decreases opening shock.

Capsule Ejection

The Handbook of Instructions for Aircraft Design (HIAD) specifies that any aircraft flying above 50,000 feet or above 600 knots IAS must provide an inclosed escape system, or capsule. Escape capsules reduce such problems as windblast, cold, and low pressure, and extend escape capabilities at high speeds and altitudes (see figure 16–11).

The F–111 aircraft is the first operational aircraft designed to provide a separable crew compartment (see figures 16–12 and 16–13).

A comparison of the characteristics of this type of escape system and the encapsulated seat (B-58) is shown in table 16-1 (see also figure 16-14).

TABLE 16-1. COMPARISON OF ENCAPSULATED SEAT AND SEPARABLE CREW COMPARTMENT

Condition	*Encapsulated Seat*	*Separable Crew Compartment*
Human tolerance	Good to 700 KEAS	Goal of 900 KEAS
Aerodynamics and stability	Good	Good
Man/seat/chute collision	Not possible	Not possible
Collision between ejectees	Possible	Not possible
Minimum time — Low altitude ejection and recovery	7 to 10 seconds	8 to 12 seconds
After landing survival	Good	Excellent
Relaxation and comfort	Poor	Improved
Backup pressurization	Good	Poor
Bailout coordination	Necessary	Improved over ejection seats or single capsules

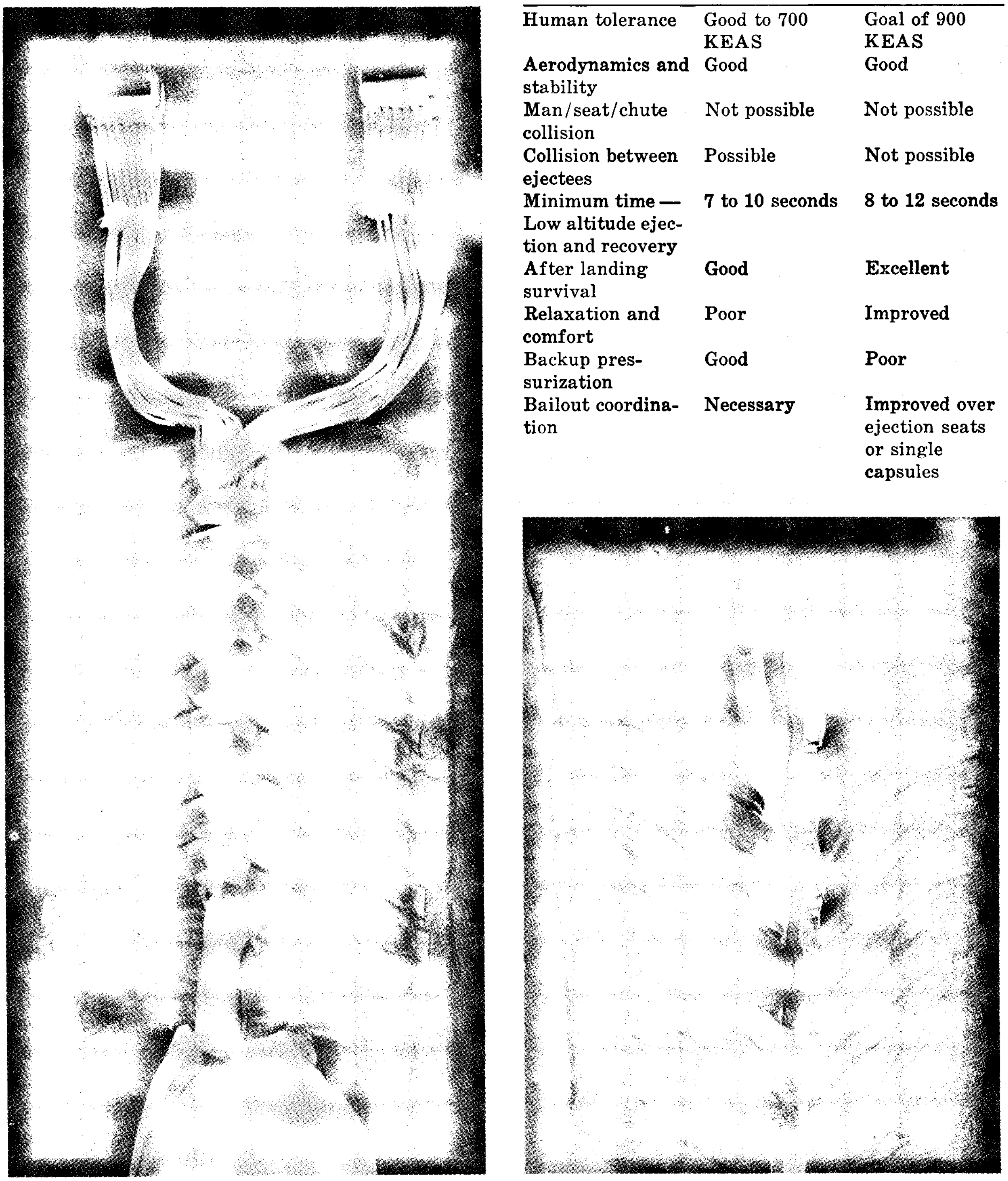


Figure 16-10. Quarter Deployment Bag.

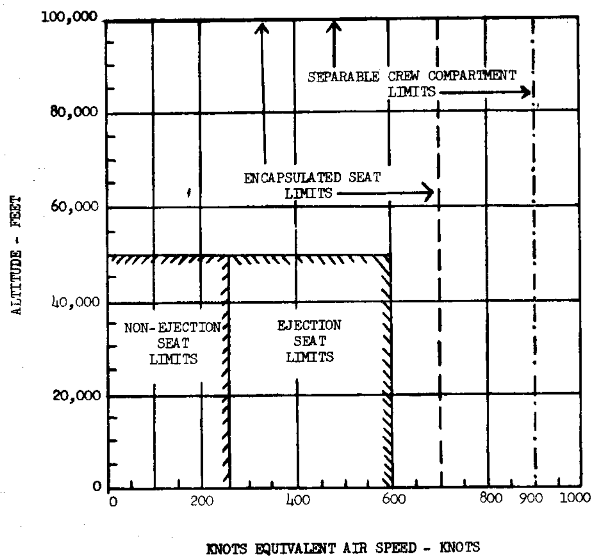


Figure 16–11. Escape Provision Requirements.

