AEROSPACE MUSEUM OF CALIFORNIA

TECHNICAL HISTORY SERIES

(Volume VIV)

ACES II EJECTION SEAT

DROGUE PARACHUTE RIGGING & REPACK PROCEDURE FOR STATIC DISPLAY OR MUSEUM-USE-ONLY PURPOSES.

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(Note: This procedure is described here for the sole purpose of aiding aerospace historians in rigging and repacking the ACES II aircraft ejection seat drogue parachute system on museum ejection seats set up for non-operational static display. It is not intended to serve as a functional technical directive on how to pack this chute for actual use on a live or flyable ACES II ejection seat, which work must be undertaken only by an FAA certified egress technician with extensive training and experience in related systems. The source document for this procedure is Douglas Aircraft Technical Memorandum A114761 dated 9 October 1976.)

SECTION I: TECHNICAL INSTRUCTIONS

1) General Remarks

The ACES II aircraft ejection seat, presently used on most US Air Force combat aircraft, utilises a ribbon-type drogue parachute to stabilise and decelerate the seat during high altitude and high speed ejection from a disabled aircraft. This drogue parachute assembly is deployed by a ballistic slug automatically actuated by the seat's 'smart' sensor system. The drogue assembly consists of two major components, a small extraction parachute and the main drogue parachute. This assembly normally deploys at seat/aircraft separation and is jettisoned prior to man/seat separation during actual use. At low and slow corners of the flight envelope, the seat drogue assembly is not deployed and the main recovery parachute assembly is directly deployed to assure successful recovery.

On an 'inerted' museum or static display ACES II seat, this drogue parachute assembly is frequently either missing entirely, or is physically removed from the two recesses on the aft left side of the seat where the assembly is normally stowed; it may also be present but require restowing and packing. The overall length of this two-part drogue parachute assembly is about 30 feet, including the heavy duty seat webbing straps that attach to the seat at two points on left and right aft sides.

The two compartments in which the assembly is stowed appear quite small, relative to the size of the recesses of the seat, and at first glance it may seem impossible that such

a great amount of nylon canopy, webbing, riser, and strapping material can fit into such a small compartment.

It should be noted that although the instructions here show the entire process in great detail, it is optimal to actually observe the drogue being packed, since there are a great many small but important nuances of the procedure that the technical instructions cannot completely convey. There is no fully effective learning substitute for direct observation of this procedure as undertaken by a professional egress technician.

A few specialized tools will help the procedure along and reduce the time required to complete it, but by and large, ordinary museum tools and restoration instruments will suffice to accomplish this procedure. Once packed, the usual prophylactic precautions should be observed that will prevent accidental or inadvertent deployment of the drogue parachute system, since once released from their recesses, the parachute assemblies will expand slightly, thereby presenting further challenges in repacking the components.

Please refer to the accompanying diagrammatic illustrations for visual cues on each step of the process. When completed using this protocol, the ACES II ejection seat drogue parachute system will appear to be completely accurate and authentically installed, as if it were rigged and packed for actual use. It should be repeated that this procedure applies *only* to static-display seats as found in aviation museums.

1. OVERALL CONFIGURATION:

The ACES II Drogue parachute system consists of two parts: a 2.0 foot *hemisflo* (ribbon-type) extraction parachute and a 5.0 foot *hemisflo* (ribbon-type) drogue parachute. The two chute canopies are attached to each other, with the extraction chute being deployed by a ballistic gun slug. Both parachutes, although connected together, are stowed in separate compartments on the left rear of the seat. Once stowed, the drogue parachute assembly is held in place by a lightweight aluminum compartment door that is kept closed by a latch that is released by the firing of the drogue gun. The extraction chute compartment cover (a fabric cover) is retained by a locking loop of cord attached to the deployment yoke connected to the ballistic gun slug.

2. DROGUE ASSEMBLY COMPONENTS:

The ACES II Drogue Assembly (Douglas Part Nr J114712-501) consists of the following parts:

A) DROGUE PARACHUTE ASSEMBLY – 5.0 foot diameter drogue canopy.

The drogue parachute is a 5.0 foot diameter *hemisflo* ribbon-type canopy incorporating 16 gores and 16 nylon suspension lines. The canopy incorporates two towlines that are attached to the extraction chute high-drag brindle. The opposite ends of the towlines are fastened to the apex of the drogue canopy and

to the drogue riser at the confluence of the riser arms. During rigging, 24 inches of slack are introduced in the apex towline by an arrangement of the two loops secured together by a removable pin. This is to minimise slack in the suspension lines during deployment. The pin is pulled out of the loops to release the 24 inches of slack towline by a release lanyard attached to the drogue riser. A 'lazy leg' in the drogue riser assures release of the pin when the drogue nears line stretch. For identification purposes here, the smaller of these loops (0.75 inch) sewn on the towline closest to the main canopy is called 'Loop R' and the larger loop (1.0 inch) sewn further up on the towline away from the canopy is called 'Loop S'.

B) EXTRACTION PARACHUTE ASSEMBLY—2.0 foot diameter extraction canopy

The extraction chute is a 2.0 foot diameter ribbon type *hemisflo* canopy incorporating 12 gores and 12 nylon suspension lines. The suspension lines are attached to one end of a six-foot high drag brindle, the other end of which attaches to the drogue chute towline. The brindle is a special 'alternate twist' design to provide maximum drag area. The brindle also incorporates a static line and pin to release the drogue slug from its attachment to the extraction chute via the deployment yoke. A disconnect cord and pin are attached to the brindle to release the static line and brindle from their attachment to the seat structure after the drogue slug is released. The extraction chute includes an anti-squid line to promote rapid inflation.

C) DROGUE PARACHUTE RISER ASSEMBLY

The drogue riser strap assembly consists of a 37 inch, 4 PLY, 9000 pound nylon webbing main section with two 72 inch double ply legs that attach to the ejection seat structure (on left and right rear sides), and four 48 inch single play arms to which the drogue chute suspension lines are attached. The drogue riser strap assembly has a 69 inch, three ply, 6000 pound nylon webbing body with 40 inch legs and three 48 inch arms.

D) DROGUE GUN (Douglas Part Nr. A114312-527)

The drogue gun fires a one pound slug at a muzzle velocity of 200 feet/sec which unlocks the drogue compartments and deploys the extraction parachute.

E) YOKE ASSEMBLY—Drogue Deployment (Douglas Part Nr C114719-501)

This webbing yoke is used to attach the drogue slug to the apex of the extraction chute. It also is used as the locking loop to hold the cover on the extraction chute container. The yoke is a 9.5 inch long nylon cord with a loop at each end. For identification purposes in this manual the larger loop (1.75 inch) is called 'Loop Z'. This loop attaches to the clevis bolt of the drogue gun slug. The smaller loop

(0.75 inch) is called ‘Loop Y’. It has a small keeper adjacent and attaches to the apex of the extraction chute by means of the loop of the anti-squid line.

F) CONTAINER ASSEMBLY—Drogue extraction chute (Douglas Part Nr J114731-1

This is small sheet metal box into which the extraction chute is packed. This container attaches directly to the seat structure with four screws. It includes three nylon cord loops for retaining the cover on the container.. As an aid to the packing instructions, the three retainer nylon loops are identified in figure 2 as end A, end B, and end C. The tie assembly to which the slug disconnect static line and the high-drag brindle are attached is also fastened to this container.

G) EXTRACTION CHUTE CONTAINER COVER (Douglas Part Nr C114930-1)

The cover for the extraction chute container consists of 2 plies of nylon duck fabric with bound edges and a protective flap (coated on one side with aluminized material).

H) DROGUE COMPARTMENT DOOR RETAINING LATCH (Douglas Part Nr C114708-1)

This latch, which is bolted to the drogue gun slug, holds the drogue chute compartment door closed and locked until the slug is fired.

I) SEVERANCE CUTTERS (Douglas Part Nr. A1143021-505)

Two webbing cutters ultilising flexible linear shaped charges (‘FLSC’--one on either side of the aft rear seat) are mounted adjacent to the drogue attach bolts to sever the drogue brindles. The brindles are severed approximately 150 milliseconds after initiation of the recovery parachute mortar (Douglas Drawing Nr J114506 shows how to install these cutters).

J) DOOR ASSEMBLY FOR DROGUE COMPARTMENT (Douglas Part Nr D114707-501).

This is a lightweight shaped sheet metal door used to hold the drogue parachute in its compartment. It has distinctive ribbed moldings for reinforcement and two small extended ‘feet’, on either side at the bottom, which fit loosely into slots on the seat structure.

K) FLAME PROTECTOR (Douglas Part Nr J114506-21)

This is a thin sheet of aluminized Nomex or Kevlar type fabric that is installed over the packed drogue chute to protect it from the rocket flame in the cracks between the compartment door and the compartment recess.

L) CARTRIDGE, DROGUE GUN (Douglas Part Nr A114312-533)

This is the pyrotechnic charge used to fire the drogue gun slug. (Note: this item is omitted from the museum static display seat, as is the case with all pyrotechnic seat devices such as initiators, etc., unless such devices have been deliberately and specifically 'inerted' for use as display components).

M) MISCELLANEOUS COMPONENTS

Attachment hardware as specified and required to mount and/or attach the various hardware items (including nuts, bolts, washers, etc.). For static display seats, it is not important to match the Douglas TO specifications, since the seat is not intended for use as an actual operational 'live' seat.

Cotton Thread in three sizes: 24/4 (4 pounds breaking strength), 8/4 (15 pounds breaking strength), and 8/7 (30 pounds breaking strength). Color coding is not required, except that a contrasting color helps facilitate visual distinction on a static display seat.

Paint masking tape, 1 inch wide, of any type.

3. DROGUE PARACHUTE OPERATION INFORMATION

During an actual ejection, as the seat approaches the top of the ejection seat rails, an electrical impulse from the recovery sequencer fires the drogue gun. The initial travel of the drogue gun slug unlatches the drogue chute compartment door (which is ejected and blown away by the wind blast), releases the extraction chute container cover, and then tows the extraction chute away from the seat. As the extraction chute deploys, the following sequence of events occurs:

A) The thread-tie for the 15 inch 'lazy leg' in the extraction chute high-drag brindle breaks.

B) The static line between the slug release pin and the tie-in to the seat structure becomes taut.

C) The slug-release pin pulls free, disconnecting the slug.

D) As the wind-filled extraction chute continues to deploy, the disconnect pin pulls free, disconnecting the static line from the seat structure.

E) As the extraction chute brindle deploys, the lock-tab on the towline pulls out of the locking loop on the fabric flap which retains the drogue parachute inside the drogue compartment after the compartment door has been discarded.

F) The deployed extraction chute pulls the drogue chute from its compartment.

G) The release pin holds the drogue apex towline taut, preventing excessive flailing of the suspension lines until the drogue chute canopy fully inflates.

H) As the drogue nears line stretch, the thread tie-in on the 24 inch ‘lazy leg’ breaks, pulling the pin that releases the 24 inches of slack in the drogue apex towline.

I) The drogue chute fully inflates.

J) The drogue risers are severed by the Flexible Linear Shaped Charges (FLSC) cutter immediately (50 milliseconds) after the main recovery parachute starts to deploy.

4) INSPECTION

[Note: In actual operational use, at this time all the components of the DROGUE PARACHUTE ASSEMBLY (Douglas Part Nr. J114712) would be examined in detail to assure that there were no visible defects, inadequate serviceability, or obvious wear associated with any of the subcomponents. Since these instructions are intended purely for static-display purposes, these precautions would not apply. The exception would be to assure that all hardware components are operating smoothly and that there are no defects on them such as metal burrs, or similar defects that would damage any of the ‘soft’ components (i.e. chutes, lines, covers, et al).]

