



**U. S. Army Rotary-Wing
Emergency Egress Study**

By

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Research Support Division

May 1995

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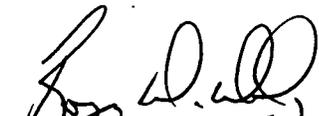


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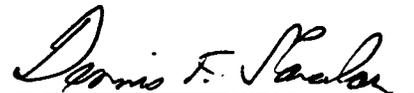
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Background

This study was a partial effort to survey the emergency egress mechanisms for all helicopters in support of a North American Treaty Organization (NATO) Advisory Group for Aerospace Research and Development (AGARD). This part of the study deals only with U.S. Army helicopters.

A literature search revealed the only U.S. study of this kind had been a survey of egress from U.S. Navy fixed-wing jet aircraft over water. A study was done by BioTechnology, Inc., to see how best to present the emergency egress information in the manual of the Naval Air Training and Operating Procedures Standardization Program (NATOPS). The study concluded that the best way to facilitate learning was for the manual to strongly emphasize pictorial descriptions. Also, the study's authors found that presentations with pictorial support had a higher rate of learning and retention (Post and Kershner, 1979).

The Naval Aerospace Medical Institute then was tasked to prepare mechanicals (layouts) on emergency egress to be included in all aircraft NATOPS manuals. This tasking also included standardization of the mechanicals. The process for manual standardization was developed by Lee, 1990. This paper follows Lee's suggested presentation method.

Method

The intent of the study was to evaluate various factors affecting the egress from U.S. Army helicopters. Factors include: location and description of the operating mechanism, location of and ease of viewing the operating instructions, force required to operate, direction of opening, size of aperture and restrictions to evacuation, overall ease of operation and access for crews, extent of instructions in the operator's manual, and finally photos of each apparatus.

Operator's manuals for each aircraft were reviewed and pertinent information was extracted to include system descriptions, operating procedures, and equipment diagrams. In all the operator's manuals, chapter 2 describes systems and chapter 9 covers emergency procedures.

The study was conducted at Cairns Army Airfield, Fort Rucker, Alabama. Aircraft used were from "A" Company, 1/223 Aviation Battalion. The results were obtained by attaching a Chatillon DPP-25 force gauge to the emergency egress handles on the aircraft and operating the mechanism according to the operator's manual. All handles that required safeties were safe tied with 0.020" safety wire. The cockpit exit restrictions common to most U.S. helicopters are the collective (left side only), the cyclic, and armor plating.

The aircraft studied were the UH-1 Huey, the UH-60 Black Hawk, the AH-1 Cobra, the AH-64 Apache, the OH-58 Kiowa, and the CH-47 Chinook. The study was divided into two areas of concentration for each aircraft: the cockpit egress and the cabin area egress.

Note: All nonphoto figures are found in the Appendix.

Results and Discussion



UH-1 Huey

Cockpit --- Emergency exit release handles are located on the front of the cockpit doors, directly above the upper hinge. The T-shaped handles are yellow and black striped. Operating instructions are readable easily and located on the front door frame above the T-handle, as



Figure 1. UH-1 cockpit area.

shown in Figures 1 and 2. Pulling the T-handle upwards pulls a cable which releases pins through the door hinges. Once the pins come out, the hinge separates, and the cockpit door is free to fall away. Force required to break the safety and disengage the pins is 25-30 lbs. The door then will fall off by itself or with slight pressure upon it. The opening then is the size of the door frame minus the restric-

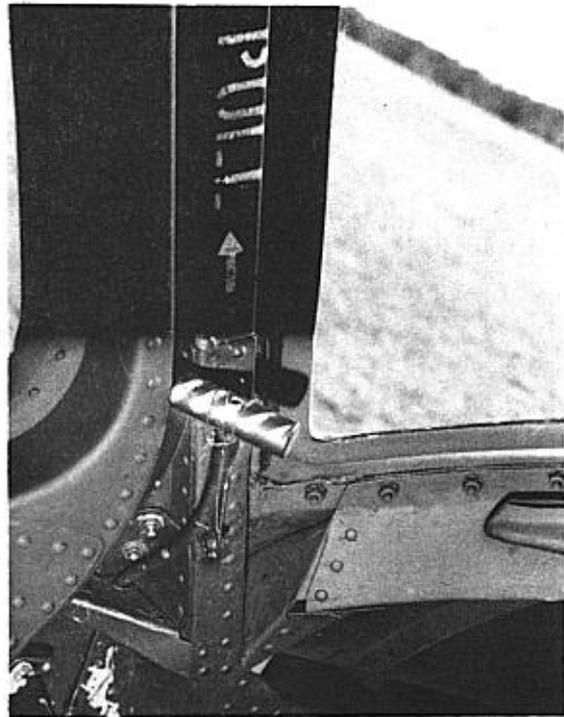


Figure 2. UH-1 cockpit emergency egress handles.

tions of the cyclic, armor plate and the collective. The operator's manual displays the emergency exit release handles, but does not have them labeled as seen in the Appendix, Figure 3. Emergency procedures in chapter 9 of the operator's manual are simple and adequate. The cockpit

doors jettison easily and quickly. The armor protection panel on the seat is difficult to slide rearward and takes both hands to operate. With the panel forward, it is difficult to egress and this is the procedure's weak link.

Cabin --- The cabin door window emergency release handles are located at the bottom center of each window. The handles are yellow and black striped. Operating instructions clearly are visible as can be seen in Figures 4 and 5. Lifting up on the handle with 20-25 lbs. of force

retracts stops along the bottom of the window. The bottom of the window then can be pulled inward with minimal force. The top of the window falls free of the frame and the entire window drops into the cabin. It is important to note the window can not be pushed outward, it must be pulled inside, and is so noted in the instructions. Then occupants are unrestrained from exiting the aircraft. The operator's manual displays a labeled picture of the exits and handles as seen in the Appendix, Figure 6. Emergency procedures in chapter 9 are simple and adequate.

Figure 5. UH-1 cabin emergency egress handles.

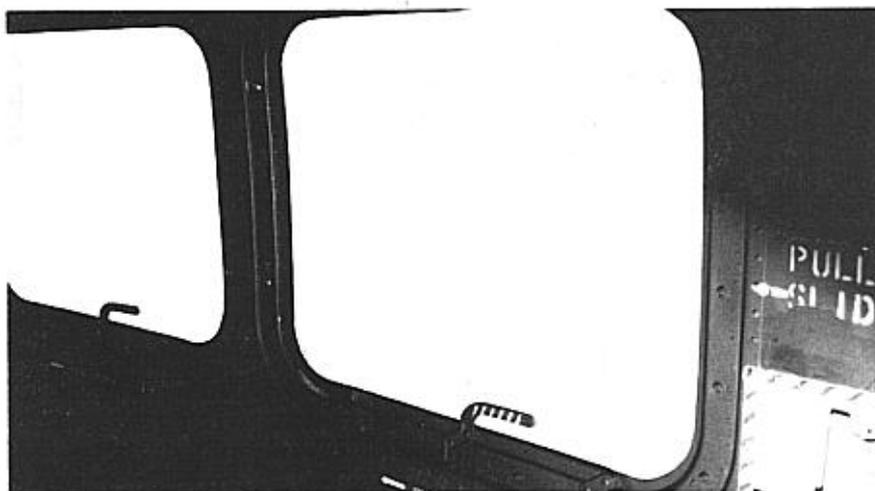


Figure 6. UH-1 cabin emergency exits.





UH-60 Black Hawk

Cockpit --- Emergency release handles are located on the inside frame of each cockpit door. They allow the cockpit doors to be jettisoned in case of an emergency. The handles are yellow and are



Figure 7. UH-60 cockpit area.

surrounded with ample instructions as shown in Figures 7 through 9. Pulling the emergency handle with 40-45 lbs. of force turns a cam inside the door allowing the door to be separated from the hinge at the mounting points. The operator's manual emergency procedure states the door then may be jettisoned by kicking the lower forward corner. This procedure works; however, on the doors tested, it required *substantial* force to dislodge the door from the hinge. Once the connection is broken, the door falls away from the aircraft. As with the UH-1, the egress is hampered substantially if the protective armor plating has been moved forward. However, unlike the UH-1, the plating on the UH-60 can be moved rearward with only

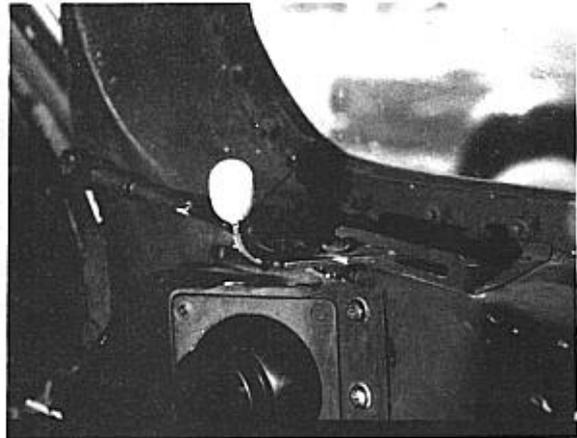


Figure 8. UH-60 cockpit emergency egress handles.

one hand. The weak link of this procedure is the process of kicking the door away from the hinge.

Cabin --- The egress from the cabin area of a UH-60 is unique and poses no

physical difficulties, but it could be confusing under certain circumstances. First under normal egress procedures, passengers seated in the aft area are unable to reach the handle of the cabin door when the system of seating four across the center is used. The doors must be opened by someone sitting in the forward area or from the outside. Second, there is only one cabin door window jettison handle on each cabin door, and they are in different locations on each side. The handles are located under the front window on the left cabin door and under the rear handle on the right side door as shown in Figures 10 and 11. In the Appendix, the cabin's emergency exits can be seen in Figure 12. The locations make it very difficult for passengers in the front area to operate the right side emergency exit, and for passengers in the rear area to jettison the cabin windows on the left side. The direction of handle pull on each side also is different. On the left side the handle is pulled aft and the handle on the right is pulled forward as explained under emergency exits in the operator's manual. On the positive

side of the egress procedure, it takes only approximately 10 lbs. of force to operate the handles and then the windows easily are pushed outward. Pulling the handle releases both the front and the rear cabin door windows on that side.

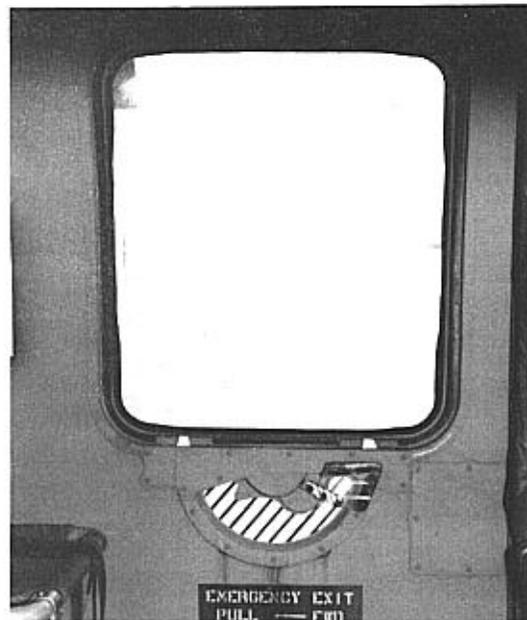


Figure 10. UH-60 cabin area.