Manual Bailout

When aircraft are not equipped with ejection seats, situations may develop which will make escape difficult or impossible.

An adequate warning system is essential to alert all flight personnel so that each can be prepared and know when to jump. The aircraft commander must be quick in making the decision to jump at the earliest possible moment in order to avoid the excessive G buildup which makes escape impossible.

Aircraft out of control develop centrifugal forces of such magnitude that it becomes difficult or impossible to don parachutes, change to walk-around bottles, and reach escape hatches. At 2 Gs, movement is impaired, and at $3\frac{1}{2}$ Gs, a crewmember will find it nearly impossible to move from his position.

Excitement of the emergency increases oxygen utilization.

Certain crewmembers may find it neces-

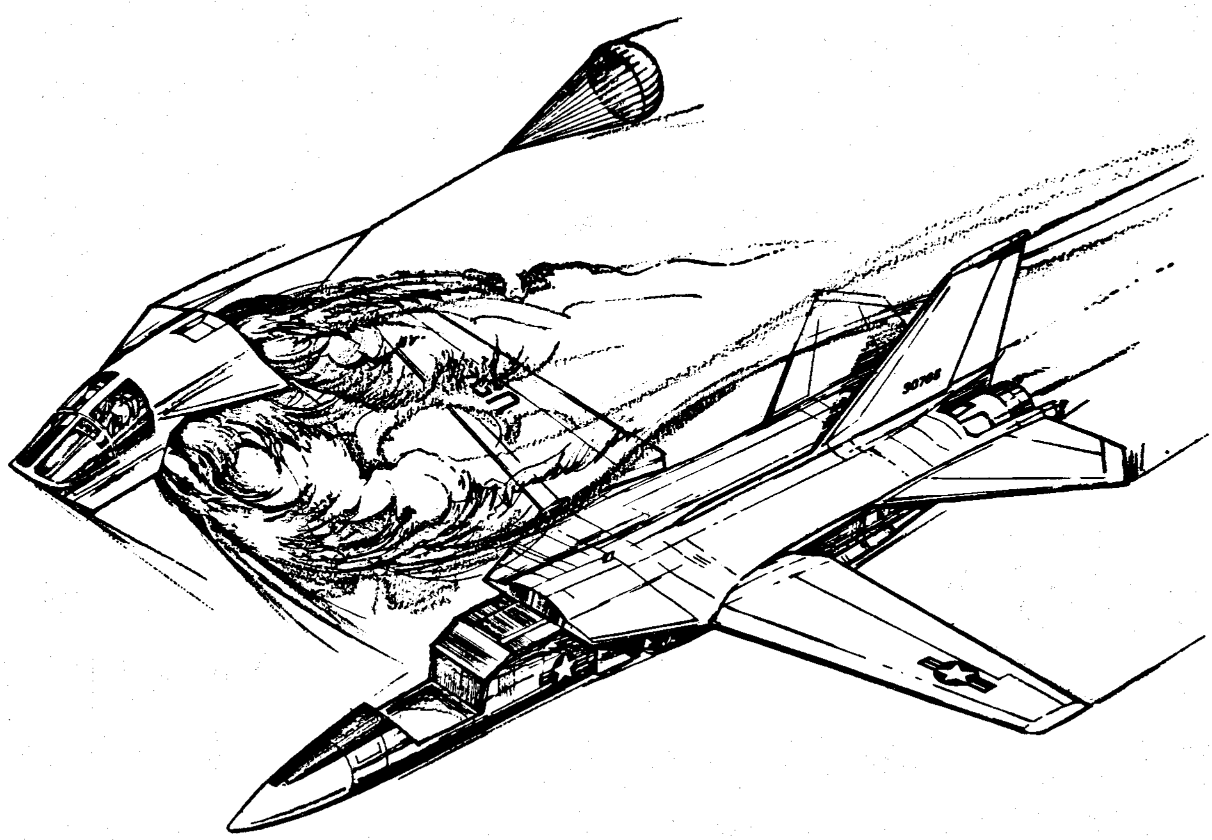
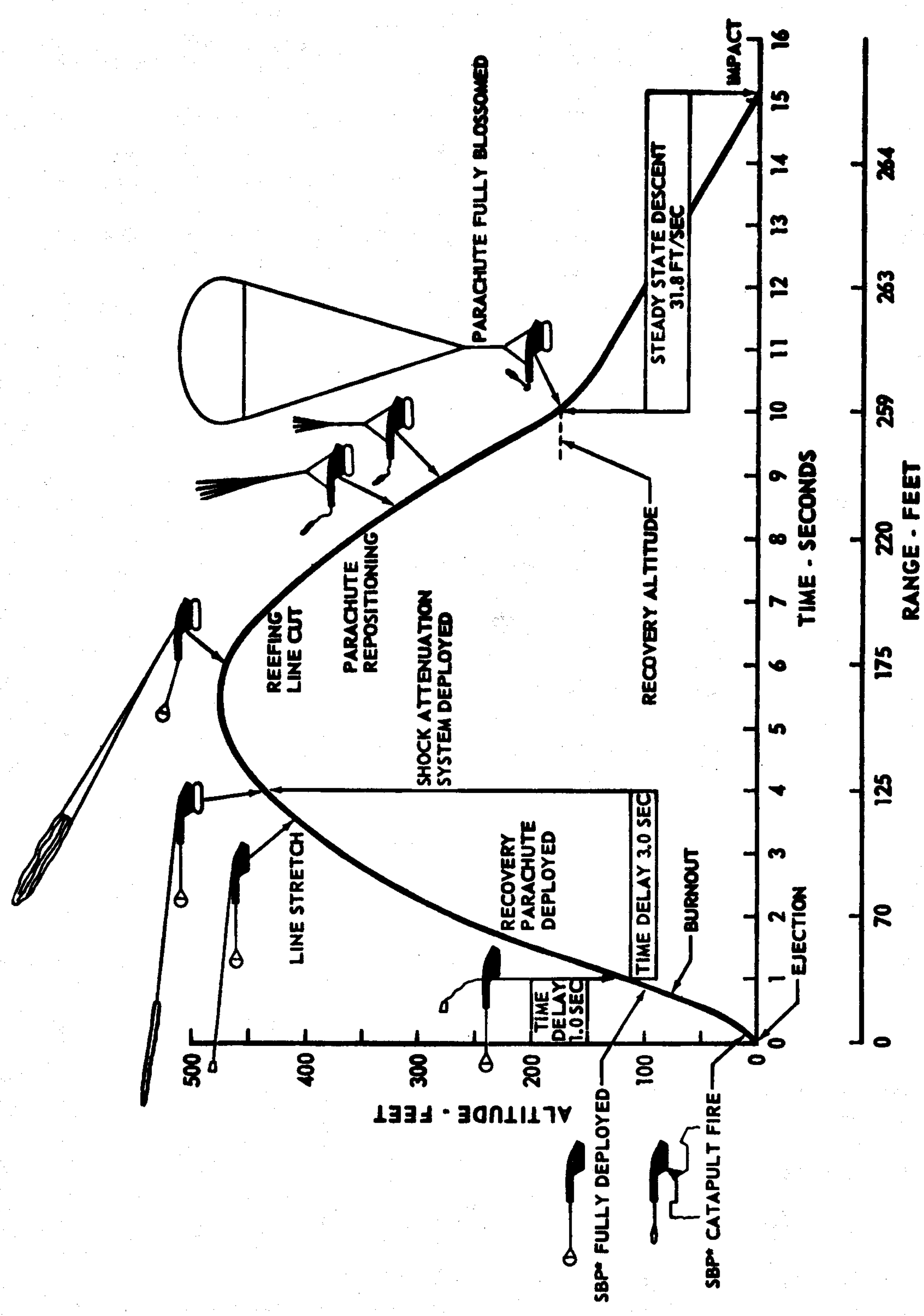