5) ARRANGING AND RIGGING THE ACES II DROGUE PARACHUTE SYSTEM (see following diagrammatic illustrations for specific visual cues, as required)

A) Lay the drogue parachute assembly out on a clean flat surface and straighten the drogue canopy, suspension lines, and riser, so that the lines, lanyards and riser are not twisted or tangled. Stretch out the extraction parachute and brindle, remove any tangles and be sure the extraction chute canopy is not inverted (the anti-squid line must be on the inside of the canopy).

B) Pull the slug disconnect static line toward the extraction chute apex, forcing 15 inches of slack in the high-drag brindle between the two points where the static line and disconnect cord attach to the brindle (see diagrams following). Hand tack these two points together with two turns of 24/4 cotton thread, forming a ‘lazy leg’ loop of the 15 inches of slack in the brindle.

C) Pull ‘Loop Y’ of the C114719-501 deployment yoke through the loop of the anti-squid line which is attached to the apex of the extraction chute. Push the static-line pin through ‘Loop Y’, over the outside of the anti-squid line, and into

the adjacent keeper on the yoke, capturing the anti-squid line loop. Safety tie the pin to the keeper with two turns of 24/4 cotton thread (see diagrams following).

D) With the combined anti-squid line/high-drag brindle pulled taut between the apex of the extraction chute and the ‘lazy leg’ tie of the brindle, there should be about 2.0 inches of slack in the static line. Pull this 2.0 inches of slack to the pin end of the static line and tack the static line to the anti-squid line about one inch below the static line pin with two turns of 24/4 cotton thread (see diagrams following), so that the loop of slack in static line is between the tack and the pin.

E) Pull the release-in lanyard up through its tunnels on the riser body and towline towards the extraction chute. This forces the riser leg, to which it is attached, to slacken between this lanyard attachment point and the lower ‘floating’ keeper on the riser body. Hand tack 24 inches of this slack below the keeper (see diagrams following) with one turn doubled of 8/4 cotton thread, forming a ‘lazy leg’ loop of 24 inches of slack riser.

F) Pull ‘Loop S’ of the towline through ‘Loop R’. Route the release pin lanyard from its upper tunnel exit through the cotton vent cone on the canopy apex and through the vent opening (at one of its larger spaces). Push the released pin through the narrow keeper at the base of ‘Loop R’ through ‘Loop S’, over ‘loop R’, and then through the wide keeper at the base of ‘Loop S’ (as shown in the diagrams following).

G) If it is still in place, remove the manufacturer’s temporary hand tack holding the release lanyard loop attaching the pin and undo the loop, but leave the lanyard through the eye of the pin and leave the release pin installed as shown in diagrams following. Pull the combined riser/towline taut between ‘Loop S’ and the ‘lazy leg’ tie of the riser leg (support this tie to keep it from breaking). Pull the release lanyard taut between its attachment to the riser leg and its upper exit from the tunnel on the towline. This will force 12 inches of excess lanyard into a 6 inch loop of slack. Arrange this 12 inches of excess slack-loop between the end of the tunnel and the pin, as shown in diagrams following (note: the distance between the eye end of the pin and the upper end of the lanyard tunnel is approximately 25 inches. The 12 inches of slack is in excess of this). Holding this slack in position, pull the lanyard taut from the tunnel exit to the pin. Mark the lanyard where it passes through the eye and cut off the excess lanyard 5 inches from the pin. Do not sear or treat the cut end of the lanyard. Make the pin attachment identical to the original loop: 1.0 inch loop, 4.0 inches of lanyard embedded in casing (reference J114712-81). Hand stitch the splice at the penetration with 3 to 6 stitches of size 8/7 cotton cord.

H) Safety tie the release [pin with 2 turns of 3\24/4 cotton thread to the wide keeper on the line as shown in diagrams following. Hand tack the release lanyard in two places with 2 inches of slack just below the pin and 20 inches of slack between the tunnel on the towline (the 10 inches of slack is between the two

hand tacks; the 2 inches of slack is between the upper hand tack and the pin—see diagrams following).

I) The 24 inch slack loop of towline between the keepers of ‘Loop R’ and ‘Loop S’ is to be folded against the towline and safety tied to two turns of 8/4 cotton thread in three places: two places at start of loop (one on each edge) and one place near end of loop fold (refer to diagrams following).

J) Using a felt tipped pen, put a small mark on the riser leg to which the release, lanyard riser is attached, 13.5 inches above the end loop. On the other riser leg, put a similar mark 25 inches up from the end loop (if these marks are already on the riser legs, new marks may be unnecessary). With these marks aligned, fold and tape the riser legs together as shown in diagrams following. Use masking taper or equivalent, as shown. The extra small fold in riser at the left may be omitted if it facilitates packing in the seat.

6) INSTALLATION OF DROGUE ASSEMBLY IN SEAT

[Note: The sheet-metal extraction chute container may be already installed in the appropriate upper recess, using four machine screws; if it is, remove it before proceeding further. All pyrotechnic devices must have been safely inerted and/or rendered inoperable to assure safe static display configuration. Also, the left sheet metal fairing protecting the left side FLSC cutter should be in place; if it is not, the procedure may be completed without this step, since the seat will not operationally used.]

A) Insert the white nylon bushings through the seat-attach loops of the riser legs and install the loops in the seat fittings as shown in the diagrams following, using compatible bolts. The riser leg with the Velcro tape attaches to the right side fitting, the Velcro tape facing forward. There should be no twist in the riser legs (this is important to assure proper fitting of the assembly in the container)

B) If not already removed, remove the shipping/handling tape from the Velcro on the drogue parachute assembly. Route the right side riser leg across the seat from its bolt attachment and into the upper right corner of the drogue chute container compartment.. Pull this riser taut and mate its Velcro tape with the Velcro tape inside the compartment, around the curved bulkhead forward of the catapult area. The left side riser goes directly from its attachment bolt into the drogue chute container. Place the riser legs in the compartment (see diagrams following) against the forward surface of the container compartment as shown. Push the riser body into the recess forward of the catapult area and route it across the bottom of the compartment, forward of the structural beam. Stow the riser arms using tight loops with minimum gaps to utilise the compartment space most efficiently (refer to diagrams following). Avoid putting any twists in the risers. Hand tack the right hand riser leg to the seat structure with one turn of 8/4 cotton thread as shown in diagrams following.

C) Stow the suspension lines on top of (aft of) the riser webbing, distributing them back and forth in neat folds across the compartment.

At this point is may be necessary to tamp the drogue assembly material with a blunt mallet (rubber is preferable to avoid damaging material) so as to insure maximum efficient use of the compartment space. Fold the drogue chute canopy over the suspension lines with the skirt hem at the bottom (refer to diagrams following). Make two folds of the canopy, completely filling the compartment, with the canopy apex positioned approximately half way between the top and bottom of compartment. The towline is to be routed out the right upper corner of the box. Mate the lower Velcro tape on the towline with the Velcro tape on the inside, upper surface of the drogue stowage compartment (refer to diagrams following). Install the retaining flap over the drogue assembly by inserting the loop assembly on the seat structure through the grommet on the flap and locking it with the lock-tab on the towline, as shown in the diagrams. Safety tie the towline loop to the flap with a single turn of doubled 24/4 cotton thread.

D) Install the small sheet-metal extraction chute container in the upper aft seat recess above the drogue gun, using 4 machine screws appropriate to the task. Pull the doubled thickness of the towline up across the structure between the drogue compartment and the extraction chute container and down into the container. Fasten the upper Velcro tape at the towline/high-drag brindle juncture to the Velcro tape inside the container to maintain a taut, flat towline installation between the two compartments (see diagrams following).

E) Push back the sleeve at the end of the tie-line inside the extraction chute container box, exposing the loop and keeper at the end of the tie line. Put this tie-line loop through the loop at the end of the static line where it is sewn to the high-drag brindle. Push the pin of the disconnect cord through the tie-line loop, over the outside of the static line loop and into the keeper on the tie-line. Safety tie the pin to the keeper with two turns of 24/4 cotton thread (see diagrams). Pull the sleeve back over this attachment (this would prevent the extraction chute from catching on the pin during deployment, if the seat were ‘live’). This attachment allows 7 inches of slack in the disconnect cord (not counting approximately 5 inches of disconnect cord that run parallel to the taut loop end of the static line.

F) Stow the high-drag brindle/static-line configuration into the container in sequence (this would assist ease of extraction without hesitation or tangling on a ‘live’ seat). Stow the extraction chute suspension lines and canopy on top of them, pushing all into the box, below the retainer loops of the container, with the apex of the canopy on top. Route the deployment yoke to the lower left corner of the container and place its ‘Loop Z’ between the legs of the drogue slug clevis (see diagram following).

G) Place the aluminized flame protection fabric piece (Douglas Part Nr J114506-21) over the drogue compartment, completely covering the drogue assembly, and tuck edges in around the edges (note: a substitute may be easily fabricated or otherwise devised to simulate this item, if the original is missing). Place the drogue compartment door (Douglas Part Nr D114707-501 in place, inserting the two protruding legs at lower end of the door into the spaces on the seat structure. Note that the flange on the periphery of the door faces aft. Place the latch (Douglas Part Nr C114708-1) against the inboard, after clevis of the drogue gun slug, with its 'cup' recess over the end of the rod extending from the hinged door hasp. Align the hole in the latch with the hole in the slug clevis, forcing the hasp against the door, locking it closed, and install the spacer specified on J114506 through 'Loop Z' of the deployment yoke. Install the bolt through the hole in the latch, the spacer and clevis of the drogue gun slug, and retain with nut and washer. Assure the deployment yoke is captured and secured properly.

H) Place the C114930-1 extraction chute cover within the extraction chute container, under the retaining loops, with its silver flap hanging over the right edge of the container. The cover must be under the loop cords at the points where they pierce the contain box walls. Pull the single top-side loop, 'end C' through the two corner loops, 'end A' and 'end B'. The 'lock loop' on the yoke is pulled back through the 'end C' loop, locking cover in place. Hand tack the yoke lock loop to the 'end C' cord with two turns of 24/2 cotton thread (refer to diagrams, as needed). Fold the protective aluminized flame protective flap over to complete cover the container opening, the locking loops, and the yoke. Mate its Velcro tape with the Velcro on the cover (see diagram). Tuck in the fork stiffener to straddle the yoke.

I) Finally, tuck in the sleeve tabs, that extend beyond the ends of the riser leg attachment loops, into the recesses of the attachment fittings. This completes the ACES II drogue chute assembly procedure for static display or museum-use-only seats.

SECTION II: INFORMAL NOTES & PHOTOGRAPHS

As mentioned at the start of this paper, despite the completeness of the technical instructions (accompanied by the specifically diagrammatic illustrations), the complexity of packing the ACES II ejection seat drogue assembly requires direct observation of a skilled professional at work on an actual drogue repack procedure, complemented by reference to the technical material and diagrams. Fortunately, as regards static-display (and/or museum exhibit) ejection seats, since there is no intent to use the

seat in a pyrotechnically ‘live’ configuration for safe aircrew egress, small errors may be made here with no consequences other than the fact that only strict compliance with the procedures will assure successful repacking of what is a great amount of bulky material into a very limited space.

Although the ACES II seat has a substantial number of specially adapted tools required for maintenance of the seat in actual operational use, most of these tools are unnecessary for museum-grade restorations work. One exception to this is the need for several different size wooden ‘fids’, used principally for packing the chute assembly into the small compartment recesses found on the ACES II seat. Fortunately, these may be easily constructed out of high-quality hardwood, but their use is definitely recommended to museum restorations personnel who work on ejection seats.