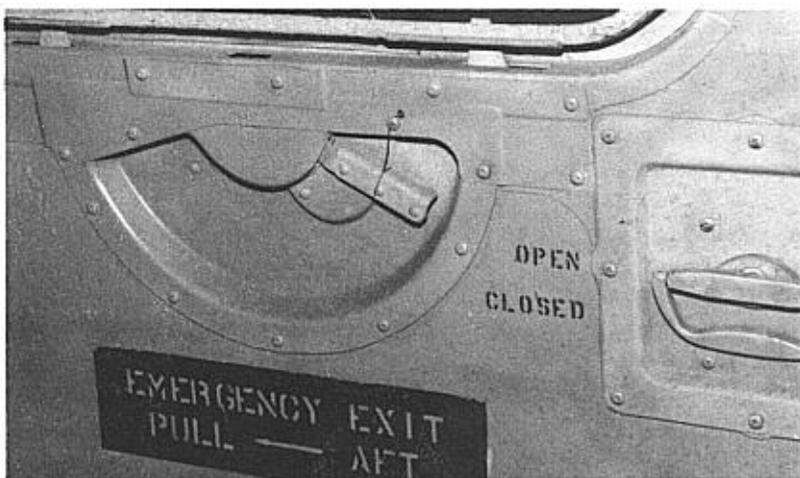
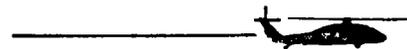
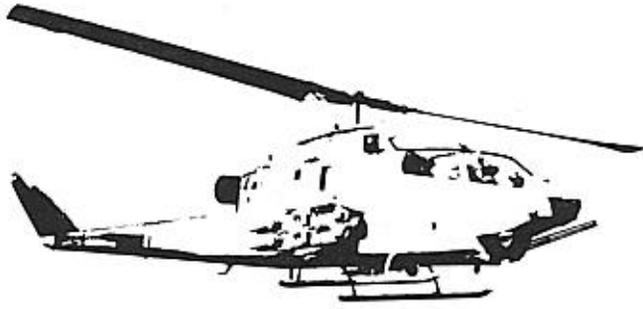


Figure 11. UH-60 cabin emergency egress handles.





AH-1 Cobra

Cockpit only --- The Cobra contains a canopy jettison system that can be operated from either the pilot's rear seat or the copilot/gunner's, (CPG) front seat. The arming/firing mechanisms are located near the instrument panel and have operating instructions on them as shown in Figures 13 through 17. These firing mechanisms are operated by turning the handle 90 degrees counterclockwise with a torque of 6-12 inch-pounds. This maneuver arms

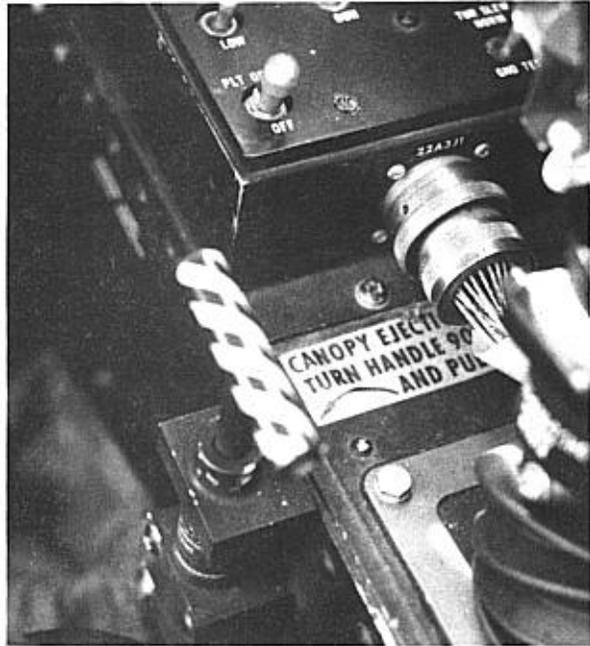


Figure 14. AH-1 copilot/gunner emergency egress handle.

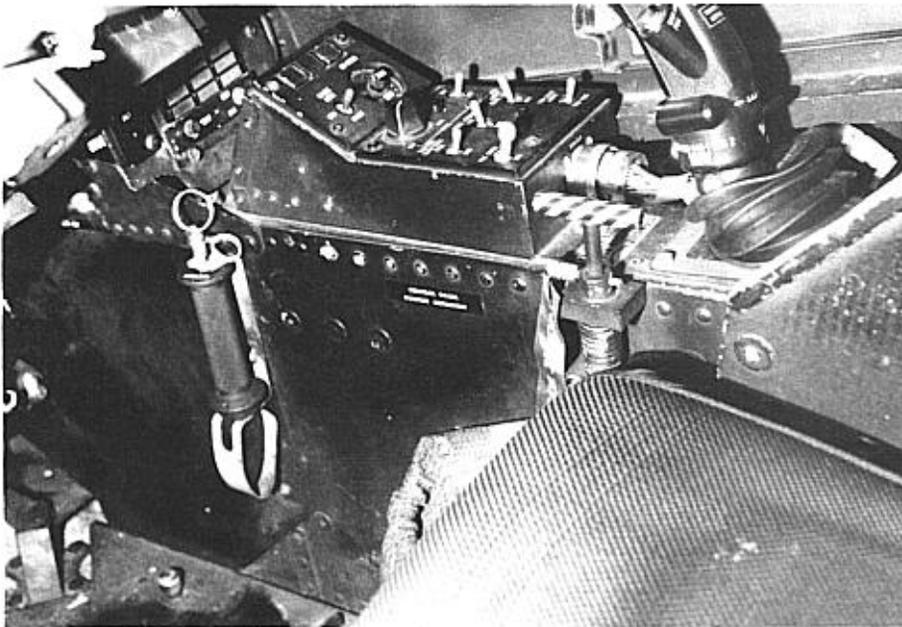


Figure 13. AH-1 copilot/gunner cockpit area.

the assembly. The operator then pulls the handle with 20-35 lbs. of tension, firing the primer and causing the cutting assembly to be detonated. The process is completed by the detonation cord, that burns around the periphery of all the side panels, sever-

ing them from the fuselage. This system is explained in chapter 2, section II of the operator's manual, but there are no emergency procedure steps outlined in chapter 9. Once the canopy is jettisoned, there is a clear access area for the pilots to egress.

Figure 15. AH-1 pilot cockpit area.

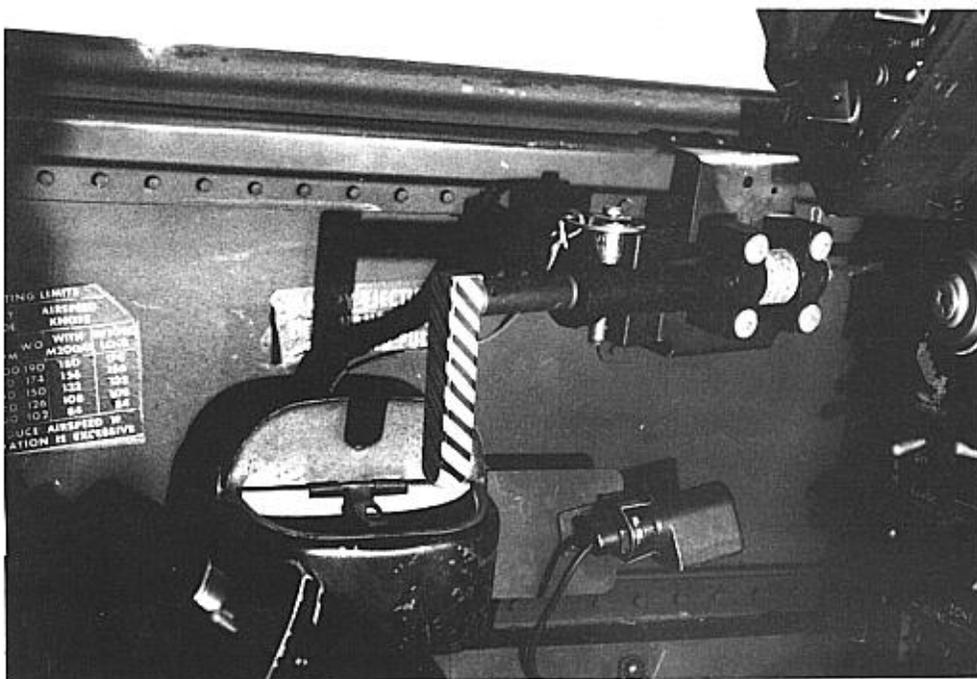


Figure 16. AH-1 pilot emergency egress handle.





AH-64 Apache

Cockpit only --- The Apache also has a canopy jettison system that expels the four acrylic panels on the sides of the pilot and CPG stations. The Apache however, has three canopy jettison handles. One is on the upper left corner of the pilot's instrument panel. A second is at the upper left corner of the CPG panel. And the third is the external ground crew handle located on the front of the aircraft, under a quick-release panel directly forward of the CPG's windshield as shown in Figures 18 through 23. Like the Cobra, the Apache system is based on an arming/firing handle, a primer/initiator, and a

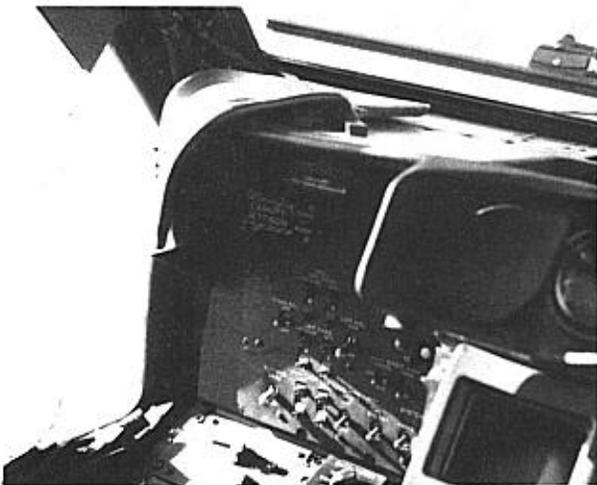


Figure 18. AH-64 copilot/gunner cockpit area.

detonation cord around the periphery of the side panels. The operating instructions again are directly on the jettison handles. The system is armed by rotating the canopy jettison handle 90 degrees left or right, which then uncovers the word **ARMED** on both sides of the handle. The system then is activated by pushing the jettison handle in, detonating the primer/initiator within the handle. The system is explained very well in chapter 2 of the operator's manual. The emergency egress procedures are in chapter 9.



Figure 19. AH-64 copilot/gunner emergency egress handle.



Figure 20. AH-64 pilot cockpit area.