Figure 16–12. F–111 Separable Crew Compartment Escape System.



*STABILIZATION BRAKE PARACHUTE

Figure 16–13. Recovery Sequence for Sea Level Static Ejection of an F–111 Escape System.

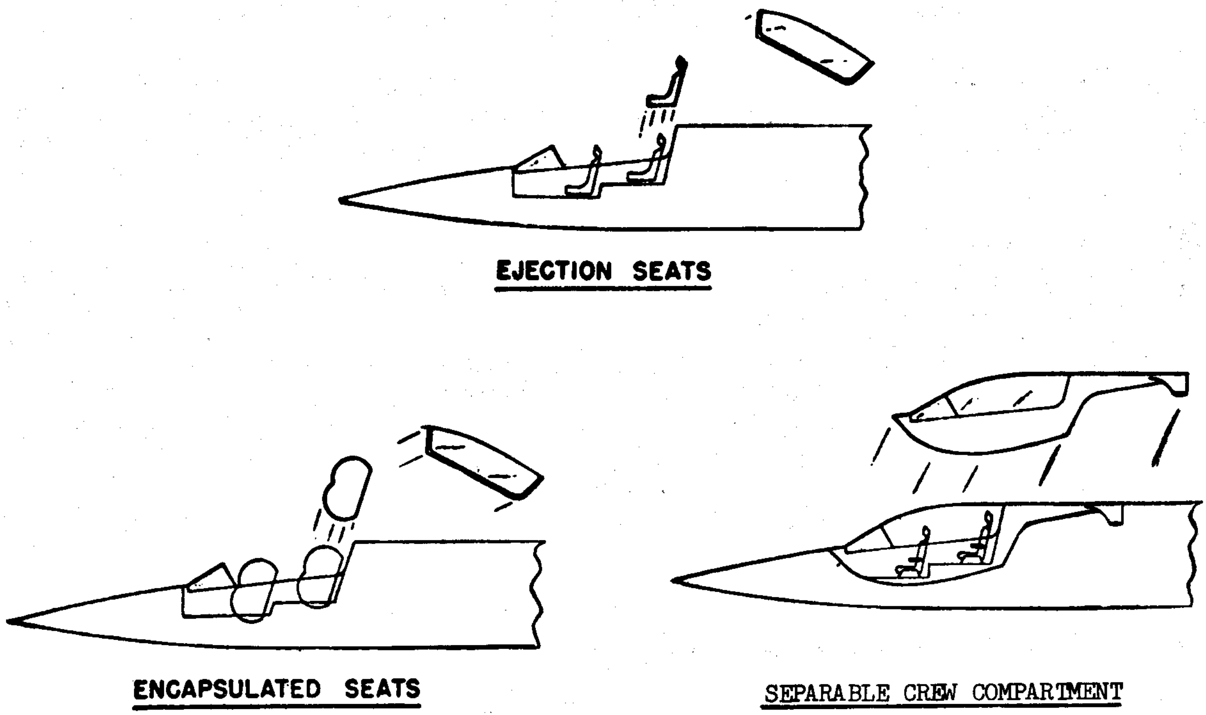


Figure 16–14. Emergency Escape Systems.

sary to use the walk-around bottle (figure 16–15) in reaching distant escape hatches.

The pilot is responsible for the preflight indoctrination of all persons aboard his aircraft, but each man must care for his own chute during flight. All flight personnel should have knowledge of the location of escape hatches, individual aircraft emergency provisions, and bailout procedures, so that escape may be preplanned and accomplished with a minimum of time and effort.

BAILOUT PROCEDURES AND BODY POSITION

Before making an emergency exit from an aircraft, one must be sure that the leg straps of the parachute are tight. For the most part, injuries incurred from opening shock can be eliminated by proper and careful fit of the harness. This factor alone will appreciably reduce sprains, dislocations and fractures of the back, arms, shoulders, and mandible (see figure 16–16).

When the use of the manual parachute release is required and a long free fall is necessary, the best altitude at which to open

Figure 16–15. The Walk-Around Bottle.