I was fortunate enough to be able to closely observe one of the Dryden Flight Research Center egress shop specialists pack the ACES II ejection seat drogue parachute assembly and can affirm that it is not something that is easily or simply done without actual first hand instruction to back-up the technical manual instructions (no matter how carefully written and prepared they are).

Aside from being able to perform the procedure in full conformance with the TO instructions, something that I feel needs to be noted by museum egress history personnel is how important it is to tamp the drogue recovery parachute assembly into its containment recess. The use of a mallet and a fid to literally pound, tamp, and stuff every last corner and cranny of the recovery chute container cannot be overstated. The importance of this part of the process may be easily seen in a comparison of a typical US Air Force egress shop drogue repack in comparison to that of a factory trained egress specialist. Due to the fact that Air Force egress personnel often do not take as great pains in carefully tamping the drogue assembly into its compartment as do factory trained personnel, the drogue parachute compartment door (made of sheet metal) is frequently found to be bowed or slightly deformed owing to the protrusion of the chute assembly after installation. When the drogue chute assembly is properly carried out, the door does not become bowed or deformed. Seemingly a small point, but judged by the factory standards, the military egress shop job is not always as careful to make sure the ACES II drogue assembly is *fully and*

completely packed into that small recess at the rear of the seat (or so I have been informed).

Thus, a certain level of strenuous effort is required to carry out what would otherwise seem like a simple and straightforward procedure.; I have had the benefit of learning this by first hand observation—an experience for which there is no satisfactory classroom substitute! Considering how important a procedure like this is regarding the drogue repack for a live and fully operational ACES II seat, it is reassuring to know that there are professionals who never lose sight of the fact that in an operational aircraft, their careful work and professional conscientiousness may well make all the difference in saving an aircrewman's life when the critical need arises to punch out of a disabled aircraft.

Nowhere was that point made more emphatically than at the Mountain Home AFB air show, a few years ago, during which a US Air Force Thunderbirds pilot had to eject almost at ground level, after an unsuccessful aerobatic recovery in his F-16 *Viper*.

Although the first ACES II Seats were introduced quite a few years ago (1975) and have remained relatively the same, throughout the various aircraft applications in which they are used, a very recent upgrade involved the replacement of the original and complicated seat drogue parachute assembly with a completely removable and replaceable discrete drogue assembly. The new system contains the entire drogue system in a removable container that is prepacked, so that an old one may be removed and a new one installed rather simply. Although I have not seen the new system myself, it certainly makes good sense, considering how complex the original (and existing) ACES II Seat drogue system was (and remains).

A selection of photographs follow that highlight the process observed in my own experience. Hopefully they will, along with this paper, help air museum egress historians undertake the somewhat formidable task of restoring an ACES II ejection seat's stabilization and deceleration parachute assembly with confidence that they are doing it correctly and properly!

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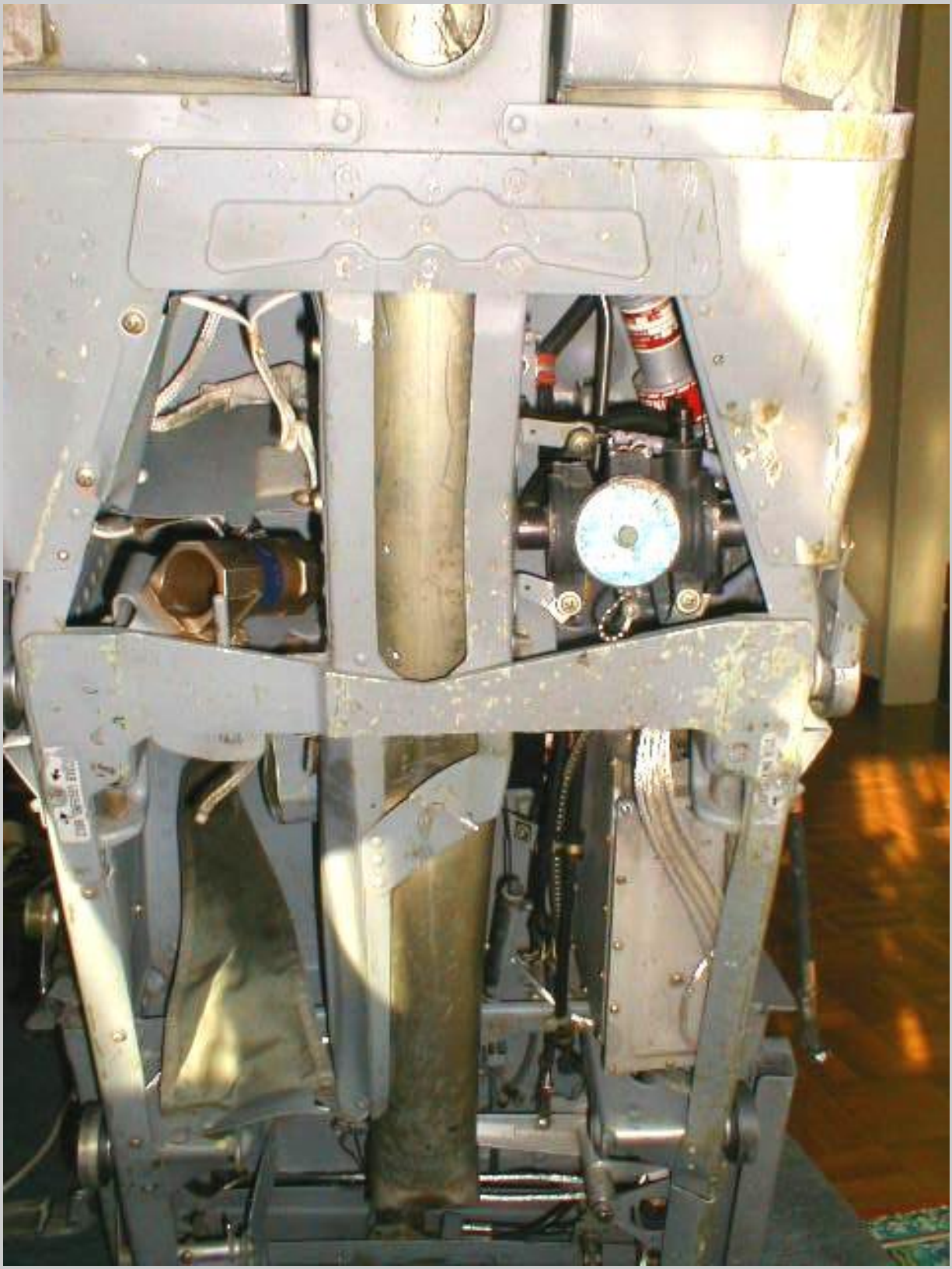


(Shown: aft view of a fired seat; drogue container lower left)

(Shown: upper extraction chute container detail on fired seat; drogue gun below)

(Shown: Tamping ACES II drogue chute assembly completely into container)

(Shown: tamping with fid is key to successful drogue assembly stowing process)

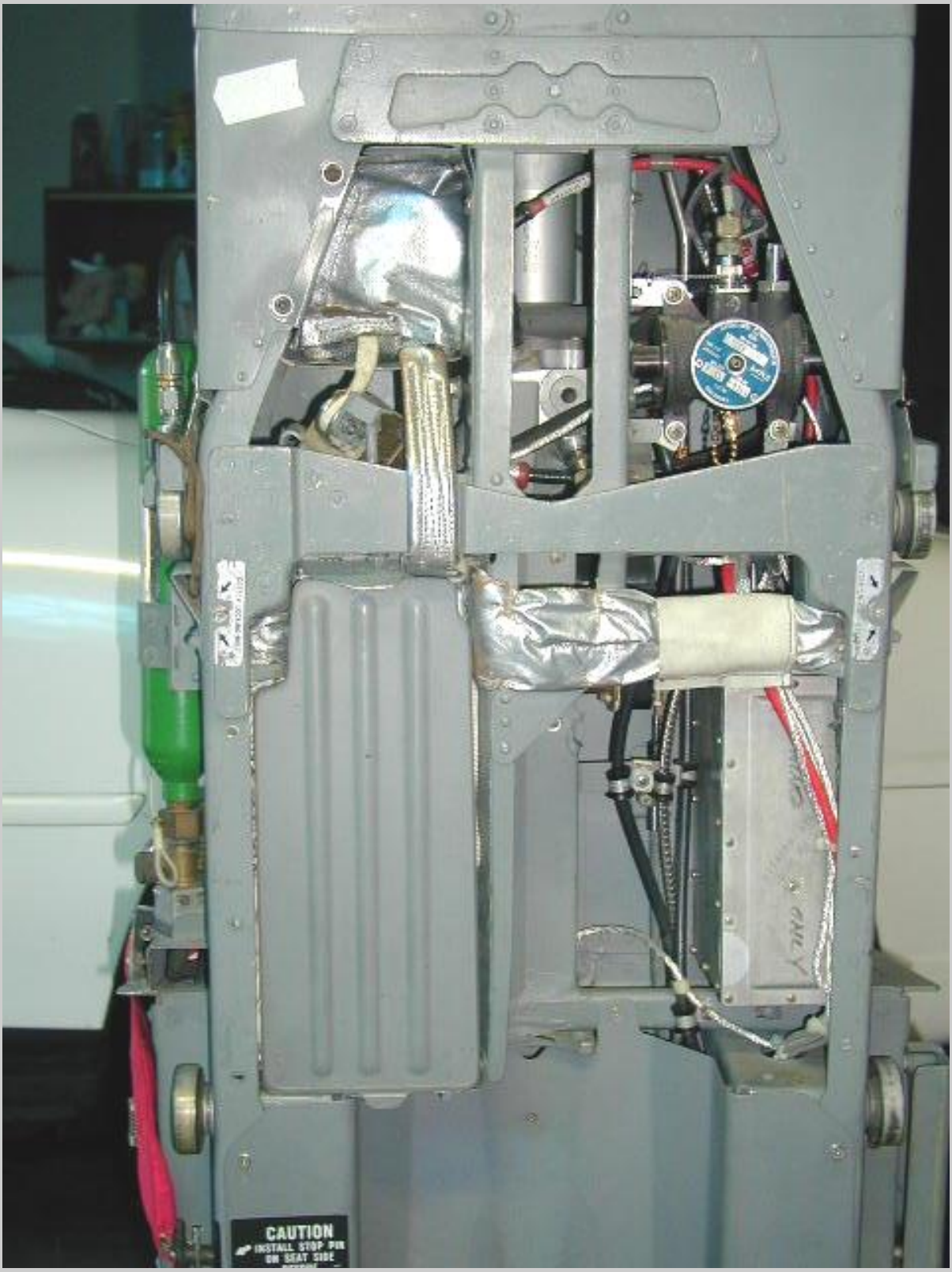
(Shown: Drogue chute assembly almost fully stowed)

(Shown: Stowing fid, right, and main riser legs/body stowed carefully)