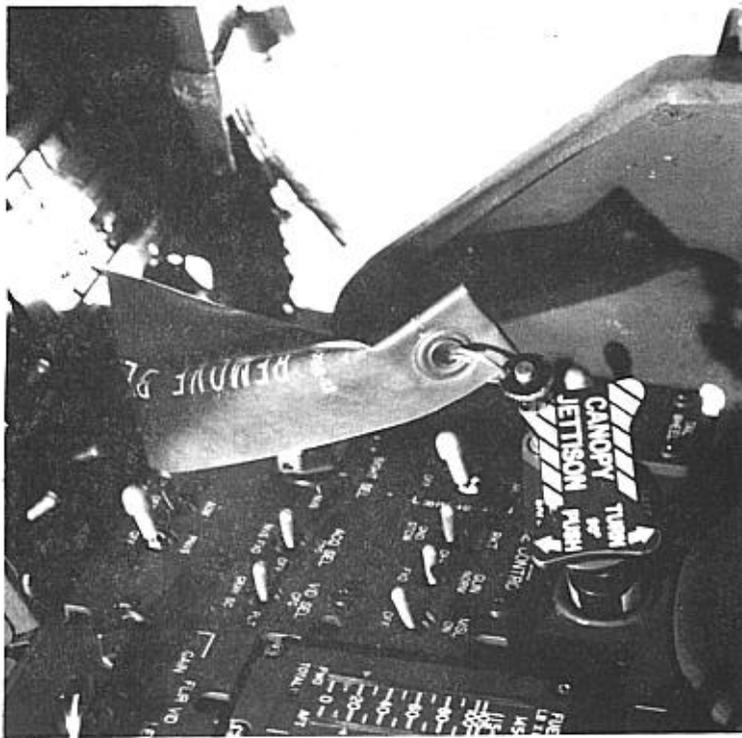


Figure 21. AH-64 pilot emergency egress handle.

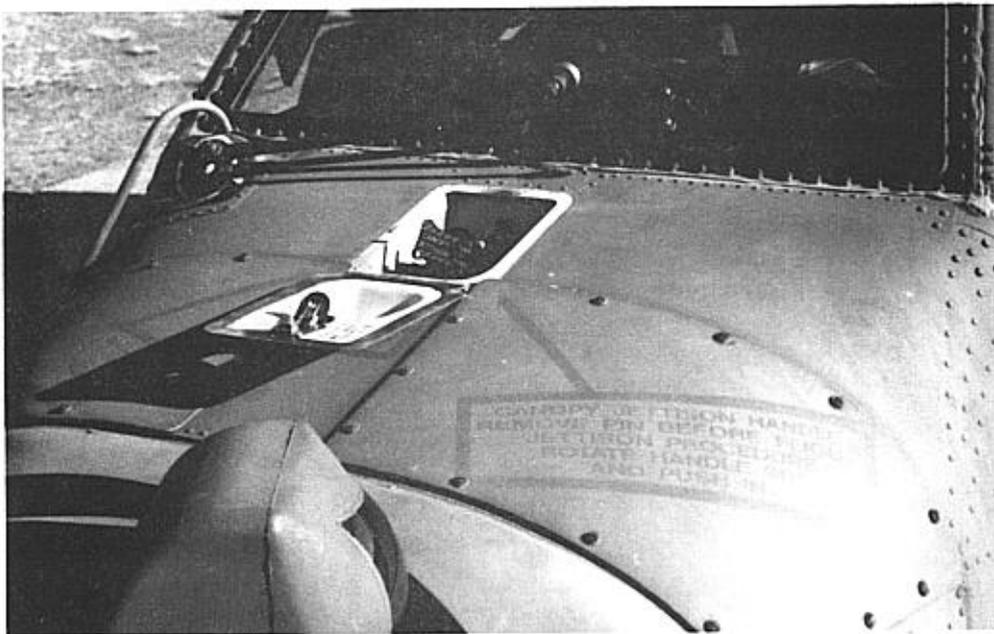


Figure 22. AH-64 ground crew emergency egress handle.





OH-58 Kiowa

Cockpit --- The cockpit door emergency jettison handles are located on the inside of the door frames just above the upper hinges. The yellow handles are di-

rectly above the emergency exit labels on the door frame as shown in Figures 24 through 26. Pulling aft on the handle with a force of 15-25 lbs. pulls pins on both hinges, allows the hinges to separate, and internal springs then push the door out and away from the aircraft. The handle was difficult to pull aft if there was pressure on the handle towards the center of the cockpit while pulling. We found the end of a mounting bolt restricted the rotation of this lever. This easily was compensated for by applying slight outward pressure on the handle while pulling aft. The armor plating opens easily and quickly

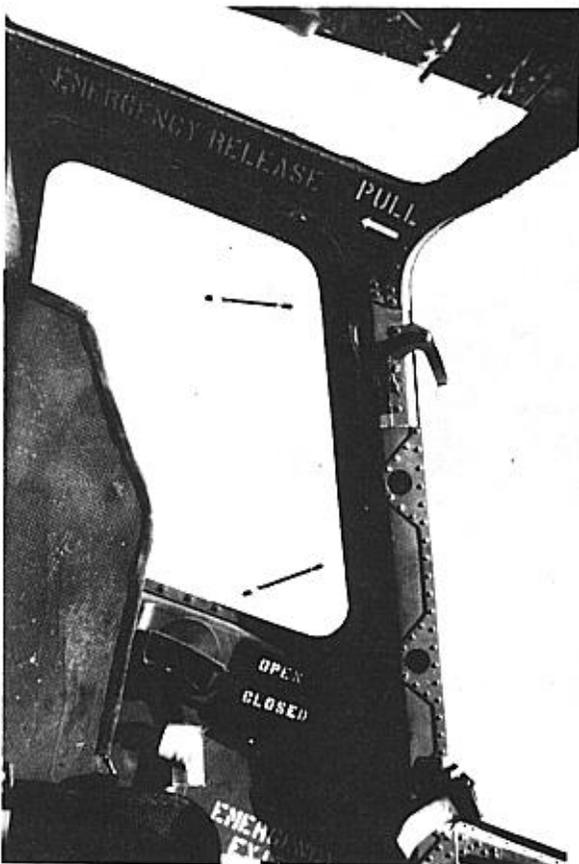


Figure 24. OH-58 cockpit area.

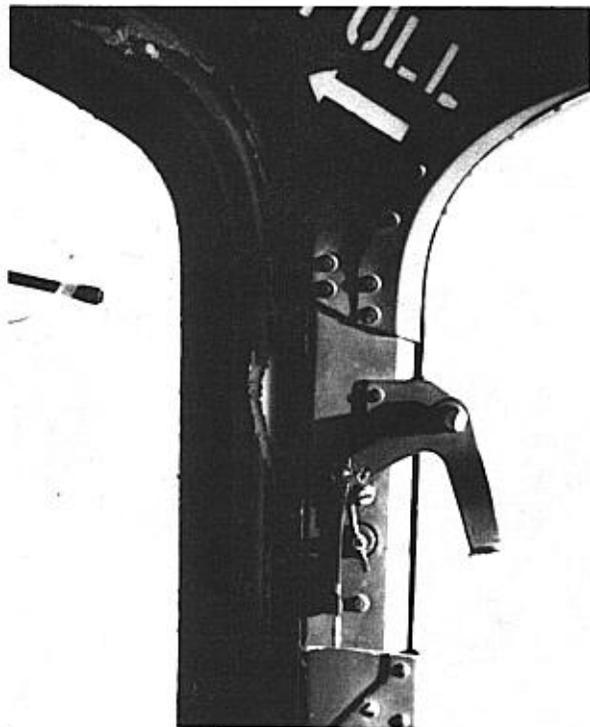


Figure 25. OH-58 cockpit emergency egress handles.

with the outside hand and is not an obstacle while exiting the aircraft. However, if for some reason, i.e., hard landing, the armor should become stuck, the egress area would be reduced substantially. The operator's manual has good figures of the

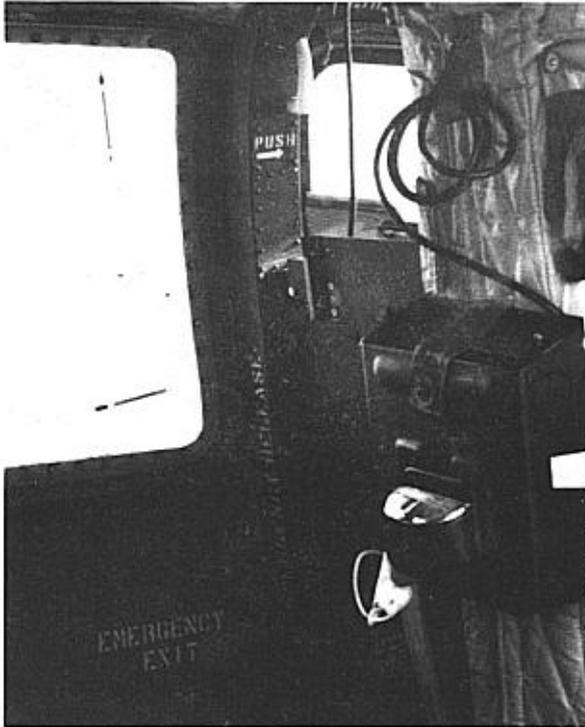


Figure 26. OH-58 cabin area.

emergency jettison handles and has concise and simple operating instructions in chapter 9. Also, it is important to note in this aircraft the cockpit emergency handles are in a good location to be utilized as hand rests. The operator's manual has a warning in chapter 2 that this may result in inadvertent jettisoning of cockpit doors.

Cabin --- The cabin emergency jettison handles are located on the aircraft frame between the cockpit and cabin doors. The handles are yellow and black striped with instructions on the frame immediately below them as shown in Figures 26 through 28. They operate in a similar fashion and equally as effectively as the cockpit jettison system. The difference is that the cabin handle must be pushed forward and the force required is 25-30 lbs. The door then is easily popped off with the assistance of springs, opening a large egress area. It should be pointed out that if the passenger in the rear is restricted by their inertial reel seat restraint, they may have difficulty reaching the emergency handle because of the distance.

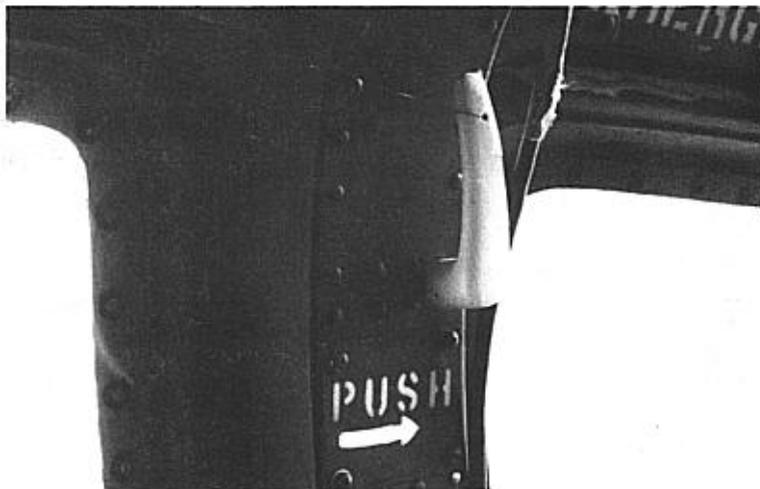


Figure 27. OH-58 cabin emergency egress handles.