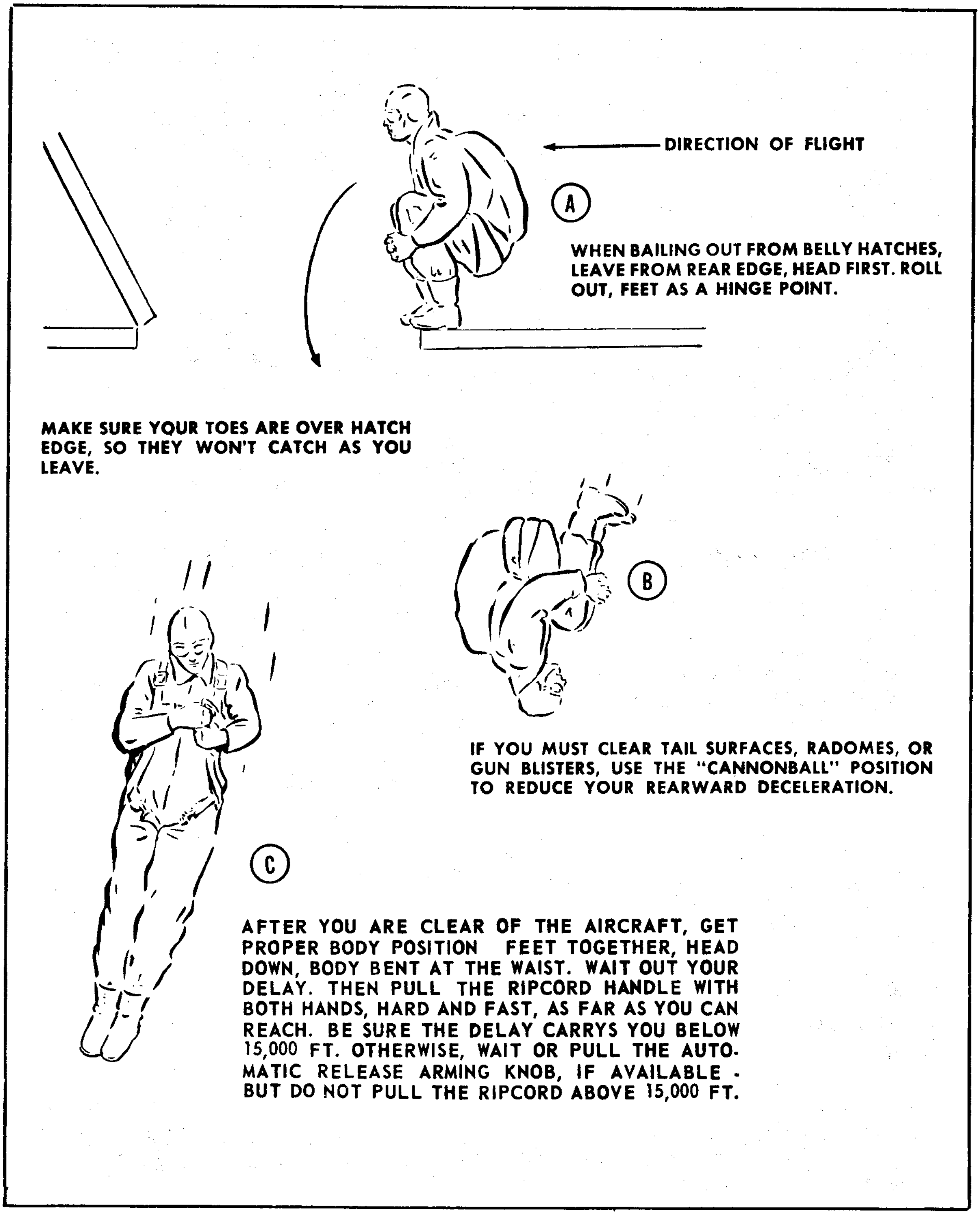


Figure 16–16. Bailout Procedure and Body Position.