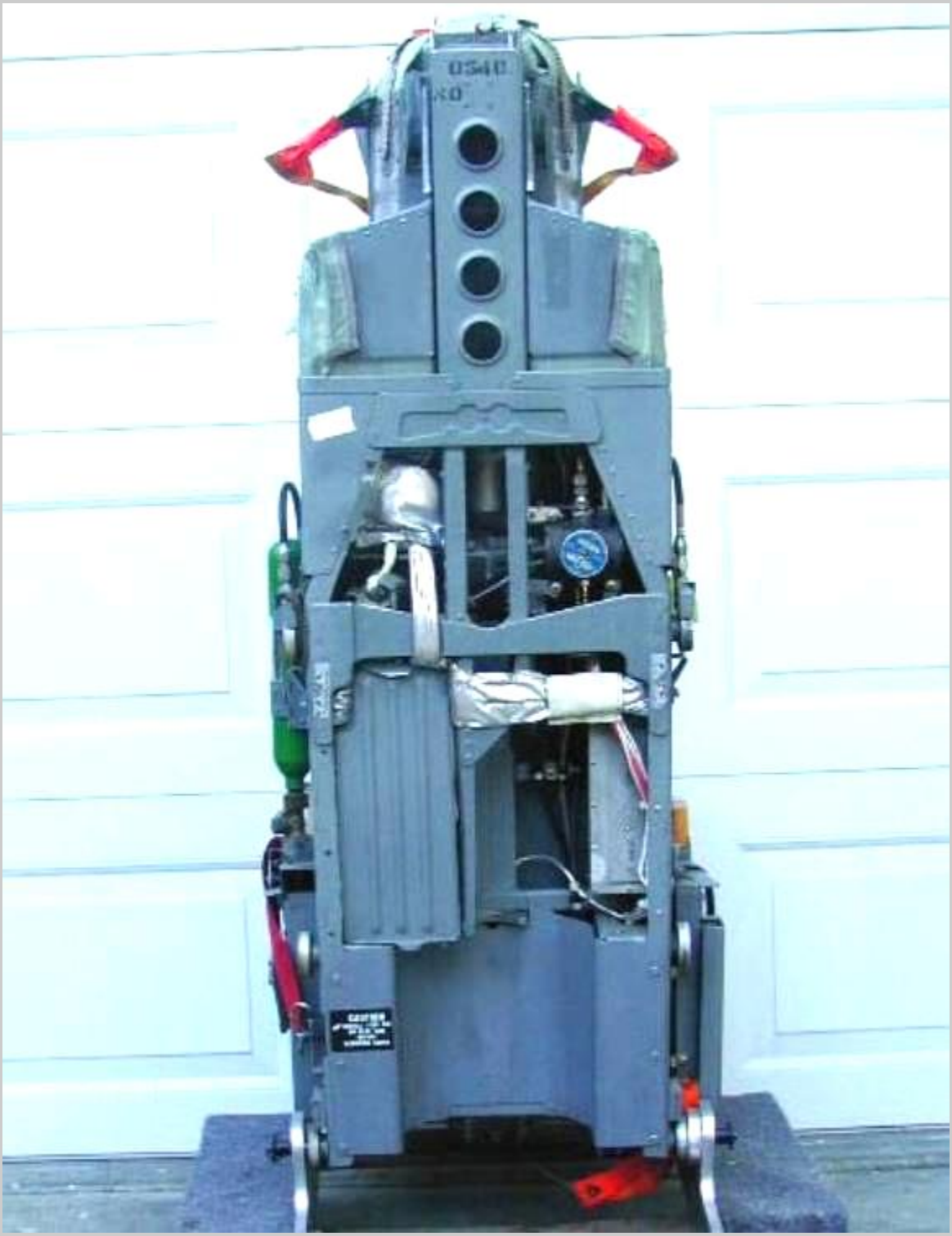
(Shown: Close-up of riser legs and riser main body stowed)

(Shown: Drogue chute assembly stowed, with retention flap in place)

(Shown: Securing extraction chute assembly, final steps)



(Shown: Final steps completed; drogue chute assembly repacked!)



(Shown: Aft view of seat with repacked drogue chute assembly completed)

SECTION III: DIAGRAMMATIC ILLUSTRATIONS

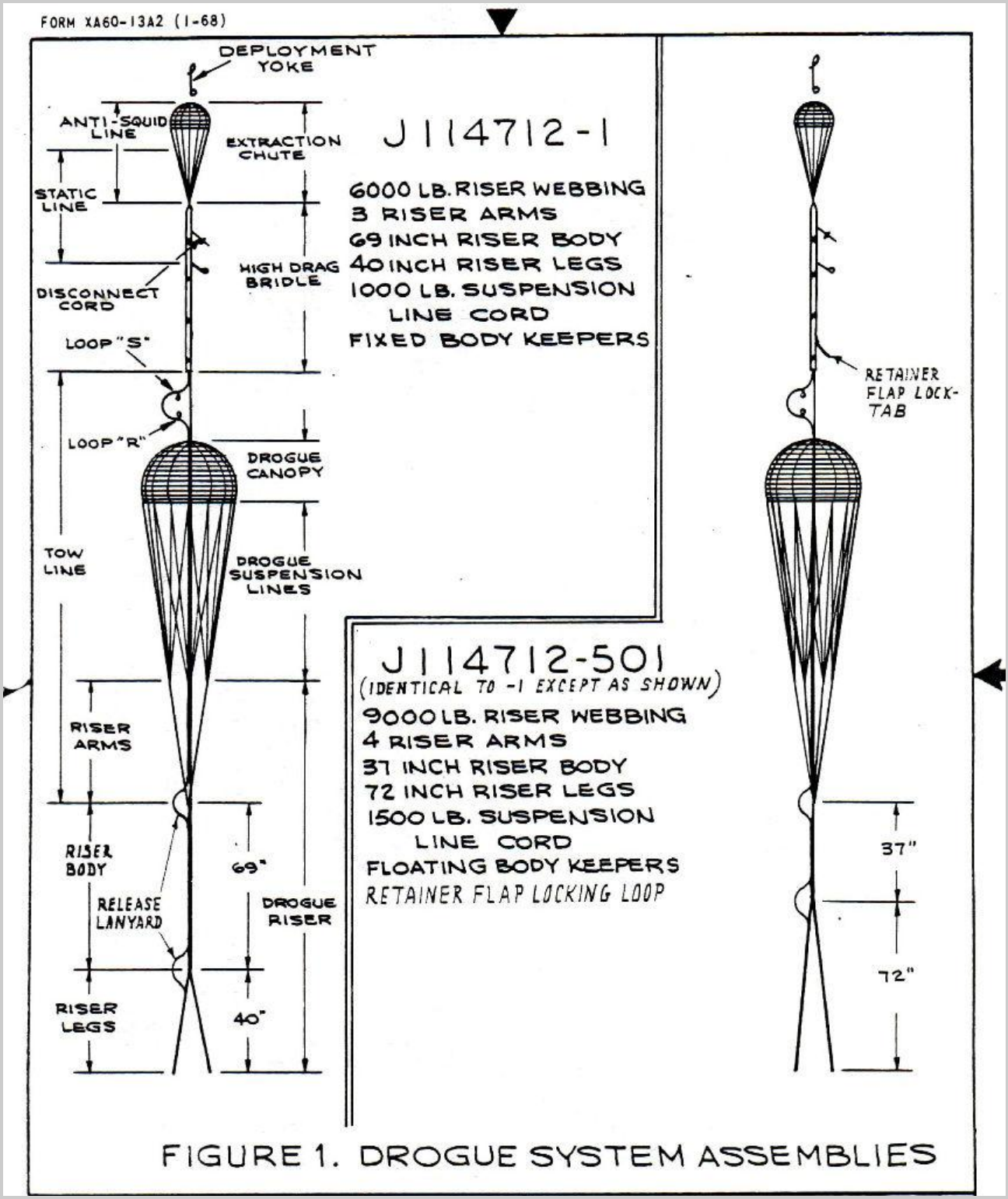
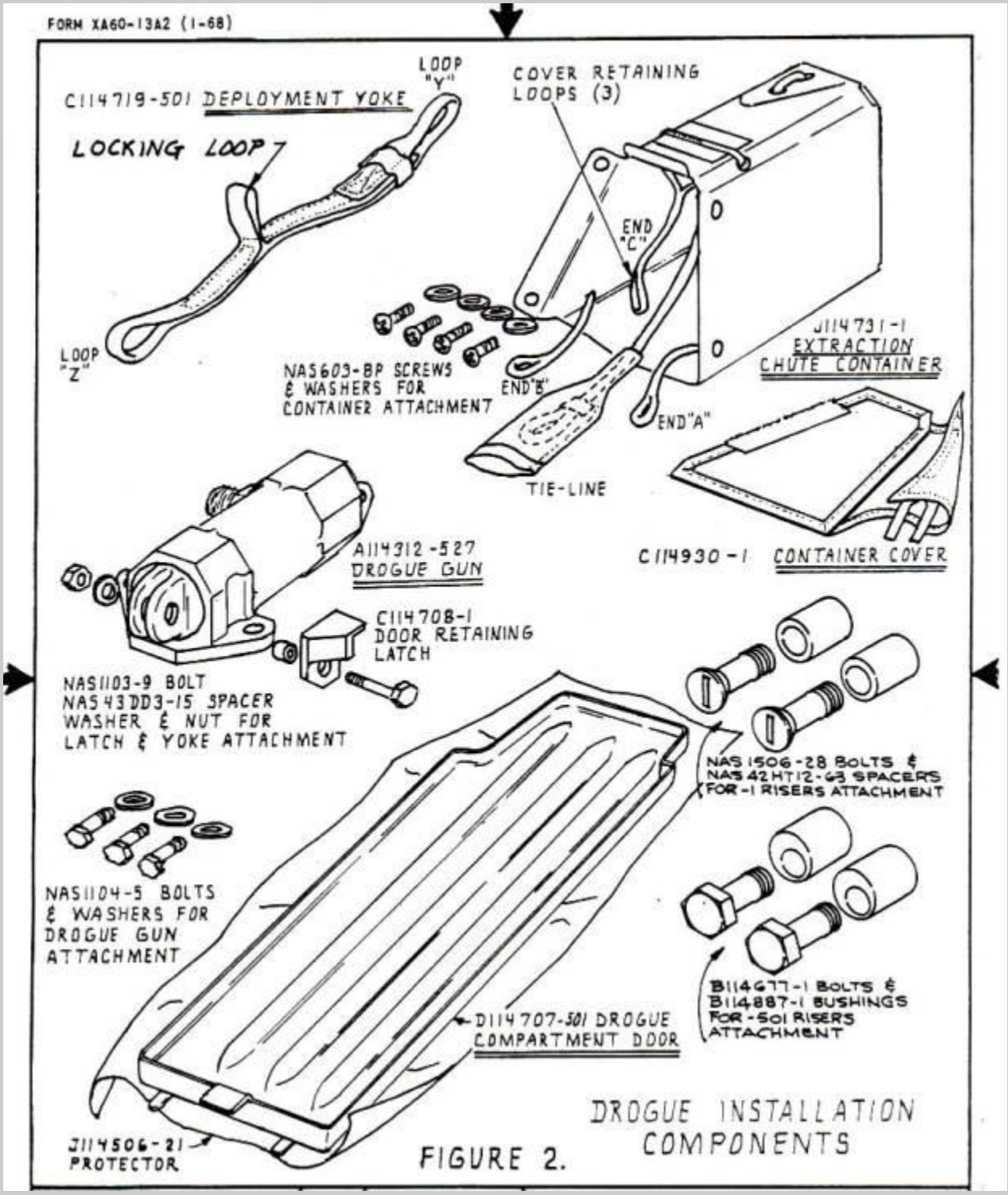


FIGURE 1. DROGUE SYSTEM ASSEMBLIES

FORM XA60-13A2 (1-68)



DROGUE INSTALLATION COMPONENTS

FIGURE 2.