CH-47 Chinook

Cockpit --- Inside handles for the cockpit door emergency exit are located directly above the cockpit doors. The handles are yellow and black striped with operating instructions on them as shown in Figures 29 and 30. The handles either can be pushed up or pulled down to disengage the entire door from the frame. The door then falls out, top first. There are no warnings in the operator's manual about using this handle as a hand rest, but care

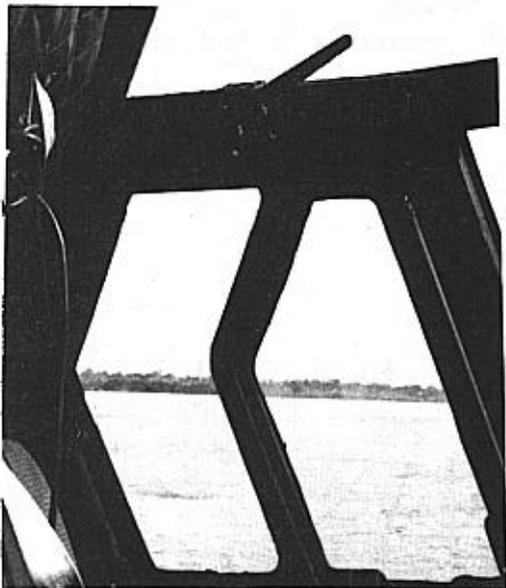


Figure 29. CH-47 cockpit area.

must be taken to prevent accidental jettisoning. The system also may be activated by outside emergency handles located directly below and aft of the cockpit doors. To operate, the handle first must be extended from the aircraft, then turned

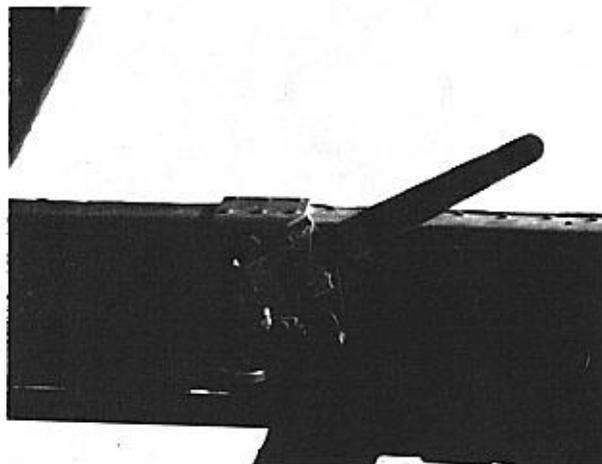


Figure 30. CH-47 cockpit emergency egress handles.

while pushing in the trigger button. The instructions for this procedure are painted on the side of the aircraft. When this technique is used, the bottom of the door comes out first. The person operating the exterior handle should be aware of, and avoid the falling door. The force required to turn either handle is between 35 and 40 lbs. With the door off, there is ample room to exit the aircraft. The operator's manual contains ample pictures of the emergency escapes in chapter 9 as shown in Figure 31.

Cabin --- Emergency egress from the cargo area of a Chinook is accomplished by jettisoning the windows, the

emergency exit on the ramp shell, the shell itself, or exiting through the cargo hook viewing hatch. The windows are jettisoned by pulling a yellow strap hanging from each window as shown in Figure 32. The strap is connected to a seal that runs completely around the window. Pulling the strap away breaks the entire seal and the window then can be pushed out. In addition to the window, a square panel around the window comes out with the front exits on either side, and the exit located on the ramp shell. Adequate instructions for operating these emergency exits are located near the exits and in chapter 9 of the operator's manual as shown in Figures 34 and 35.



Figure 32. CH-47 cabin area emergency egress window straps.

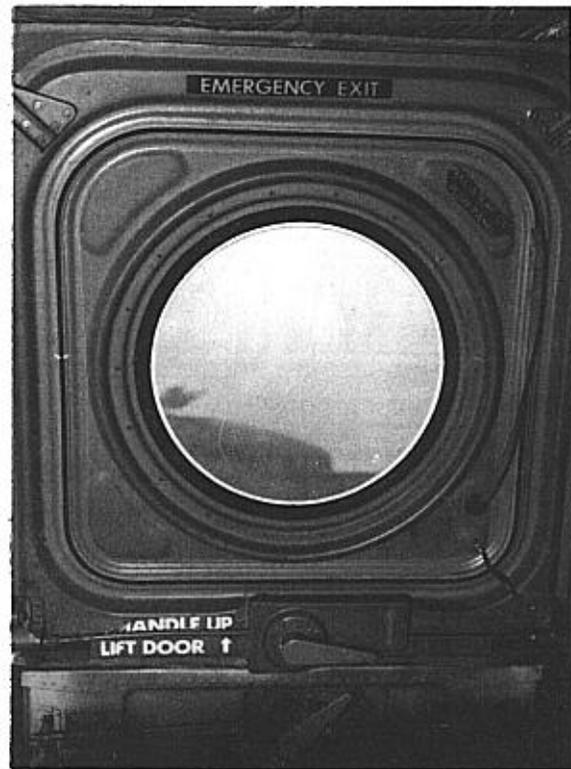


Figure 31. CH-47 cabin area emergency egress door strap.

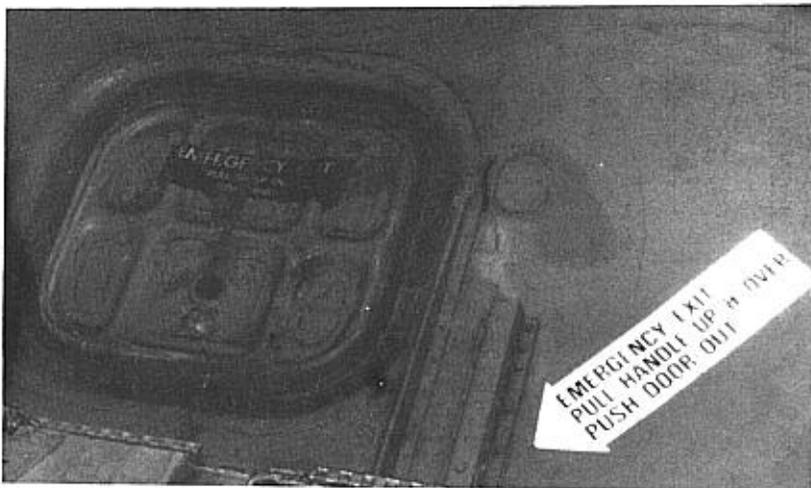


Figure 33. CH-47 cabin area emergency egress ramp.



Conclusions

There is no specific standardized method to describe emergency egress procedures in U.S. Army helicopters. The procedures are covered in chapters 2 and 9 of each operator's manual, but not necessarily in the same sections in every manual. Each aircraft has a slightly different mechanism or technique for initiating the egress process. These different procedures are displayed in or on the aircraft in strategic locations to facilitate proper usage. It is critical that pilots and passengers familiarize themselves with each aircraft. A crew and passenger briefing is required. Each helicopter's operator's manual has a preflight check list, including the emergency egress procedures.

The standard aircraft exit restrictions from the cockpit are: the collective (left side only), the cyclic, and protective armor plating if installed. Under normal egress procedures, the collective and cyclic are not very restrictive, the UH-60 collective is even collapsible. However, any time the protective armor plating is used and is difficult to retract, there is the potential for a substantial reduction in the size of the egress opening. The UH-1 Huey is an example.

During any emergency, helmet visors should be down; this is important especially during an emergency egress.

Pilots and crew members should feel safe and confident they will be able to egress from an aircraft in case of a mishap. However, they need to remember that knowledge of the proper egress procedures for the specific aircraft being flown is essential for an expeditious egress. Also, it should be noted that an egress or survival knife always can be used to exit an aircraft as a last resort.