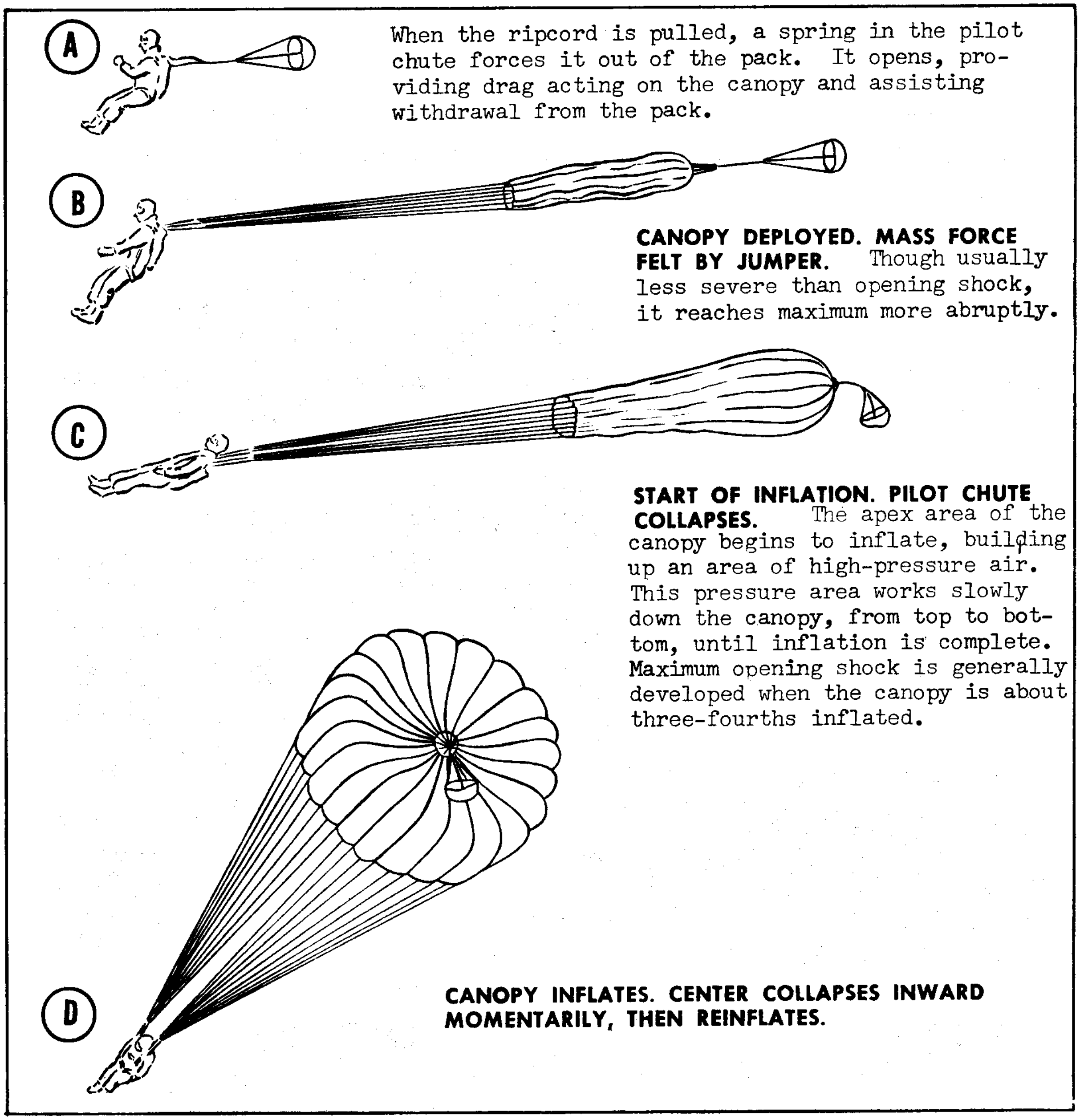


Figure 16–17. Deployment and Inflation of a Parachute Canopy.

the chute is 5,000 feet. At this elevation, the earth becomes green, details can be seen, the horizon spreads rapidly, and the ground begins to rush up to meet the parachutist. This altitude can be estimated easily, and gives the jumper good clearance, warmer air, and sufficient oxygen.

Depending upon speed, altitude, weight, and attitude, a canopy will normally open in 1.5 to 2.5 seconds from the time of ripcord pull. The term "opening time" is the time from ripcord pull to full inflation of the canopy, and is the sum of the deployment and inflation times (see figure 16–17).

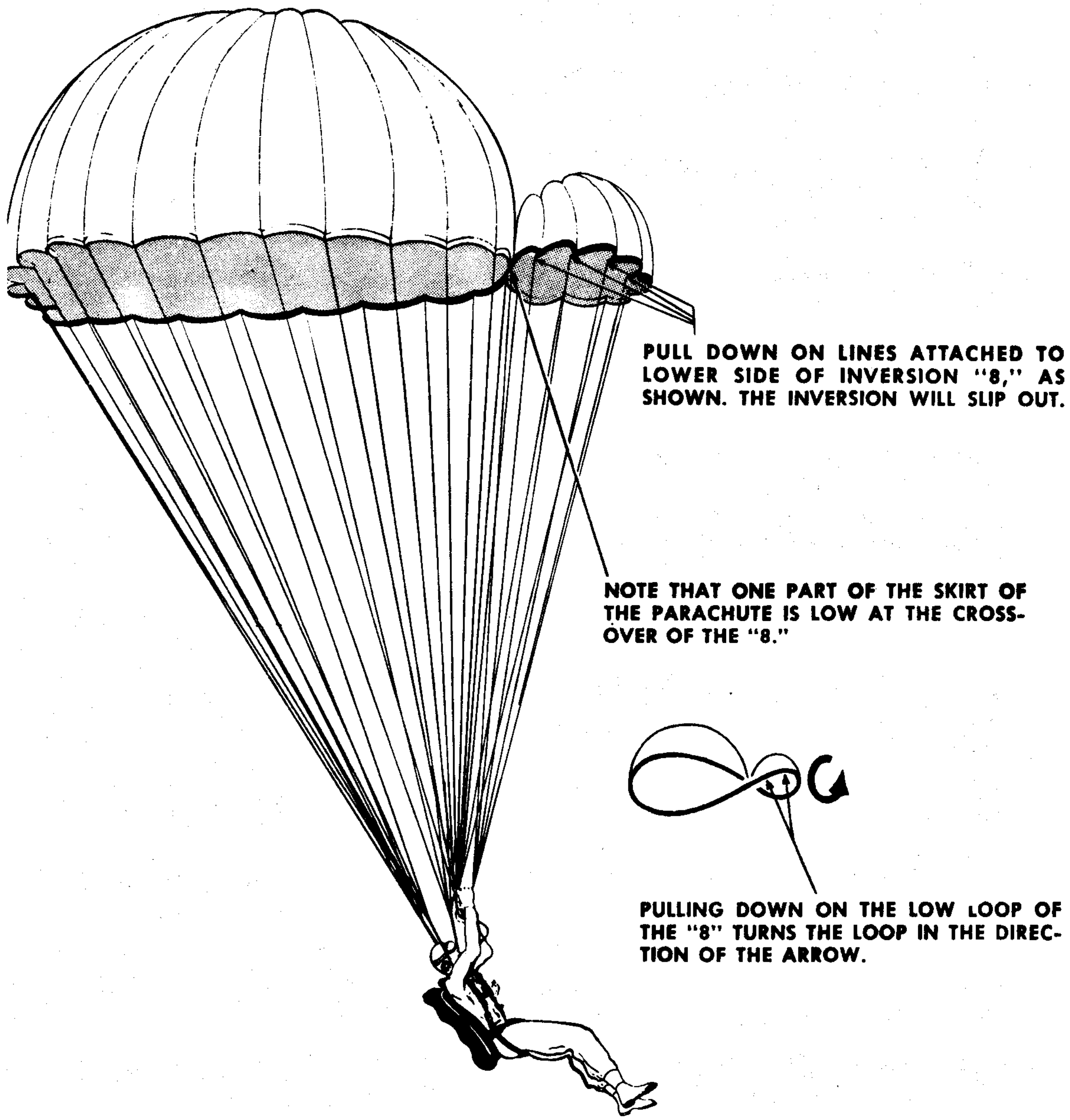


Figure 16–18. An Inversion and the Technique for Removing It From Canopy.