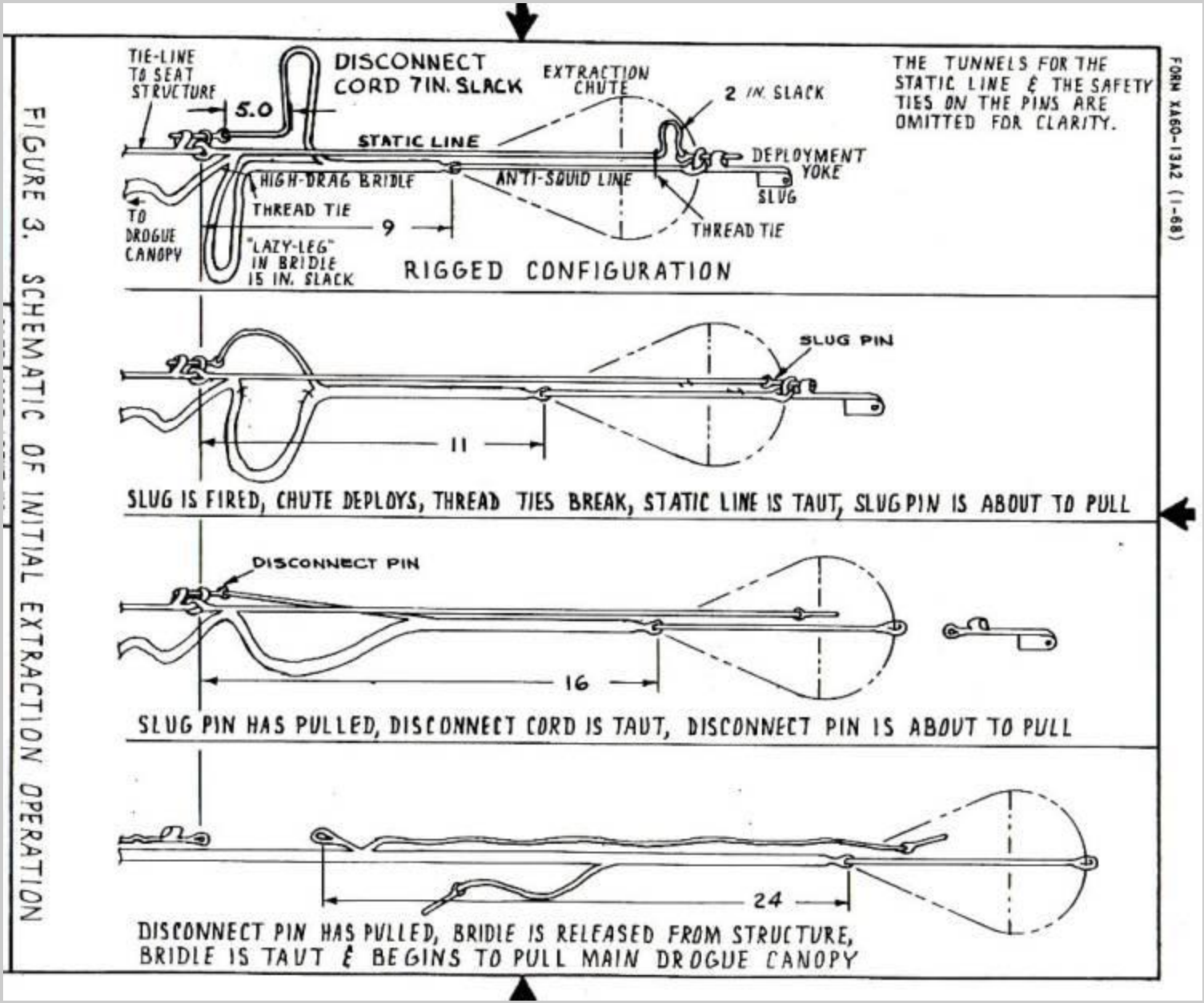


FIGURE 3. SCHEMATIC OF INITIAL EXTRACTION OPERATION

FORM XA60-13A2 (1-68)

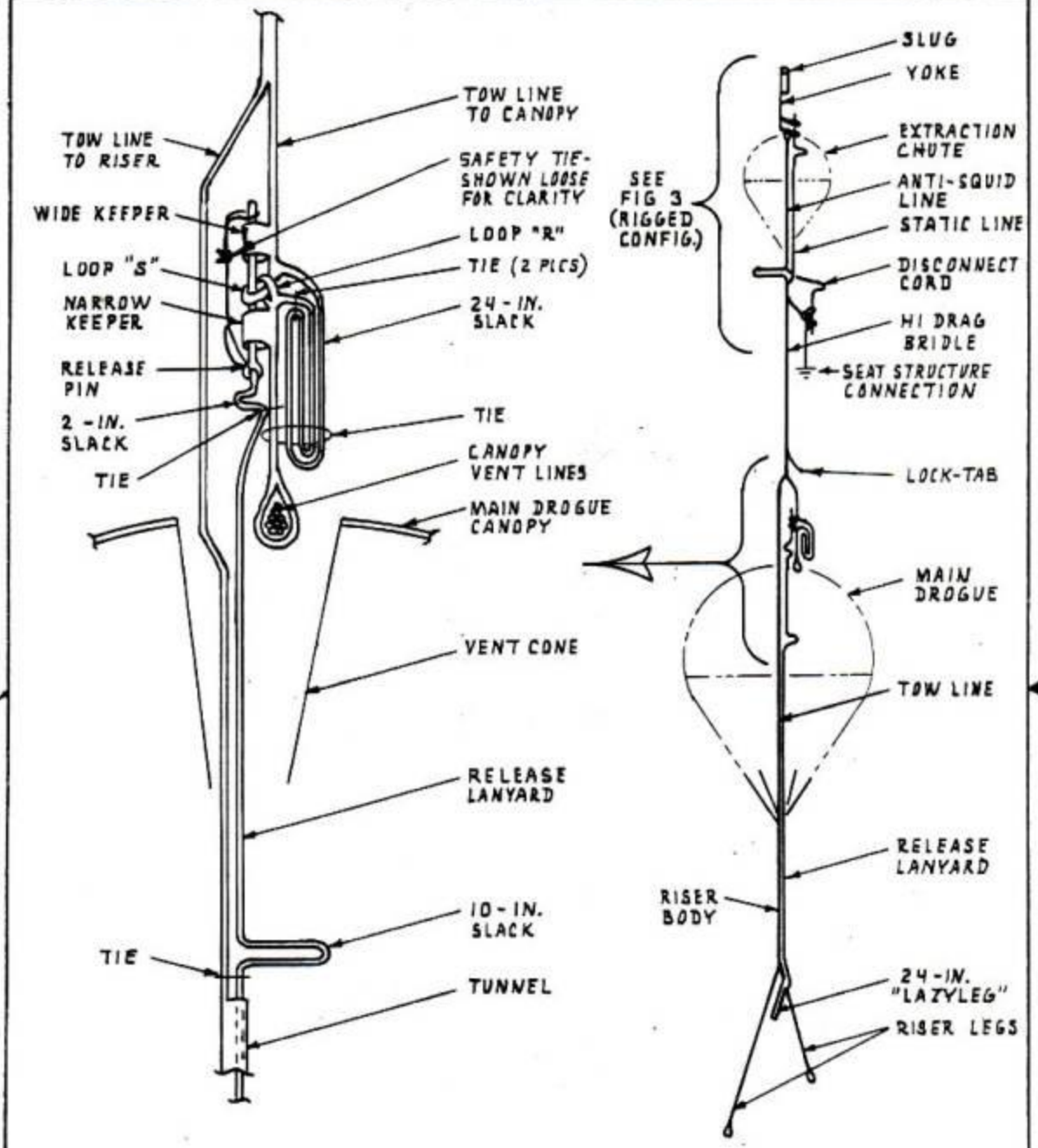


FIGURE 4. DROGUE SYSTEM RIGGING SCHEMATIC

FORM XA60-13A2 (1-68)

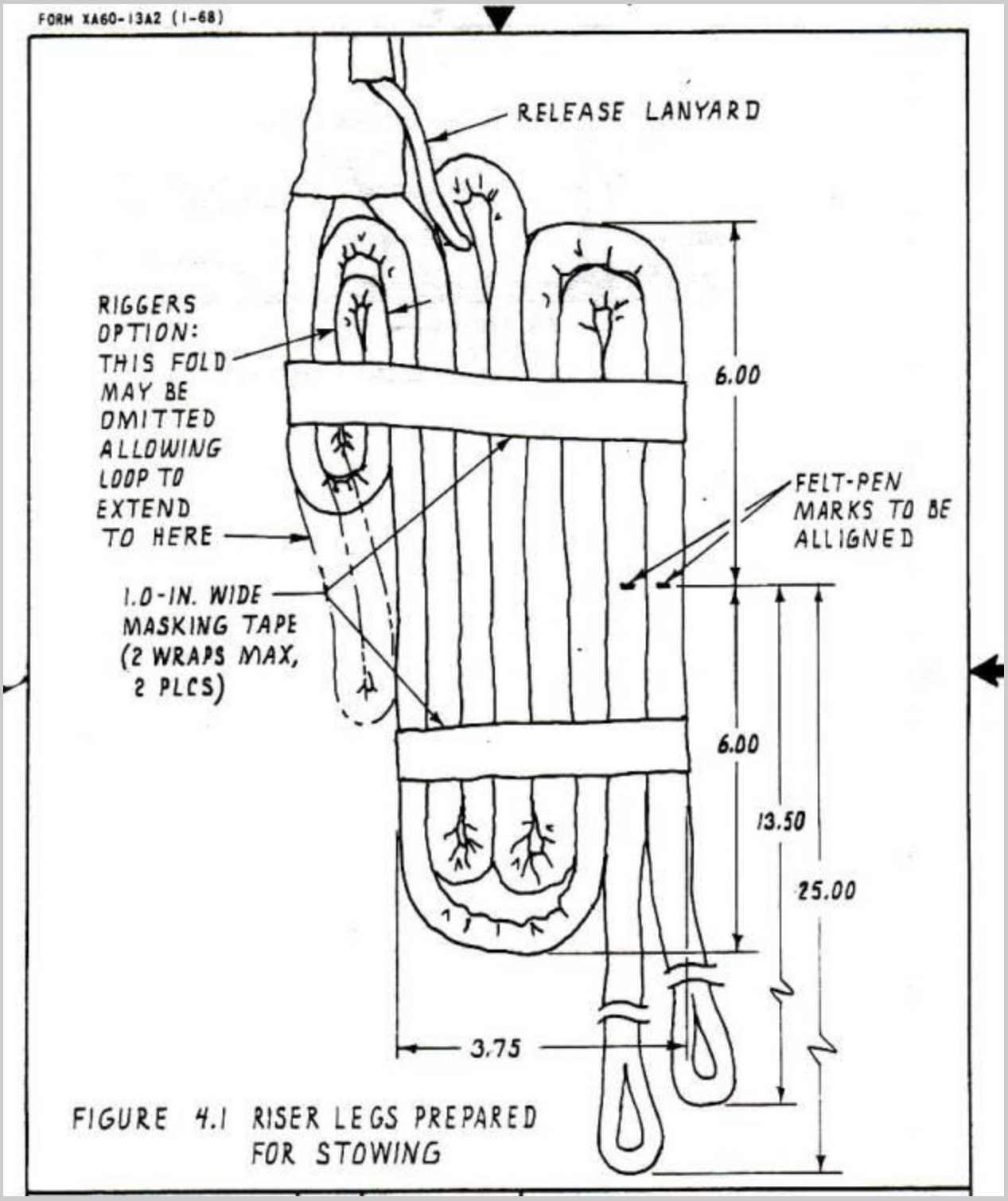


FIGURE 4.1 RISER LEGS PREPARED FOR STOWING

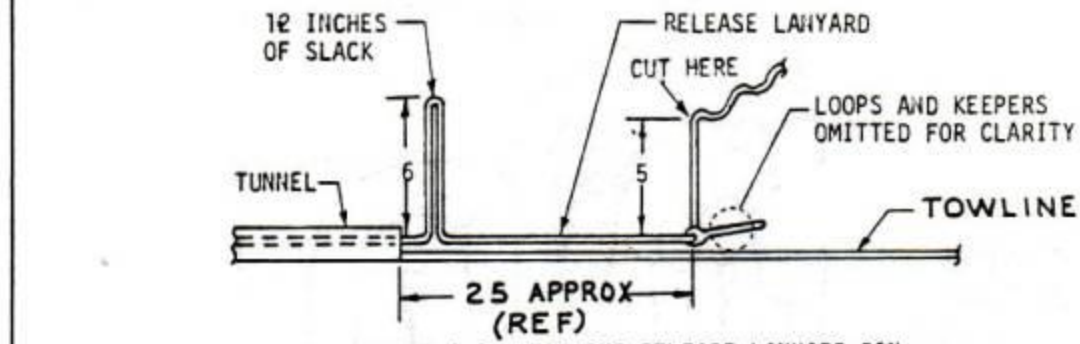


FIGURE 4.2. RIGGING RELEASE LANYARD PIN

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FORM XA60-13A2 (1-68)