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**Appendix A.
Diagrams.**

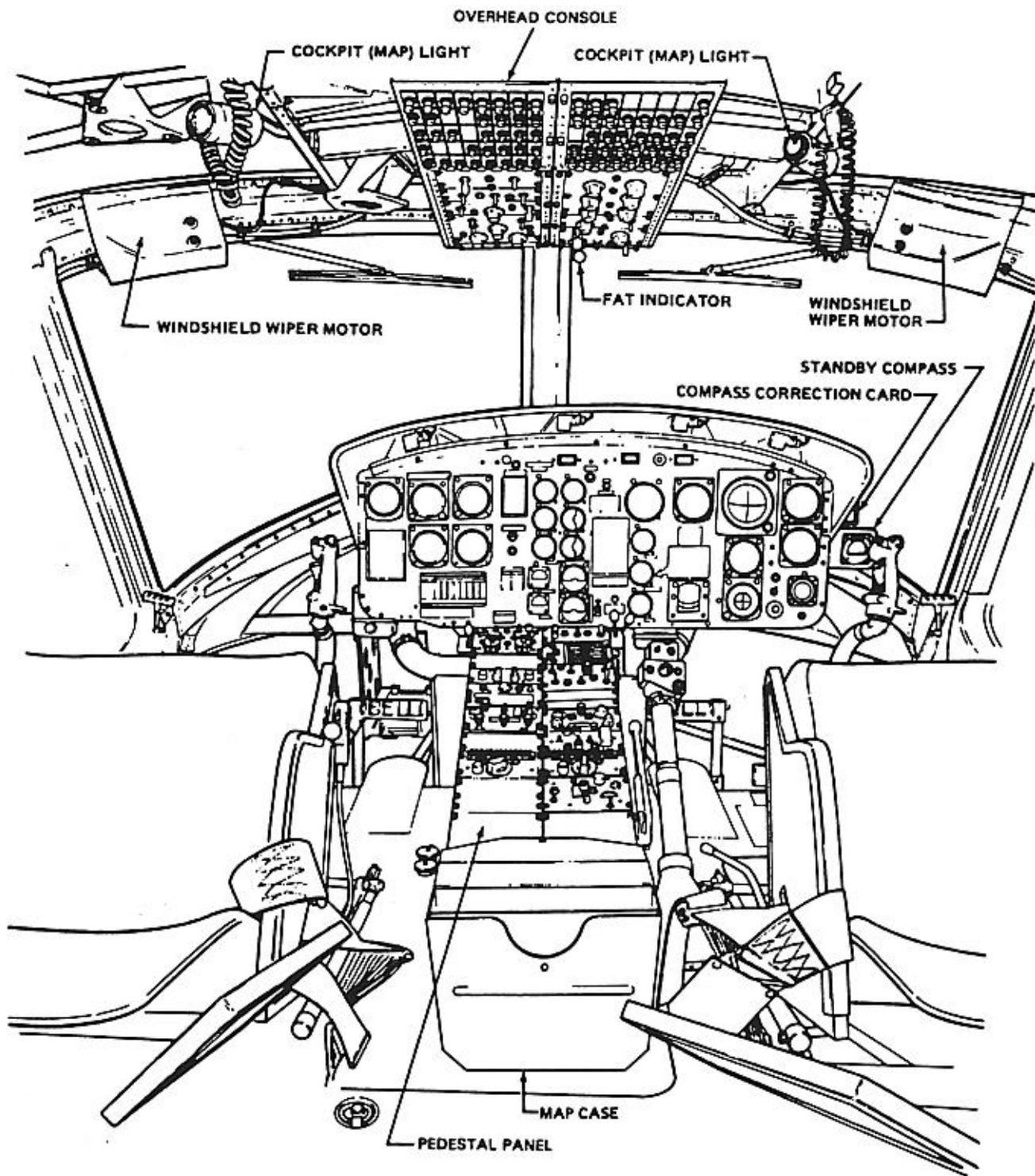
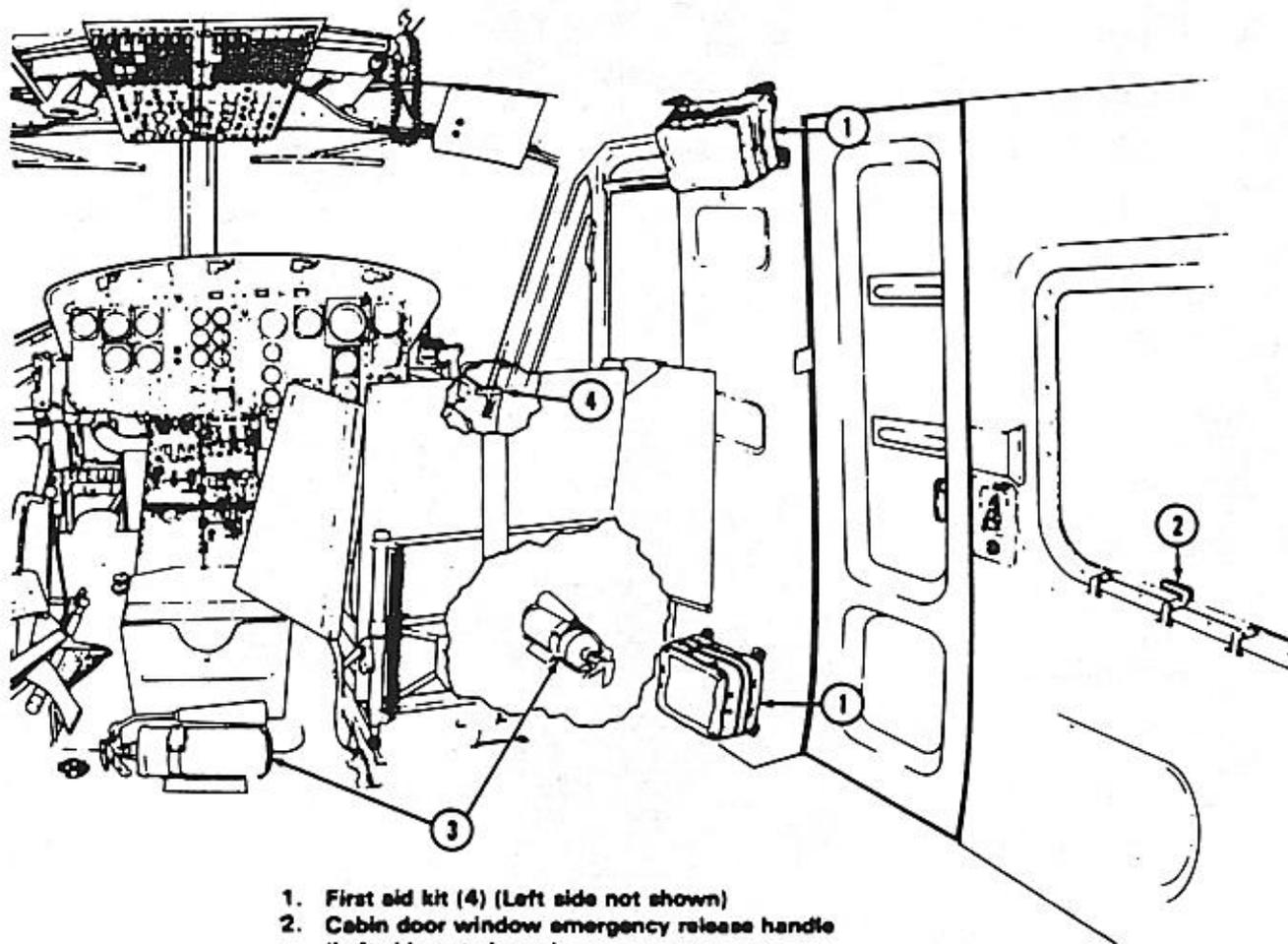
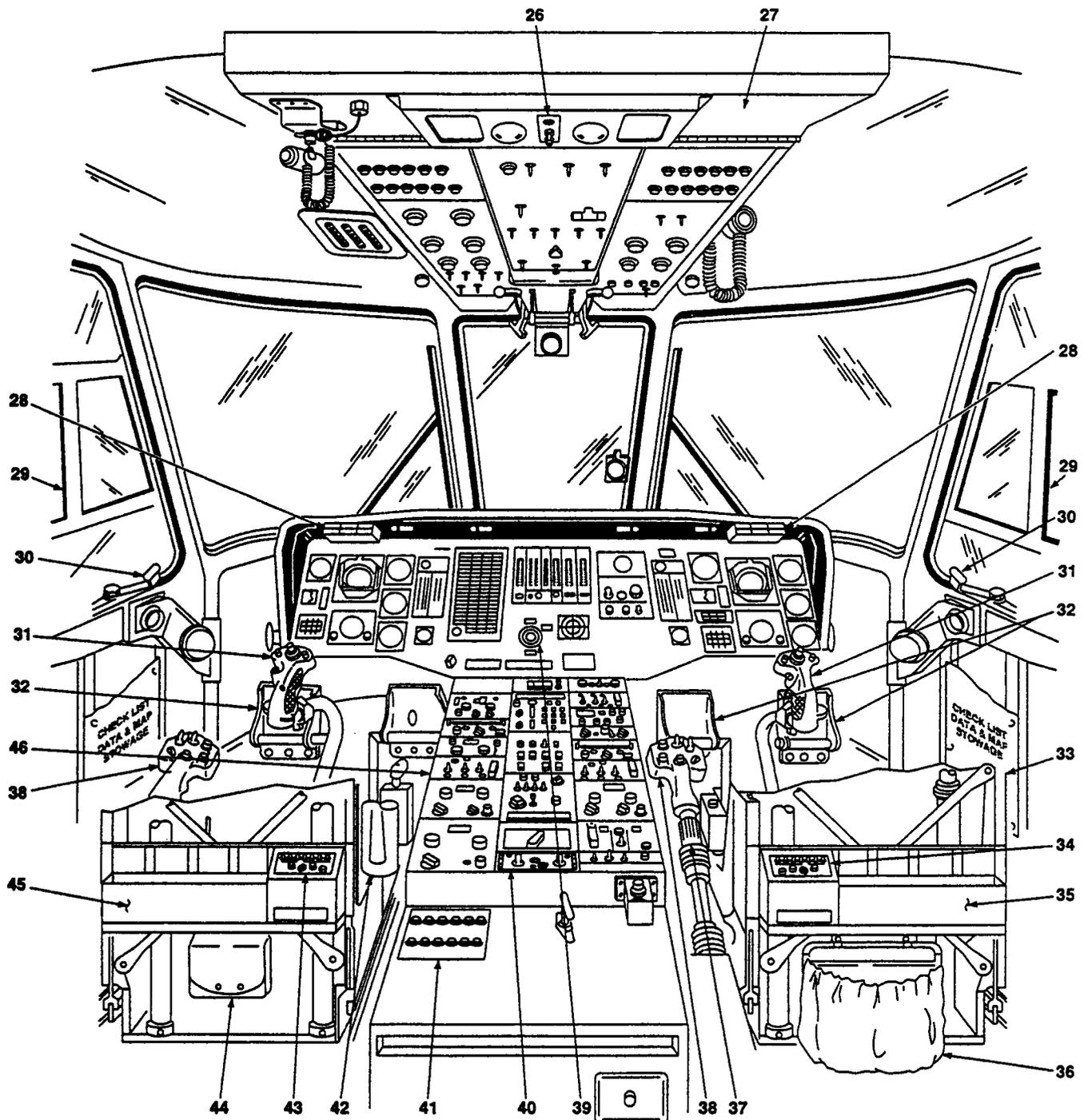


Figure 3. UH-1 cockpit diagram.



1. First aid kit (4) (Left side not shown)
2. Cabin door window emergency release handle (Left side not shown)
3. Fire extinguisher (1)
4. Crew door jettison handle (Left side not shown)

Figure 4. UH-1 cabin area.



- 26. COCKPIT FLOODLIGHT CONTROL
- 27. UPPER CONSOLE
- 28. MASTER WARNING PANEL
- 29. SLIDING WINDOW
- 30. COCKPIT DOOR EMERGENCY RELEASE
- 31. CYCLIC STICK
- 32. DIRECTIONAL CONTROL PEDALS
- 33. PILOT'S SEAT

- 34. CREW CHIEF / GUNNER ICS CONTROL PANEL
- 35. CREW CHIEF AMMUNITION / GRENADE STOWAGE COMPARTMENT
- 36. STOWAGE BAG
- 37. COLLECTIVE STICK FRICTION CONTROL
- 38. COLLECTIVE STICK GRIP
- 39. ENGINE IGNITION KEYLOCK
- 40. LOWER CONSOLE

- 41. BATTERY / BATTERY UTILITY BUS CIRCUIT BREAKER PANEL
- 42. FIRE EXTINGUISHER
- 43. GUNNER'S ICS CONTROL PANEL
- 44. FIRST AID KIT
- 45. GUNNER'S AMMUNITION / GRENADE
- 46. COPILOT'S SIDE LOWER CONSOLE

Figure 9. UH-60 cockpit diagram.

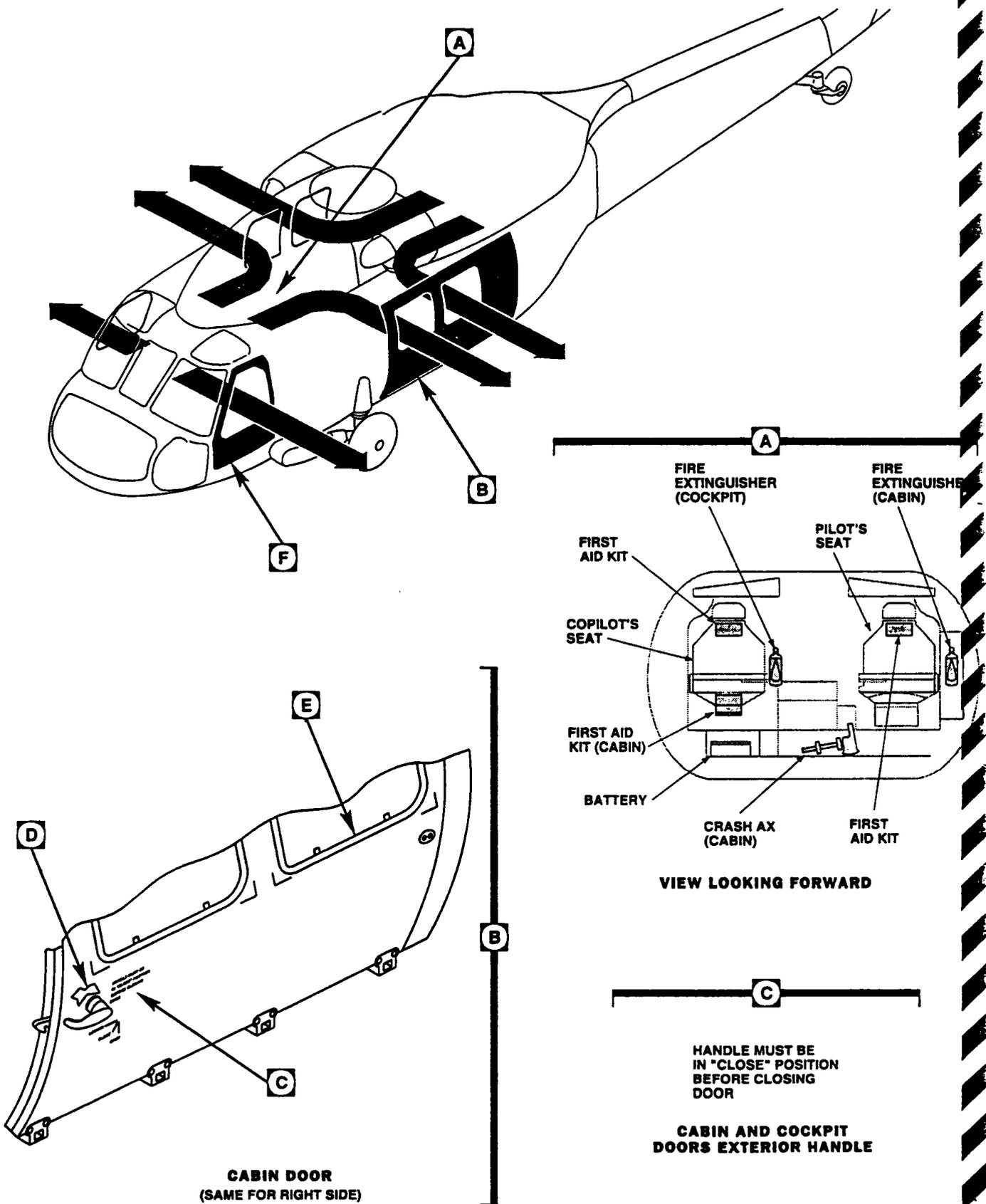


Figure 12. UH-60 cabin emergency exits.