An Inversion and the Technique for Removing It From Canopy

In rare instances, a canopy may inflate with a minor malfunction known as an inversion, line-over, or brassiere opening. If you have an inversion and a few thousand feet of altitude, take a good look at your canopy. You will notice that the skirt of the parachute forms a figure "8." At the crossover point on the "8," one skirt bank will be underneath. If you cannot tell which part of the skirt is lower, just pull down on the suspension lines attached to the smaller loop of the "8." Either method will get rid of the inversion. Very, very rarely, the canopy may be in two equal halves, and look just like a brassiere, hence, the name (see figure 16–18).

Mid-Air Modification for Steerability

This is a method to reduce oscillations and provide a capability for turning and steering the parachute canopy. It is commonly referred to as the "4 line cut." The cutting of four suspension lines (lines 1, 2, 27, and 28) will cause a large "lobe" or "scallop" to form in the rear center portion of the canopy skirt which provides a facility for turning the canopy at the approximate rate of 30 degrees per second, and will also significantly reduce oscillations.

The lines to be cut are marked by small red, fabric identification tapes, and a knife, located on the right front riser, is provided for this purpose (see figures 16–19 and 16–20).

LANDINGS

The following fundamental instructions for landing must be remembered to avoid injury (see figure 16–21).

Normal Ground Landing

a. At 1,000 feet, reach above your head as far as you can comfortably. Grasp both right risers in your right hand and both left risers in your left hand. Make your body turn if required.

b. Look at the horizon. Don't look straight down, because you can't judge distance from this viewing position.

c. Put your feet tightly together, bend your knees slightly, and point your toes so that you will land on the balls of your feet.

d. *Relax.* Prepare to land by letting yourself go limp. (Younger children are rarely hurt in falls because they are limp, so follow their example—*be limp.*)

e. If your body turn was right, you will land, drifting obliquely. Pull down on the risers at the moment of impact. Take the fall by collapsing the way the parachute wants to take you. Don't fight it. Just go limp.

f. The proper sequences for landing the right way are:

On the balls of the feet;
On the side of one leg;

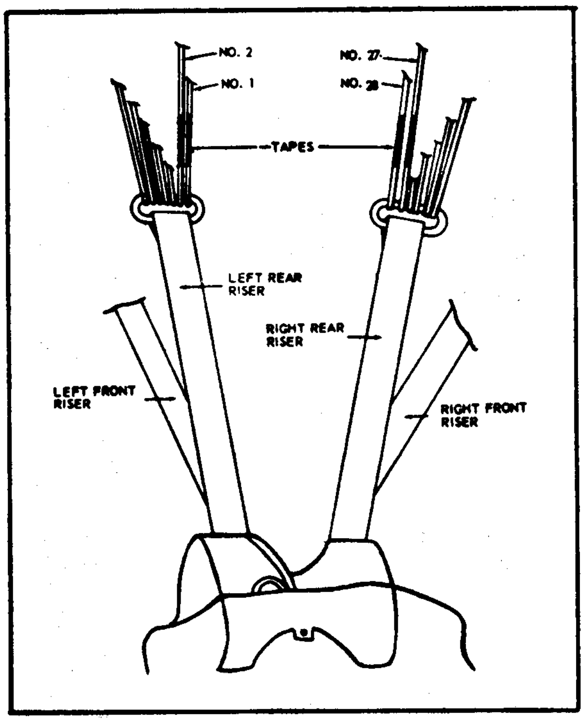


Figure 16–19. Marked Suspension Lines.

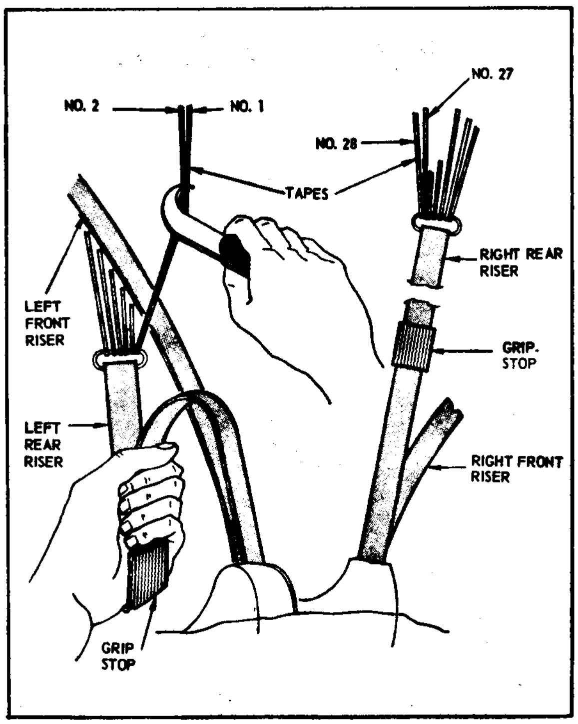


Figure 16–20. Cutting Marked Suspension Lines.