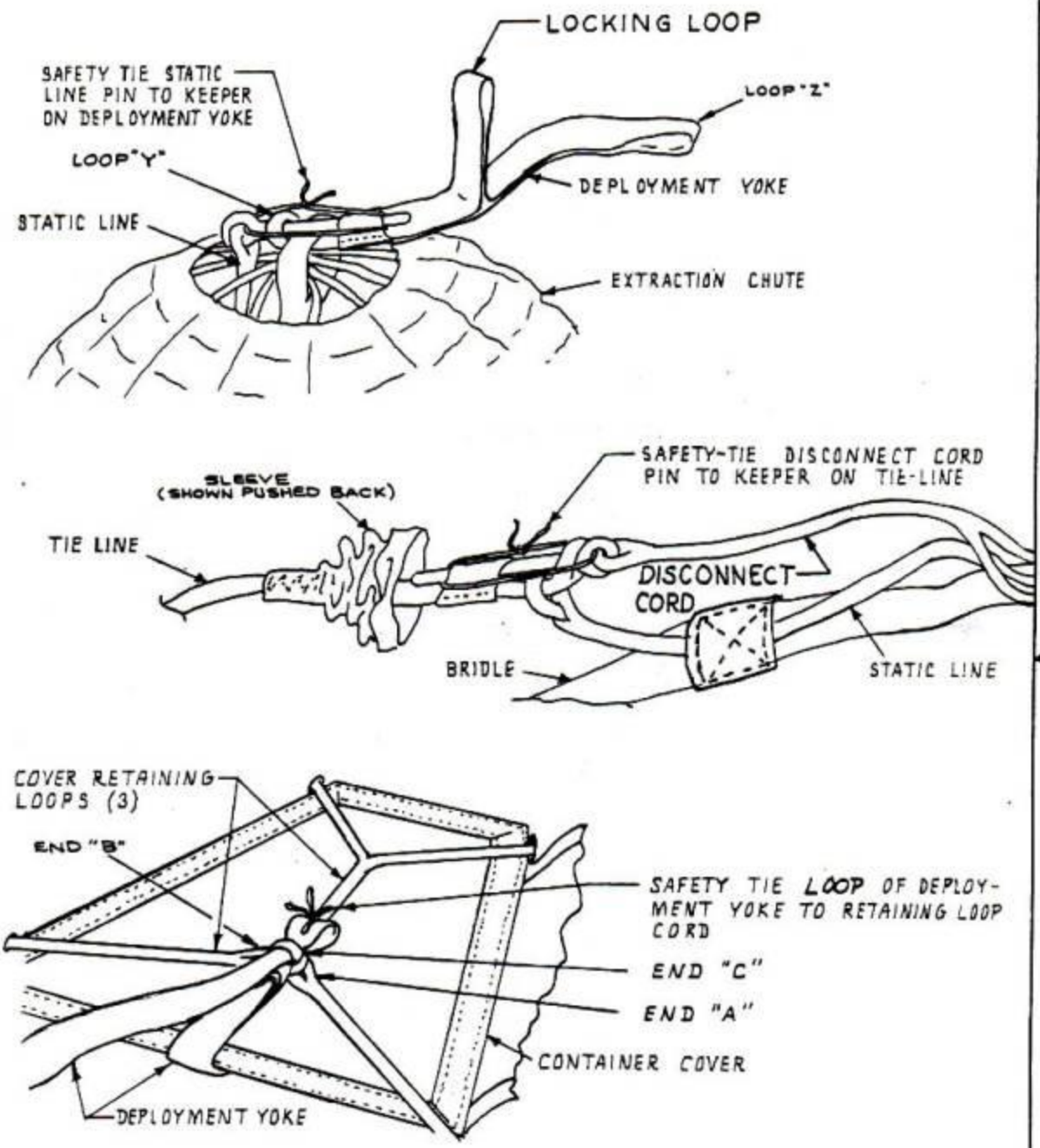

FIGURE 5. SAFETY TIES FOR STATIC LINE PIN, DISCONNECT CORD PIN, & COVER LOCKING LOOP

FORM XA60-13A2 (1-68)

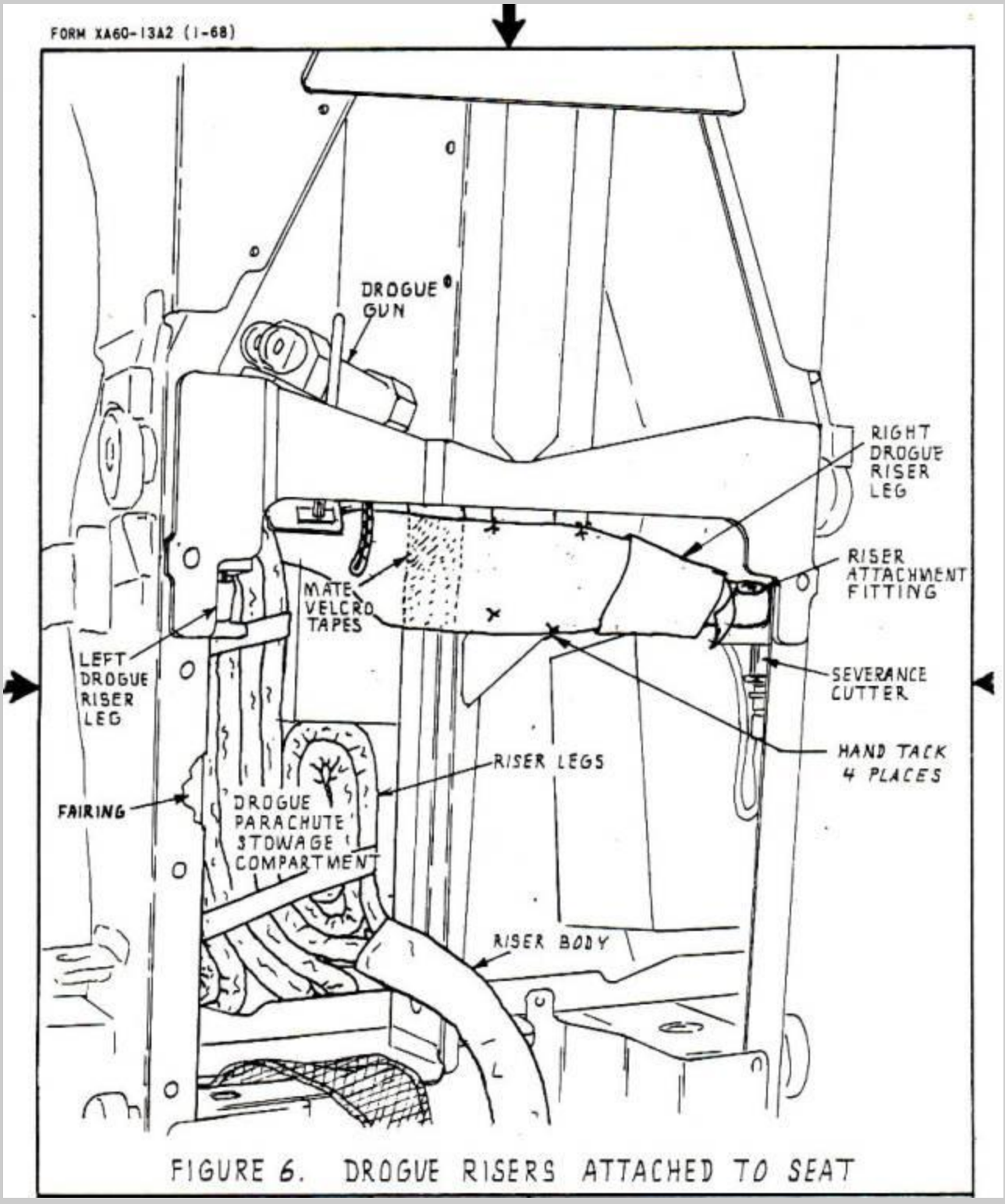

FIGURE 6. DROGUE RISERS ATTACHED TO SEAT

FORM XA60-13A2 (1-68)