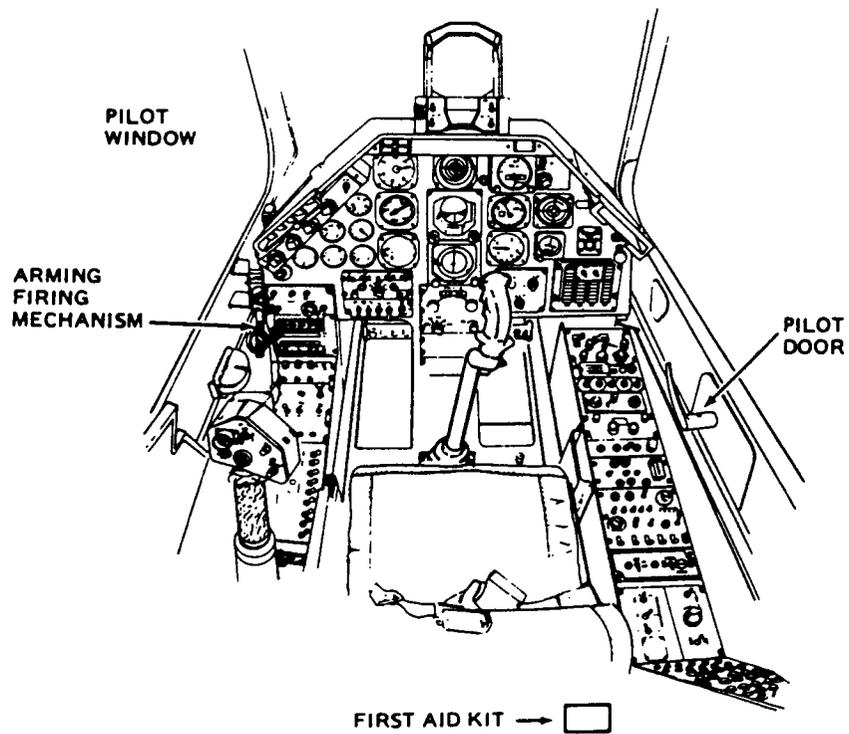
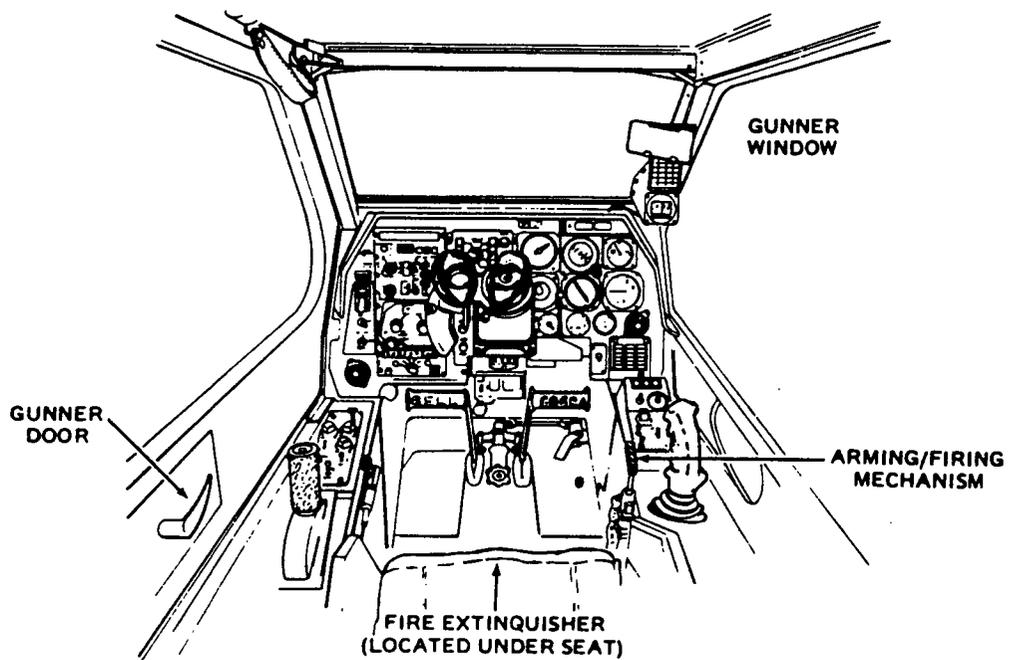
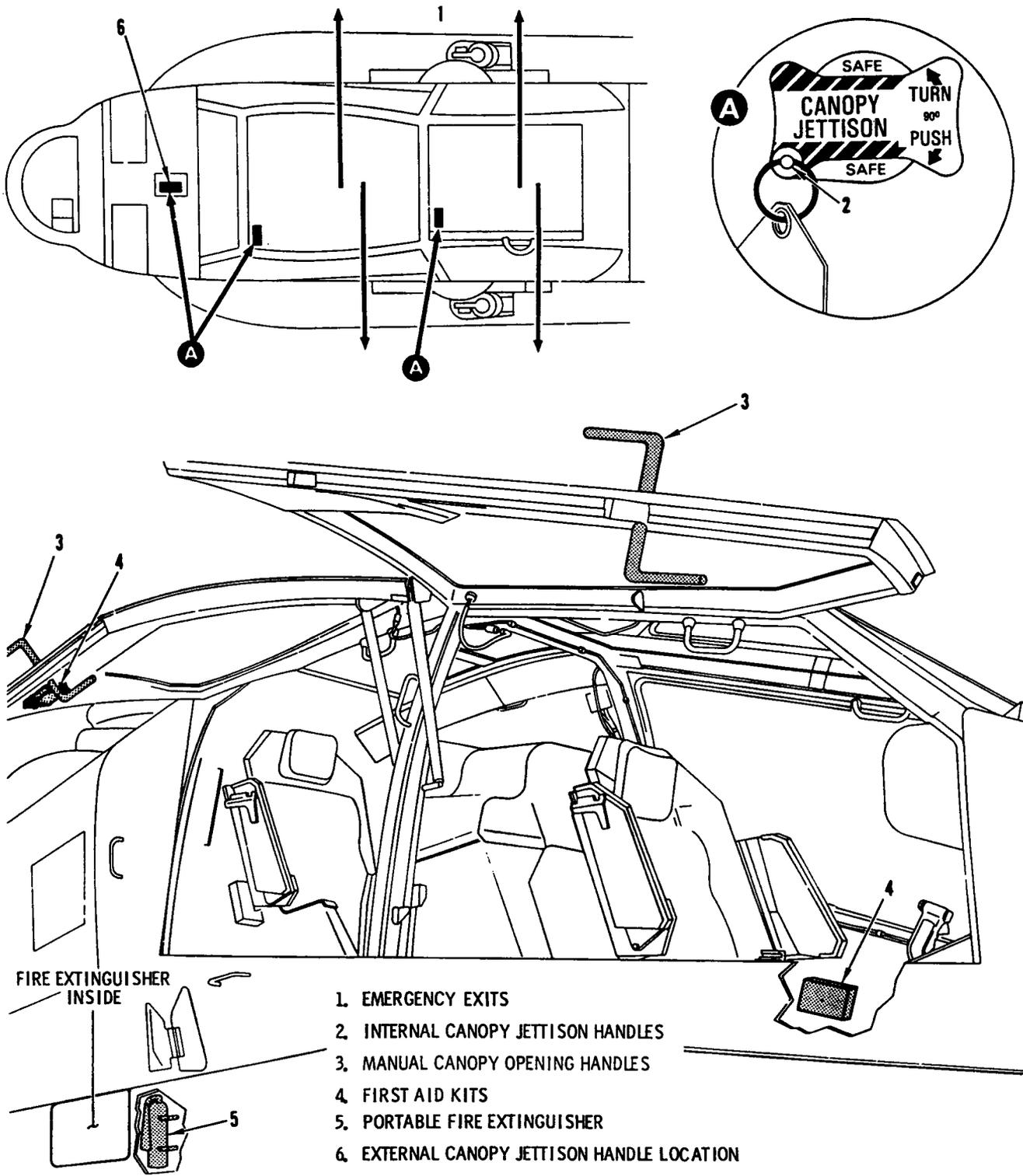


Figure 17. AH-1 cockpit emergency exits.



- 1. EMERGENCY EXITS
- 2. INTERNAL CANOPY JETTISON HANDLES
- 3. MANUAL CANOPY OPENING HANDLES
- 4. FIRST AID KITS
- 5. PORTABLE FIRE EXTINGUISHER
- 6. EXTERNAL CANOPY JETTISON HANDLE LOCATION

Figure 23. AH-64 ground crew emergency egress handles.