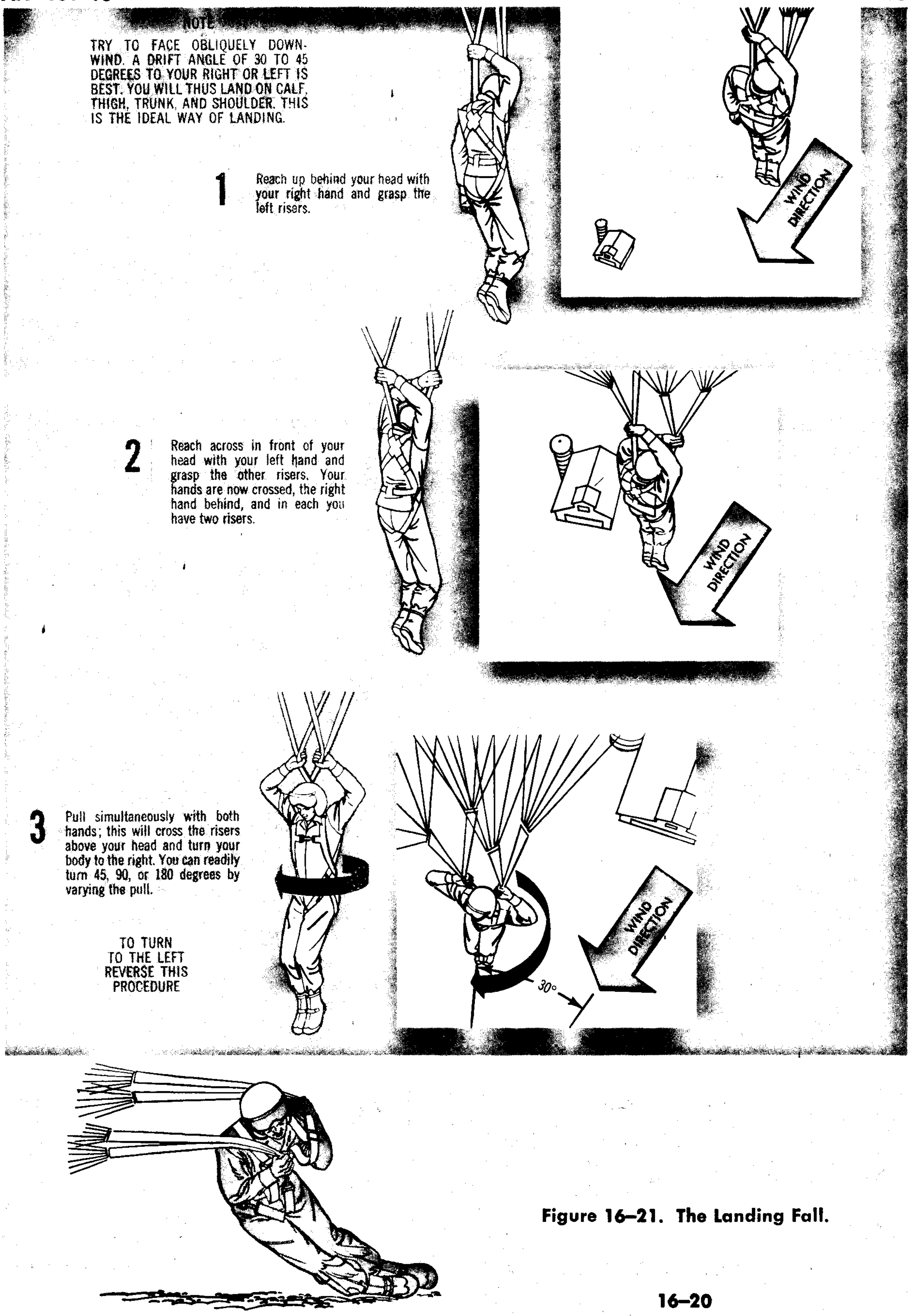


Figure 16–21. The Landing Fall.

On the thigh;
On the hip;
On the trunk; and last,
On one shoulder.

Reading and memorizing the recommended landing fall is a good idea, but will be of minimum benefit unless the technique is practiced and perfected. Practice can be conducted from a low platform (about 4 feet high will do). Practice should include front, back, and side landings. The Army paratrooper landing-injury rate amounts to a small fraction of 1%. In Air Force emergency bailouts, the landing-injury rate is about 4%. An hour or 2 of training may save the pain of a broken limb; in a survival situation, a broken leg may lead to a loss of life.

Wearing the proper footgear is of great advantage in preventing foot and ankle injuries during landings. A jump-type boot affords support to the foot and ankle. This type of boot is advisable for all flying missions other than regular passenger runs. Low-quarter shoes are frequently lost because of windblast or during parachute opening shock, and do not provide proper ankle support upon landing. Furthermore, these shoes are not suitable for extended hiking as would be required during an evasion and escape return trek to a jumper's base.

If there is wind, carry out all normal landing procedures, and immediately after ground impact, release one riser group by operating a canopy release. Use either release, as one is sufficient to spill the canopy.

Landing in Trees

If you are going to land in trees, forget the risers. Cross your arms in front of your face (figure 16–22). Don't try to stop or slow your trip through the trees by grabbing limbs. Bury your face in the crook of an elbow. Keep your feet and knees together. Don't be in a hurry to get down after your canopy hangs up. Rest a moment or two to get over the shock of bailout, and then evaluate your position. Wait for rescue if you can. If you can't, try to make a rope of the risers and suspension lines that you can cut loose. Tie one end to your harness and slide down the rope. Use a hat, handkerchief, or anything available, to keep from burning your hands. Wrapping the line around a leg a couple of times will help you to descend slowly. Don't hurry—you can get painful burns by sliding down the rope too fast. Be extremely cautious about this letdown maneuver unless you have had previous experience. (After safely reaching earth, it would be a shame to kill oneself falling out of a tree.)

Landing in Telephone and Power Wires

(These wires are usually quite high above the ground and several feet apart.) Put your hands over your head with the palms flat against the inside of the front risers. Keep your feet and knees together and toes pointed to avoid straddling a line.

Night Landing

Prepare for a normal landing as soon as the parachute has opened if the night is dark. Be prepared for contact at any time. Surprisingly, statistics show that fewer men are injured in night jumps than in day jumps. The reason seems to be simply that landing is a surprise, and men don't tense up for what isn't expected.

Water Landing

Whether the wind is high or low, the procedures for water landings are the same. While knowing how to swim is a comforting

Figure 16–22. Landing in Trees.

assurance, it will not be necessary to expend this extra energy if you are properly equipped and trained.

How the crewman conducts himself in the few minutes after ejection can determine whether or not the ejection will be successful. To prevent a possible fatality after successfully leaving the aircraft, each crewman should fully indoctrinate himself on the procedures set forth below, to the extent that they will become almost automatic when the need for them arises. These procedures are used with a back-type parachute, a seat-type survival kit, and an underarm life preserver, and should be carried out as soon as possible after deployment of the parachute. Following these procedures will reduce the time spent in the water, prevent confusion, conserve strength, and give the crewman time to check his survival gear during parachute descent.