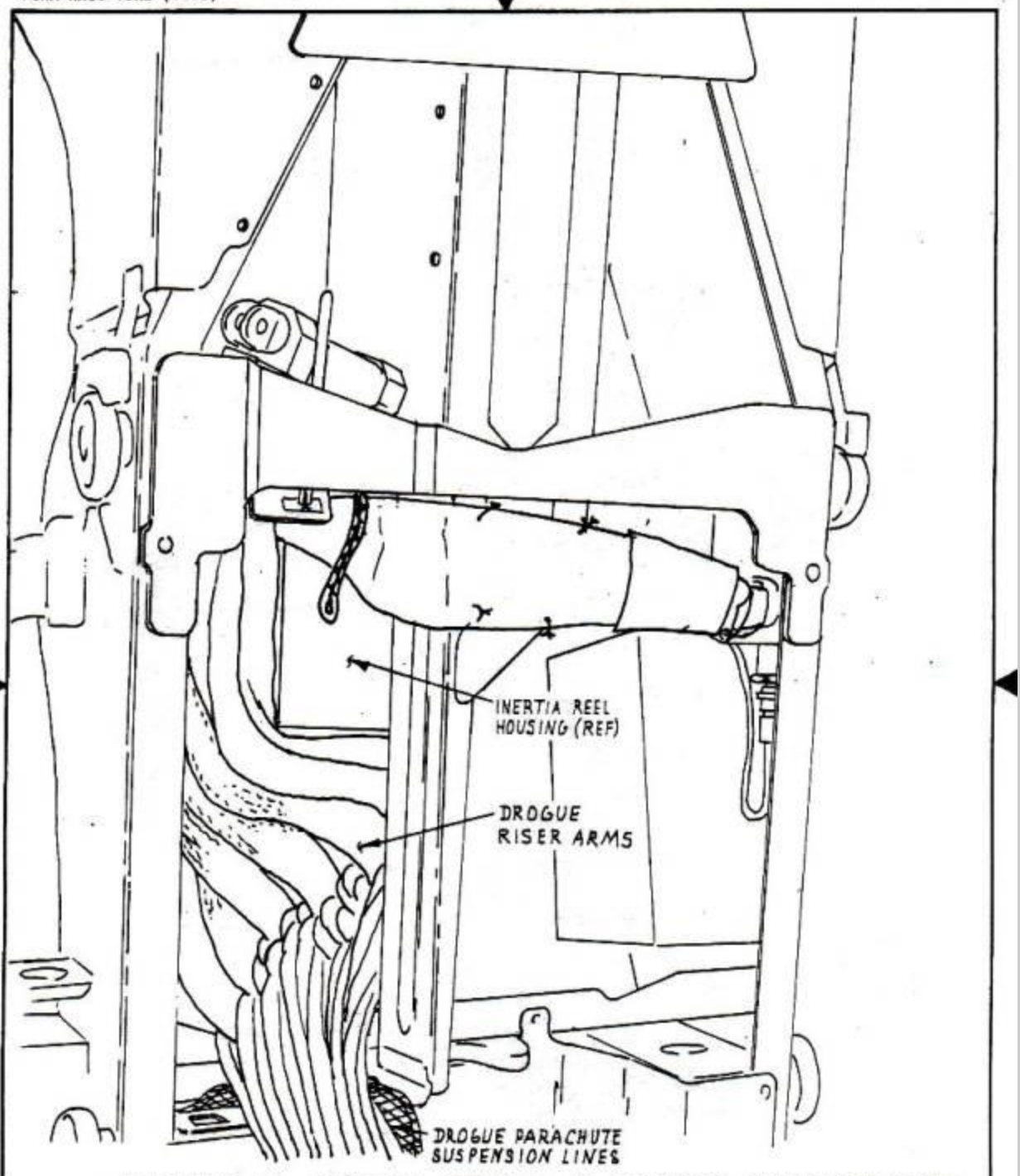

FIGURE 7. RISERS STOWED IN DROGUE COMPARTMENT

FORM XA60-13A2 (1-68)

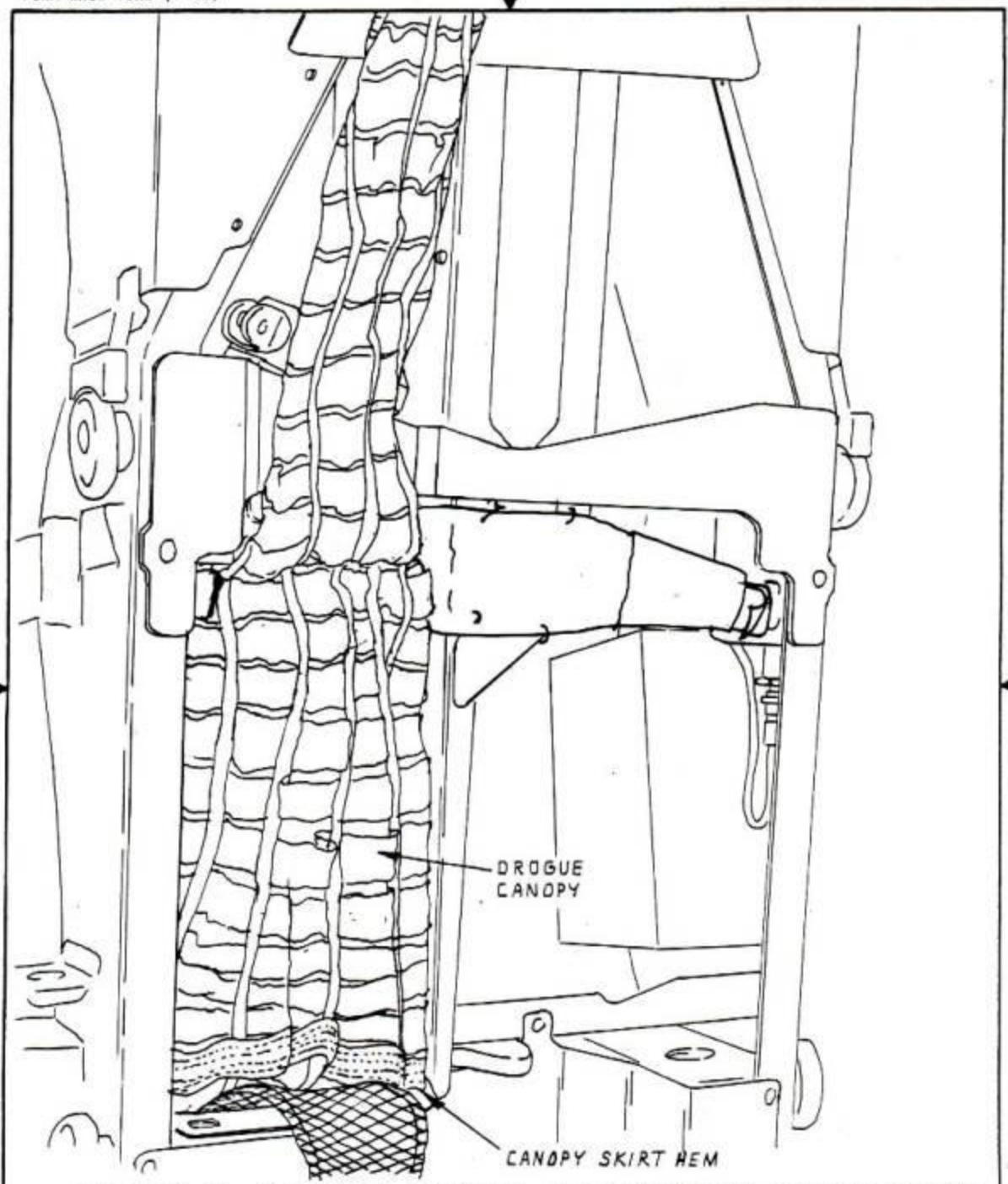

FIGURE 8. STOWING DROGUE PARACHUTE IN COMPARTMENT

FORM XA60-13A2 (1-68)

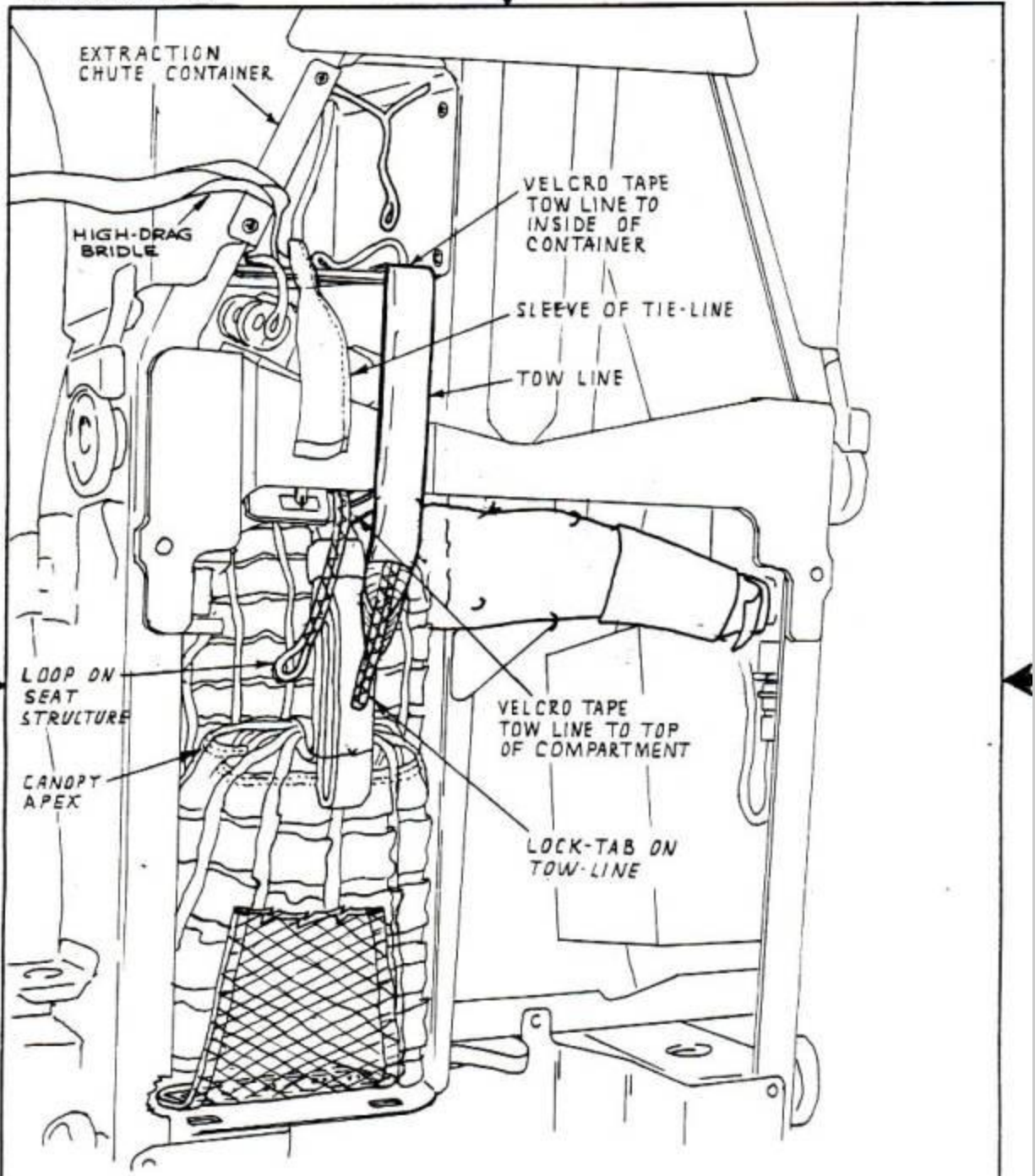

FIGURE 9. CONTAINER & TOW LINE INSTALLED

FORM XA60-13A2 (1-68)