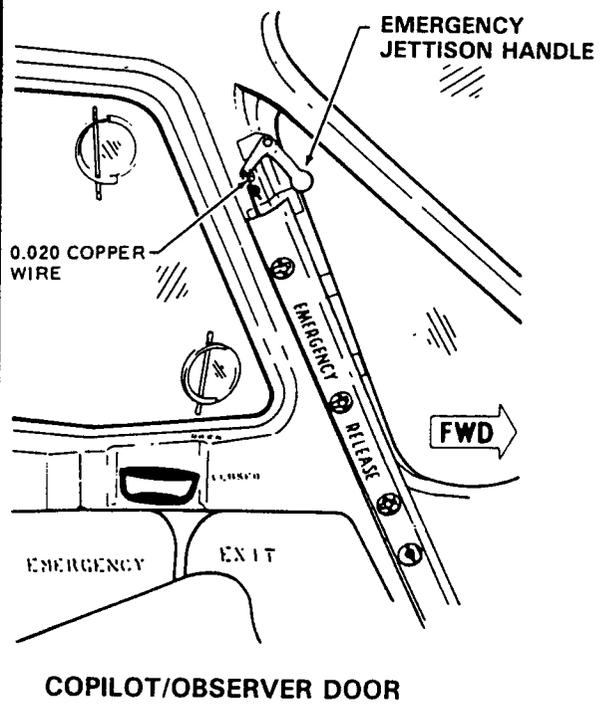
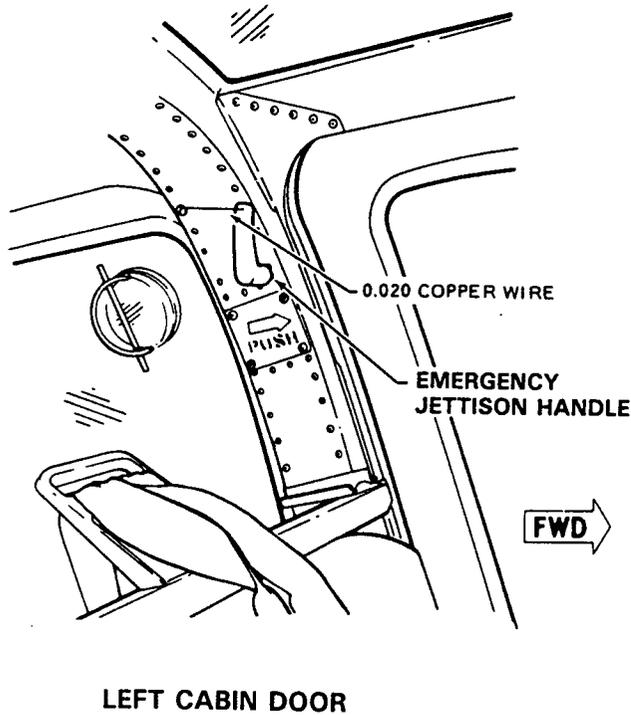
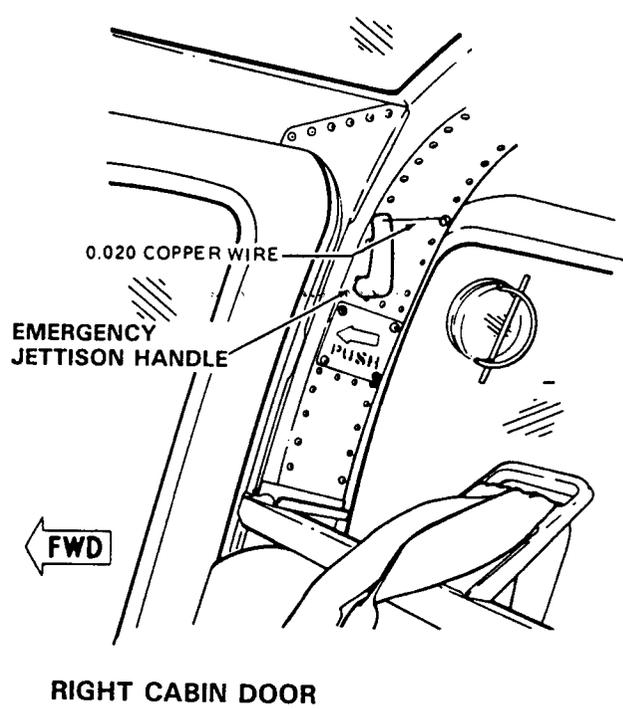
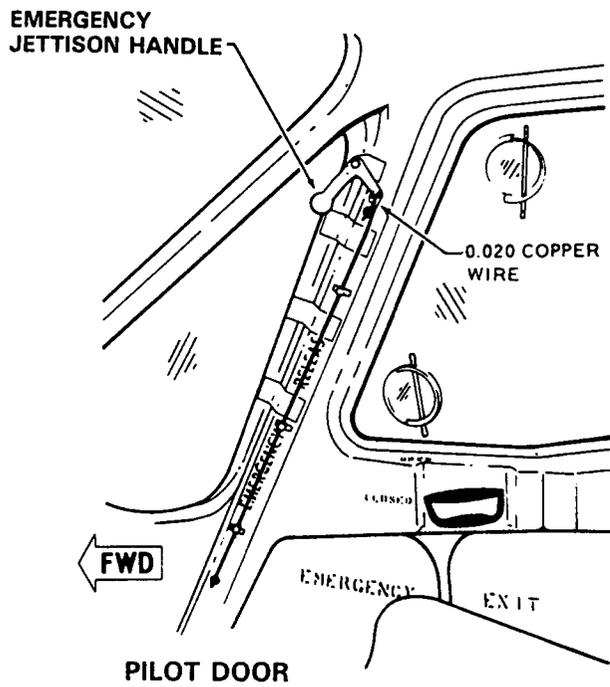
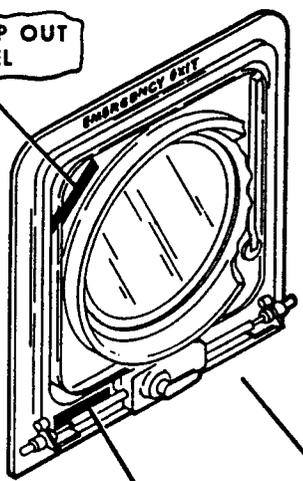


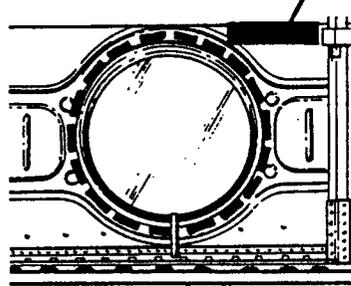
Figure 28. OH-58 cabin emergency egress handles.

PULL STRAP OUT
PUSH PANEL



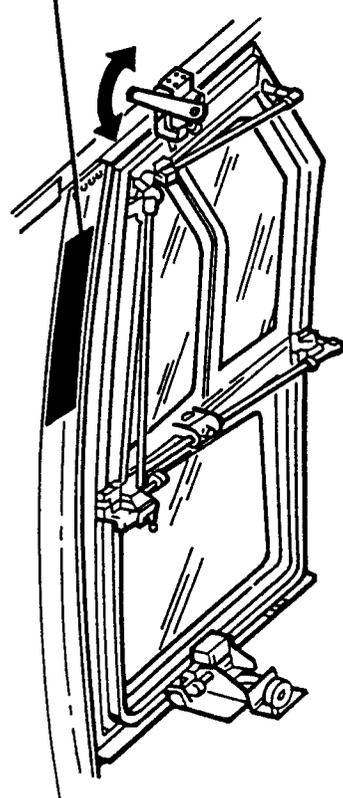
TURN HANDLE UP
LIFT DOOR

EMERGENCY EXIT
PULL STRAP OUT
PUSH WINDOW OUT



ALTERNATE ESCAPE EXIT
PULL STRAP OUT
PUSH WINDOW OUT
(TYPICAL 9 CABIN WINDOWS)

EMERG EXIT
TURN HANDLE ←



DOOR JETTISON
PUSH TRIGGER
TURN HANDLE DOWN ↓

EMERGENCY EXIT
PULL STRAP OUT
PUSH PANEL

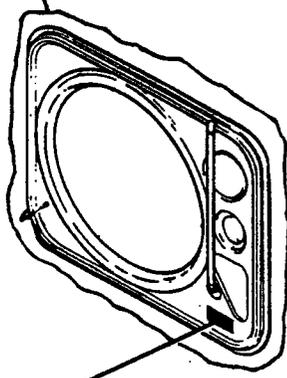


Figure 34. CH-47 cockpit and cabin emergency exits.

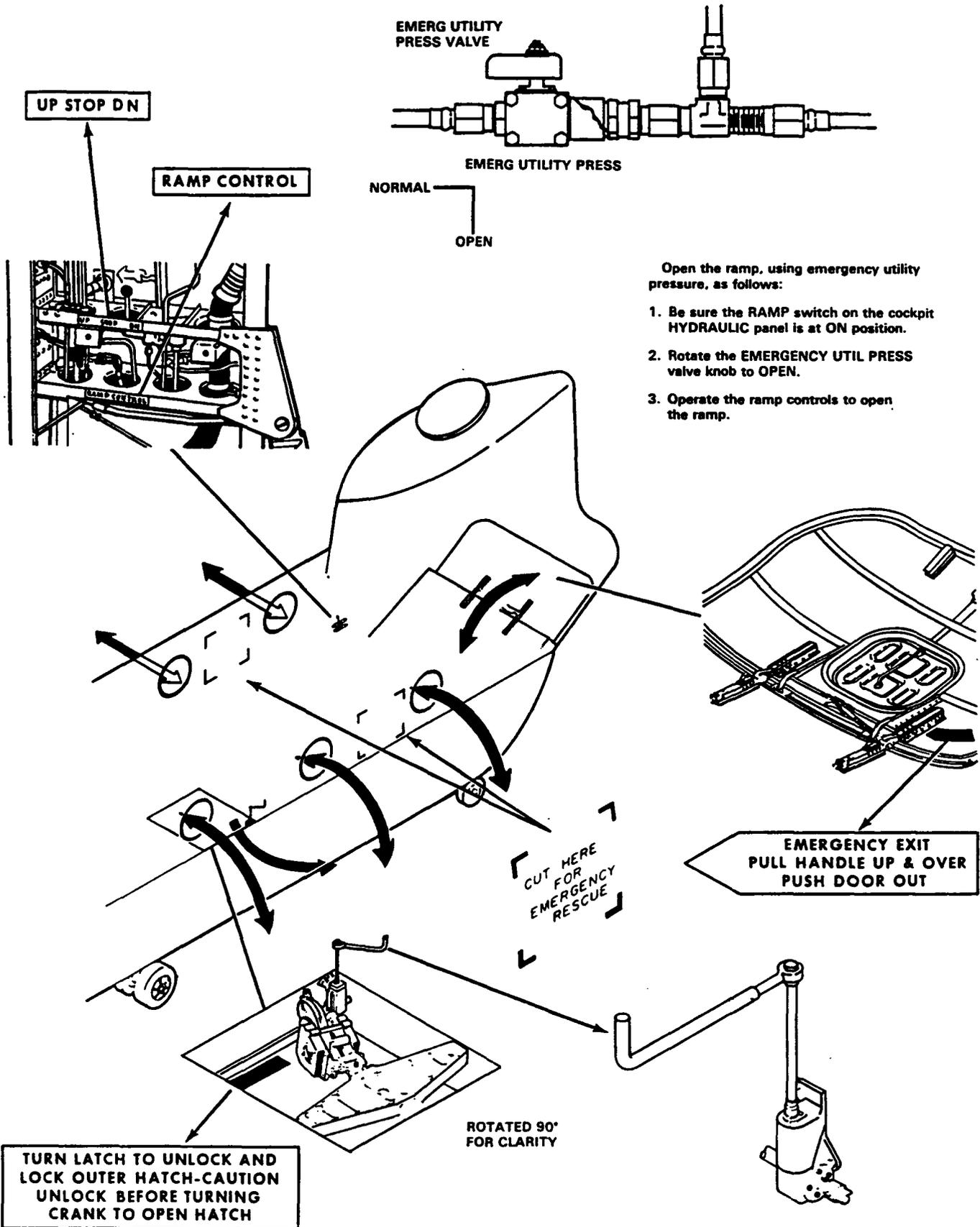


Figure 35. CH-47 cabin area and ramp emergency exits.