Operation and Procedures. After opening the parachute at 14,000 feet or below, do the following:

a. Check the canopy.

b. Remove the oxygen mask or pressure-helmet visor.

c. Actuate the release on the survival kit to inflate the life raft.

d. Check to insure that the raft has inflated properly. If it has not and time permits, the raft can be pulled up and orally inflated.

e. Inflate the underarm life preserver by pulling sharply downward and slightly outward on the lanyards that extend from the lower front corner of each container. If a failure occurs, the life preserver can be orally inflated.

f. Fasten the front of the cells together by pressing the Velcro (cockleburr) straps together.

g. At an altitude of 1,000 to 2,000 feet over water surface, remove canopy release safety guard.

WARNING

Before attempting to open the clips, insure that the clips have not already been released, as you could be opening the canopy release.

Place the right hand on the right canopy release, if provided, and the left hand on the left canopy release. When the feet touch the water, immediately operate canopy release to spill the parachute. The arms may be crossed when operating the releases. This will prevent the front position of the preserver from coming in contact with the survivor's face upon contact with the water. In any water landing, altitude is difficult to determine. *Do not release the canopy until the feet touch the water, no matter how close you think you are.*

h. After a water landing, entanglement in the suspension lines is probable. If your parachute has only one canopy release, use the hook-blade knife attached to one riser to cut the riser free or to cut suspension lines. (*NOTE:* The hook-blade knife is in a pocket on the riser. Pull the fabric tab to open the pocket. You will find the knife attached to the pocket by a short lanyard. To cut the riser, hold the webbing with one hand and using the other hand, cut the webbing between the point where you are holding the riser, and the shoulder. Do not jerk at the webbing with the hooked blade. A firm slashing motion, similar to that you would use with a straight-blade knife, will cut the webbing easily.) This should be done either before boarding the raft, if conditions permit, or after raft entry. It is recommended that the canopy be discarded rather than retained (as recommended in the past). It may do more harm than good to retain the canopy since the survivor can become entangled in the lines. If land is in sight, however, it may be advisable to retain the canopy since it can be used in many ways on land. If this is not possible, try to retain a number of riser lines and possibly a gore or two from the canopy.

i. To prevent puncture of the raft, close the canopy release safety clips. If the MD-1 kit is used, it is advisable to release one side of the seat pan to prevent its puncturing the raft.

j. Recover the raft by pulling on the life-raft lanyard attached to your kit or seat pan and board by the method most suitable to you.

k. Retrieve the survival kit.

The foregoing procedures should be used day or night after bailout over water, or over land when the possibility exists of drifting over water, or when position is uncertain. If you are certain that you are over land, you may wait and release the kit at approximately 1,000 to 2,000 feet to reduce ground impact. This delay over land may also reduce oscillation. Over enemy territory, it may be advisable not to operate the preserver or raft during parachute descent.

Boarding the Raft:

(1) Pull the raft to you by the lanyard.

(2) Hook the life preserver over the small end of the raft, elevate feet behind you, and pull your body into the raft. By using this method, it may also be possible to swim up into the raft.

(3) Hook the front of the preserver over the raft and pull the raft down until one knee is in the small end.

(4) Turn your back to the small end of the raft and pull the raft under the buttocks.

(5) (Some people have found it easier to board the raft with the cells of the preserver unhooked at the front and pushed aside with the arms.)

(6) During and after boarding, keep the center of gravity of your body low and you will board the raft easier, and even in rough water you will not tip out of the raft.

(7) After boarding the raft, the usual thought is to get rid of the harness. However, you should retain the harness when using the zip-on life preserver (LPU-3/P). Loosen the parachute straps for immediate comfort. Your survival gear is attached to the harness, and removal of the harness may result in loss of this equipment in the event of capsizing. The harness can be used in rescue operations. Therefore, you should first retrieve your equipment container by pulling in the drop lanyard, usually found attached to the neck of the CO_2 bottle, as soon as possible after boarding the raft, to prevent loss. You must insure that the raft and survival gear are securely attached to your person before attempting to remove the harness. Removal can be accomplished by partially deflating one cell of the life preserver, pulling it inside the harness and allowing that side of the harness to slide off. Reinflate the cell orally and repeat for the other side of the harness. Again reinflate the cell when the harness is completely removed.

(8) Use your parachute flares only when you are sure rescue personnel can detect them.

SUMMARY

In summary, the following key points are reiterated for emphasis:

(a) Care for the chute at all times.

(b) Wear the chute while in the aircraft unless it restricts your flight task.

(c) Check the harness fit and preflight of the chute.

(d) Know what a canopy release is, how it operates, and when to use it.

(e) Check the oxygen present in walk-around and bailout bottles.

(f) Be sure your flying helmet fits properly. (Air Force personnel who require a special fitting can be provided this service at Wright-Patterson AFB, Ohio.) (Mail Address: USAF Hosp (HWEAB), Wright-Patterson AFB OH 45433.)

(g) Do not hesitate once the decision for bailout is made.

(h) Clear the aircraft or ejection seat before pulling the ripcord or automatic parachute release arming knob. (When possible, delay at least one second.)

(i) Wait until the terminal velocity is reached, if possible, before pulling the ripcord.

(j) Free-fall to a lower, warmer, and denser altitude.

(k) Separate from the seat as quickly as possible when using the ejection seat.

(l) Practice bailout procedures and become familiar with escape exits.

(m) When making a nonejection bailout, wait until you are clear of the aircraft before pulling the automatic parachute arming knob or ripcord.

(n) Know the attitudes of the body for firing the ejection seat, exiting through escape hatches, opening shock, and landing.

(o) When an over-water bailout is performed and after the parachute canopy is deployed, if at 14,000 feet or below, inflate life raft and life preserver immediately. If CO_2 charge should fail, this will give the jumper adequate time to orally inflate the equipment.

(p) Read the aircraft's flight manual to know how to properly use emergency escape and survival provisions. (These instructions are usually found in section III of each Flight Handbook.)

REFERENCES

The reader should insure the currency of listed references.

Armstrong, Harry G., *Aerospace Medicine*, Chapter 20, Williams and Wilkins Co., Baltimore, Md. (1961).

Technical Order 14D1–2–1, 1 April 1965.