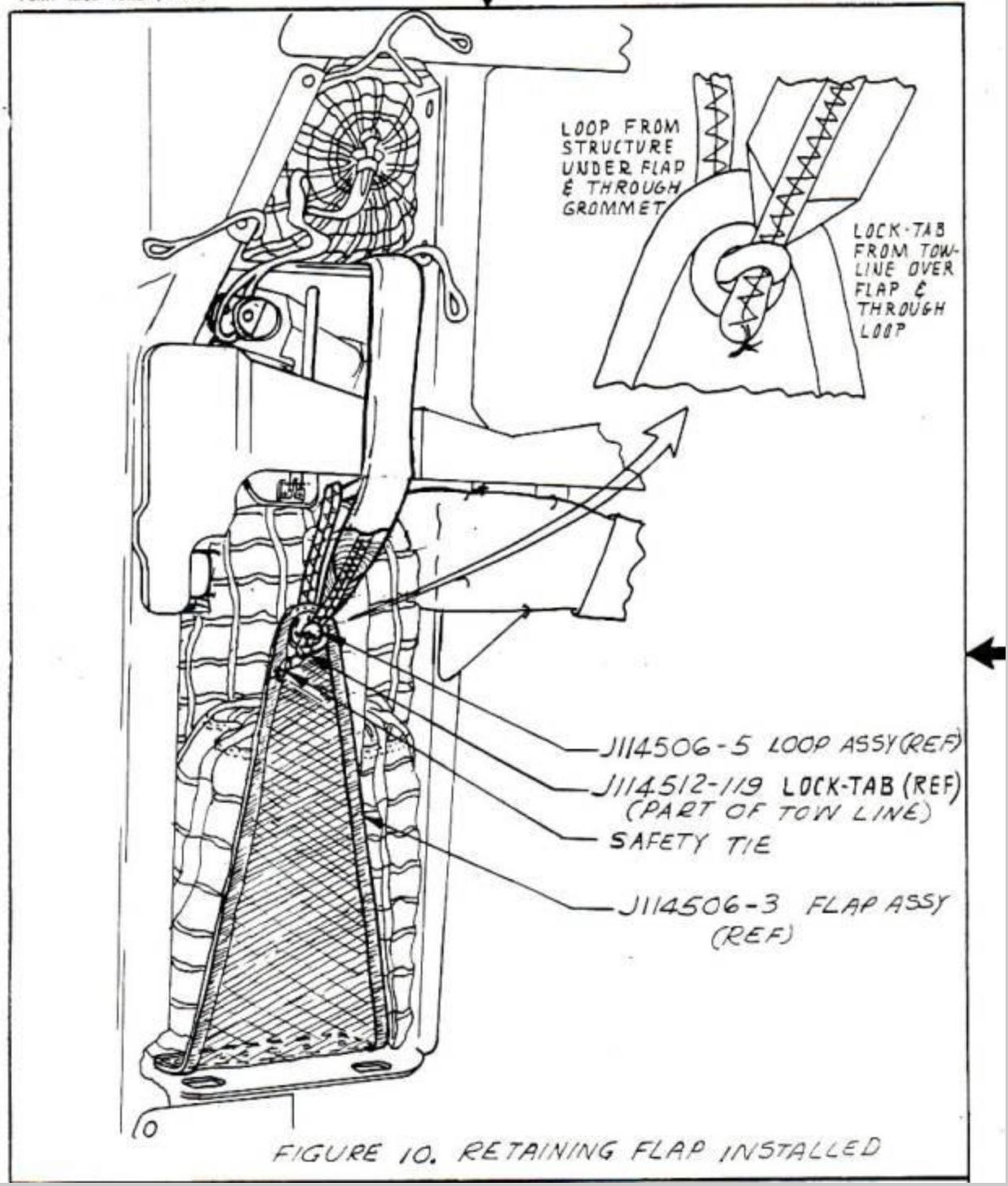

FIGURE 10. RETAINING FLAP INSTALLED

FORM XA60-13A2 (1-68)

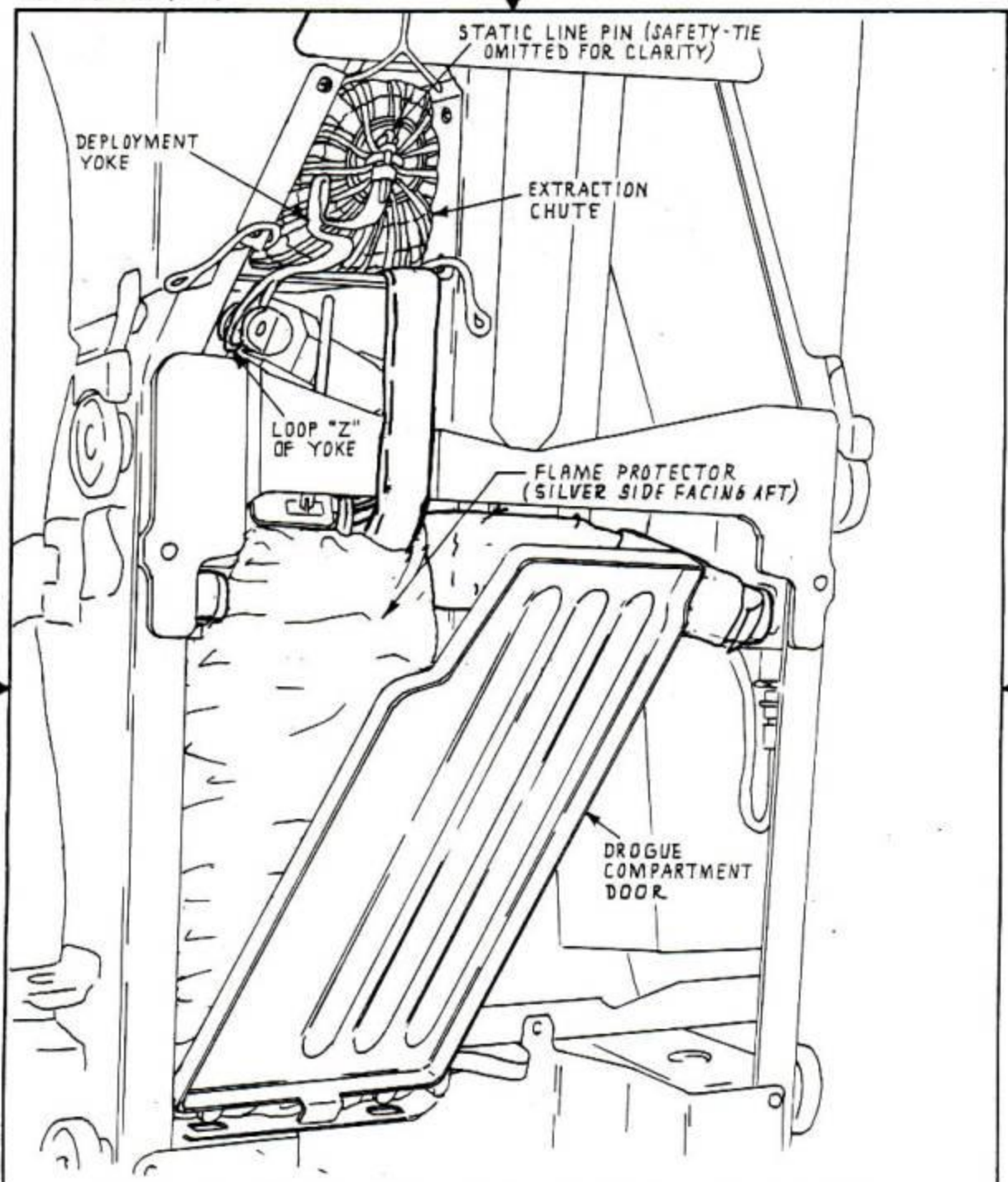

FIGURE 11. EXTRACTION CHUTE STOWED IN CONTAINER

FORM XA60-13A2 (1-68)

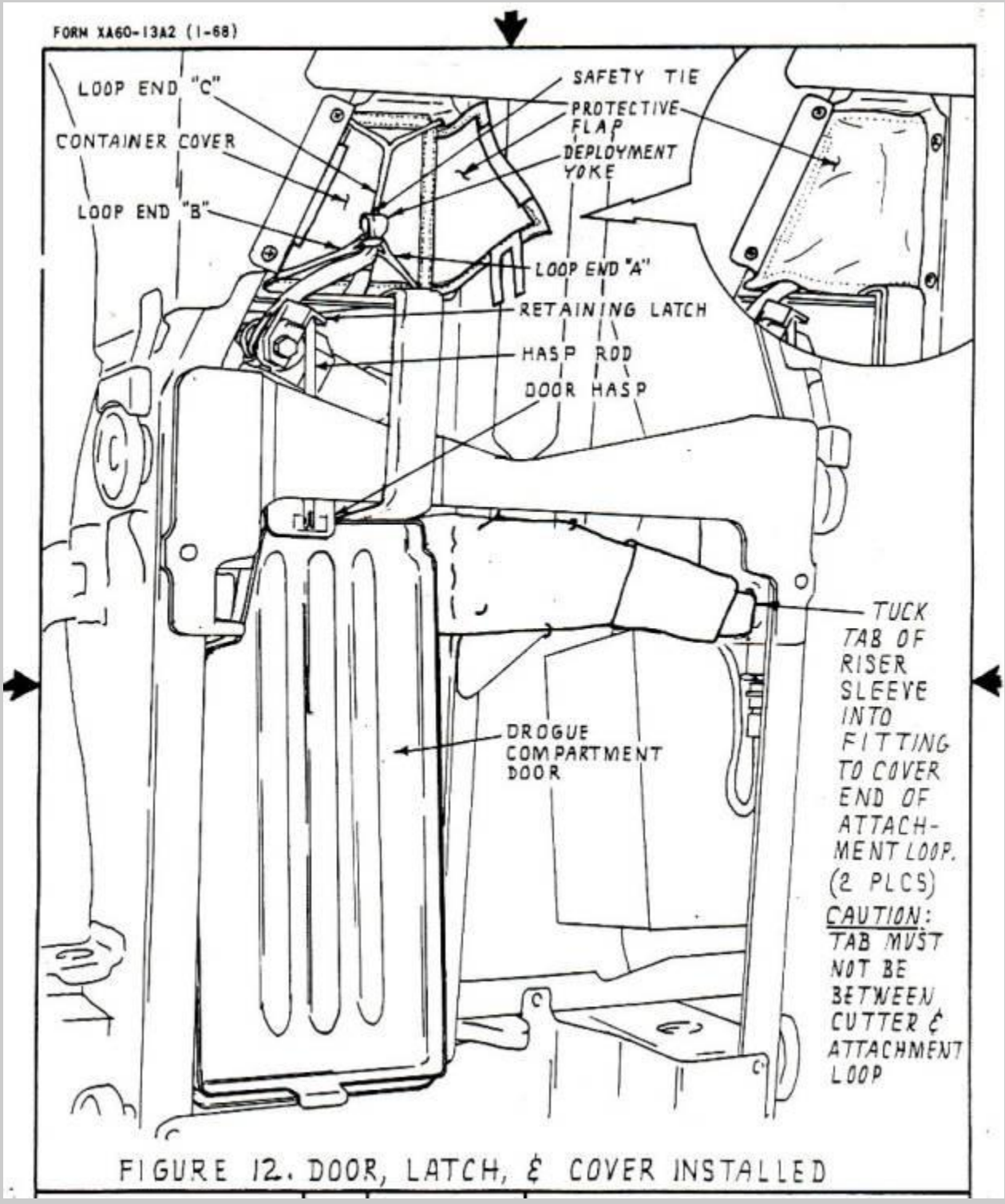

FIGURE 12. DOOR, LATCH, & COVER INSTALLED

References / Acknowledgements / Sources:

1) Douglas Aircraft Company, Long Beach California. Technical Reference A114761, "Procedure for Rigging and Packing Seat Drogue System, Ejection Seat ACES ll System", December 1975

2) Dryden Flight Research Center (NASA), Edwards Air Force Flight Test Center, Edwards, CA. Egress Systems.

3) Personal contact, communications, and observations.

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[Grateful acknowledgement is extended to the *National Aeronautics and Space Administration*, its personnel, and facilities at the Dryden Flight Research Center, without whom we would be unable to prepare and present this valuable information for the benefit of aerospace historians and museum personnel engaged in restorative work on ejection seat systems. This material is presented here to assist them in preserving egress artifacts and in sustaining general public interest in and knowledge of the very important subject of aviation emergency egress technology history.]

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Special thanks to my good friend and NASA Egress Engineer *Fred Rinke*, now retired from NASA Dryden Flight Research Center and no longer responsible for the safe rigging and operation of NASA flight research aircraft egress systems. Fred and his colleagues at the Dryden ALSE/Egress systems branch have been generously supportive of the Aerospace Museum of California over the past several years and without Fred's personal assistance, the mysteries of the ACES-2 seat would likely remain just that for the average individual…mysteries. Enjoy your retirement, Fred! You deserve every bit of it!

Low level emergency ejection from F-16 by Captain Chris Stricklin during USAF Thunderbirds flight demonstration at Mountain Home AFB, in September 2003. Photograph by SSgt Bennie Davis III, using a large telephoto lens (300 mm). The ejection took place within about 100 feet of the ground, demonstrating the capability of the ACES II system in what would be considered quite adverse circumstances (high rate of descent, close to ground). Captain Stricklin survived with just bruises, fortunately.