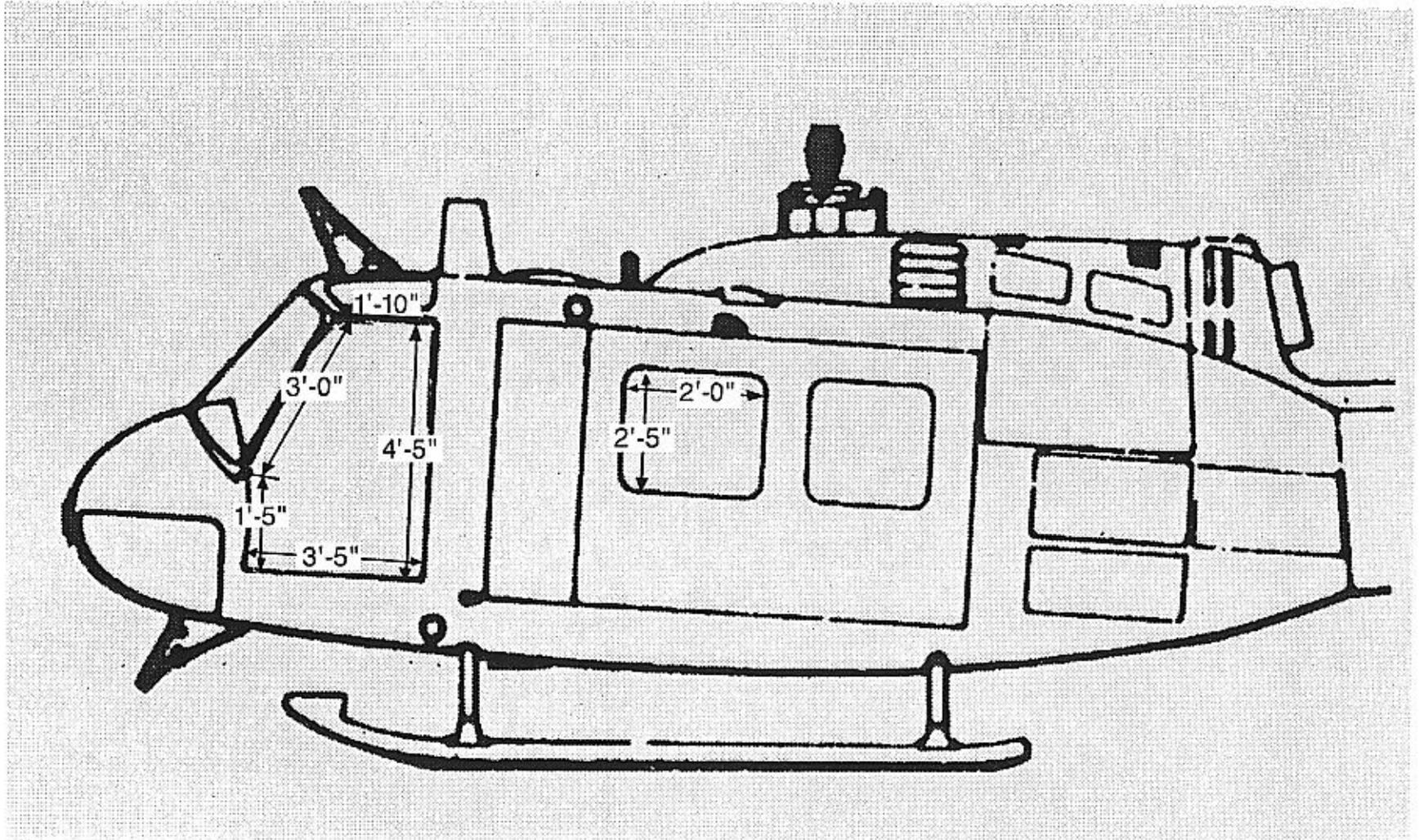


Figure 36. UH-1 Huey schematic showing dimensions of egress areas.

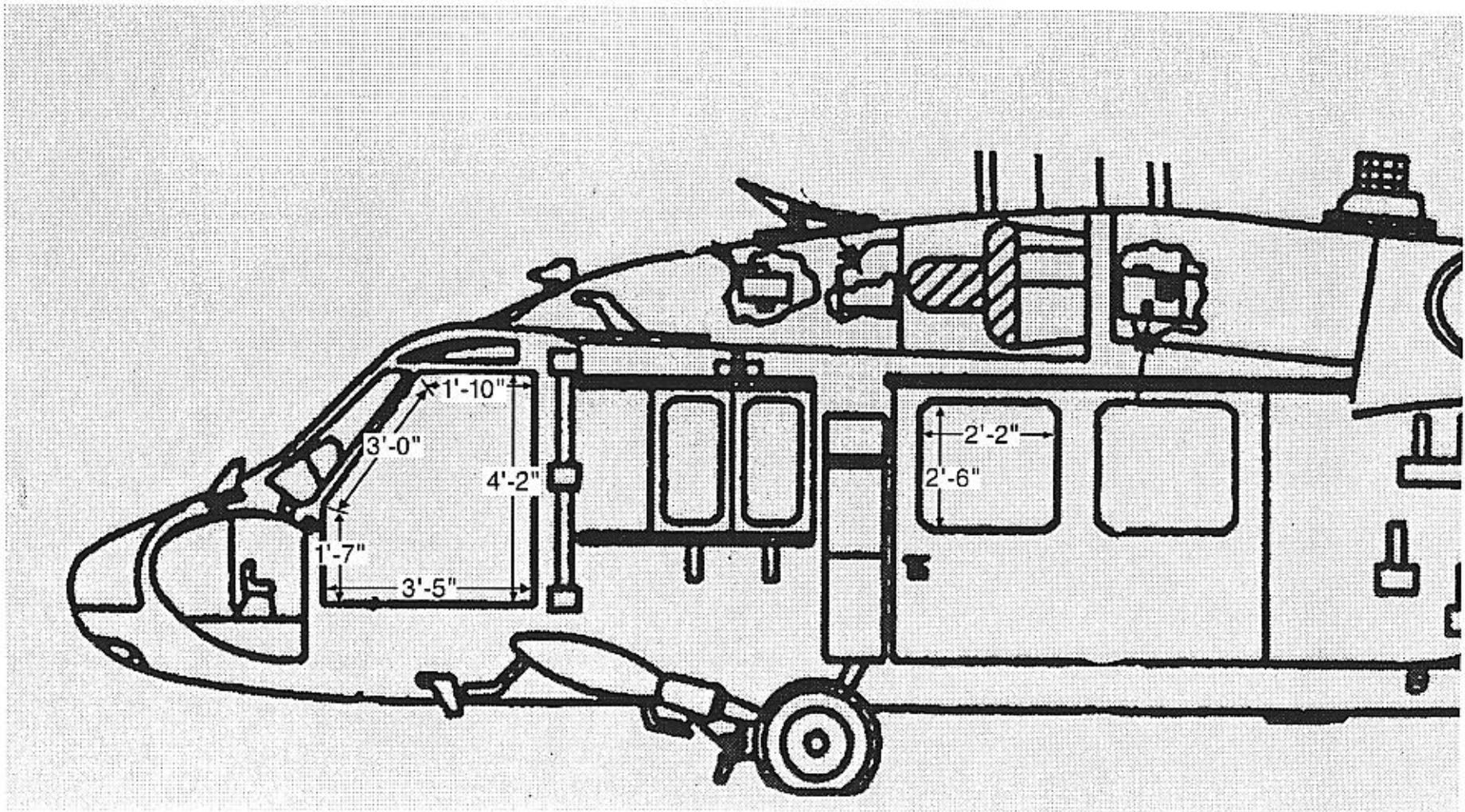


Figure 37. UH-60 Black Hawk schematic showing dimensions of egress areas.

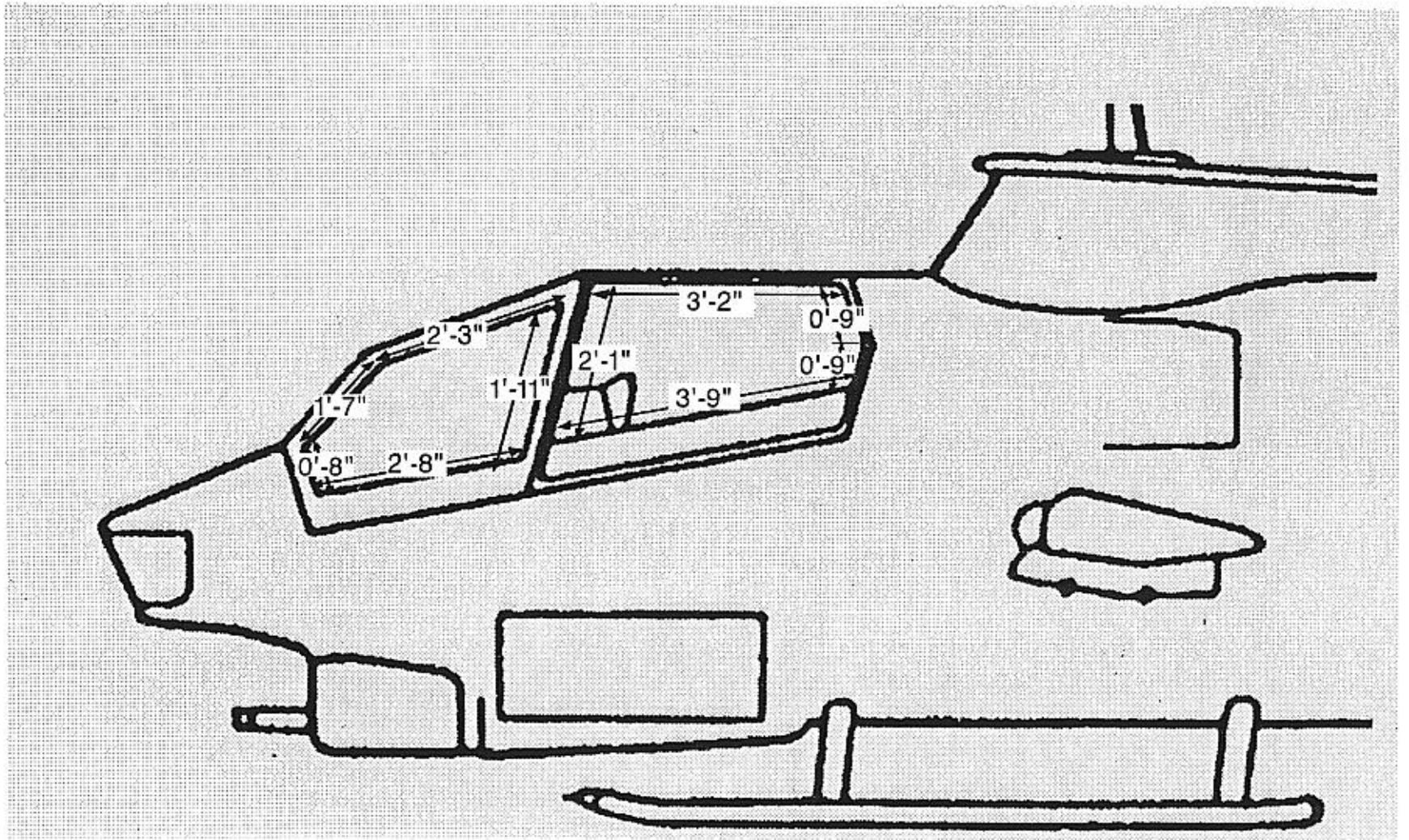


Figure 38. AH-1 Cobra schematic showing dimensions of egress areas.

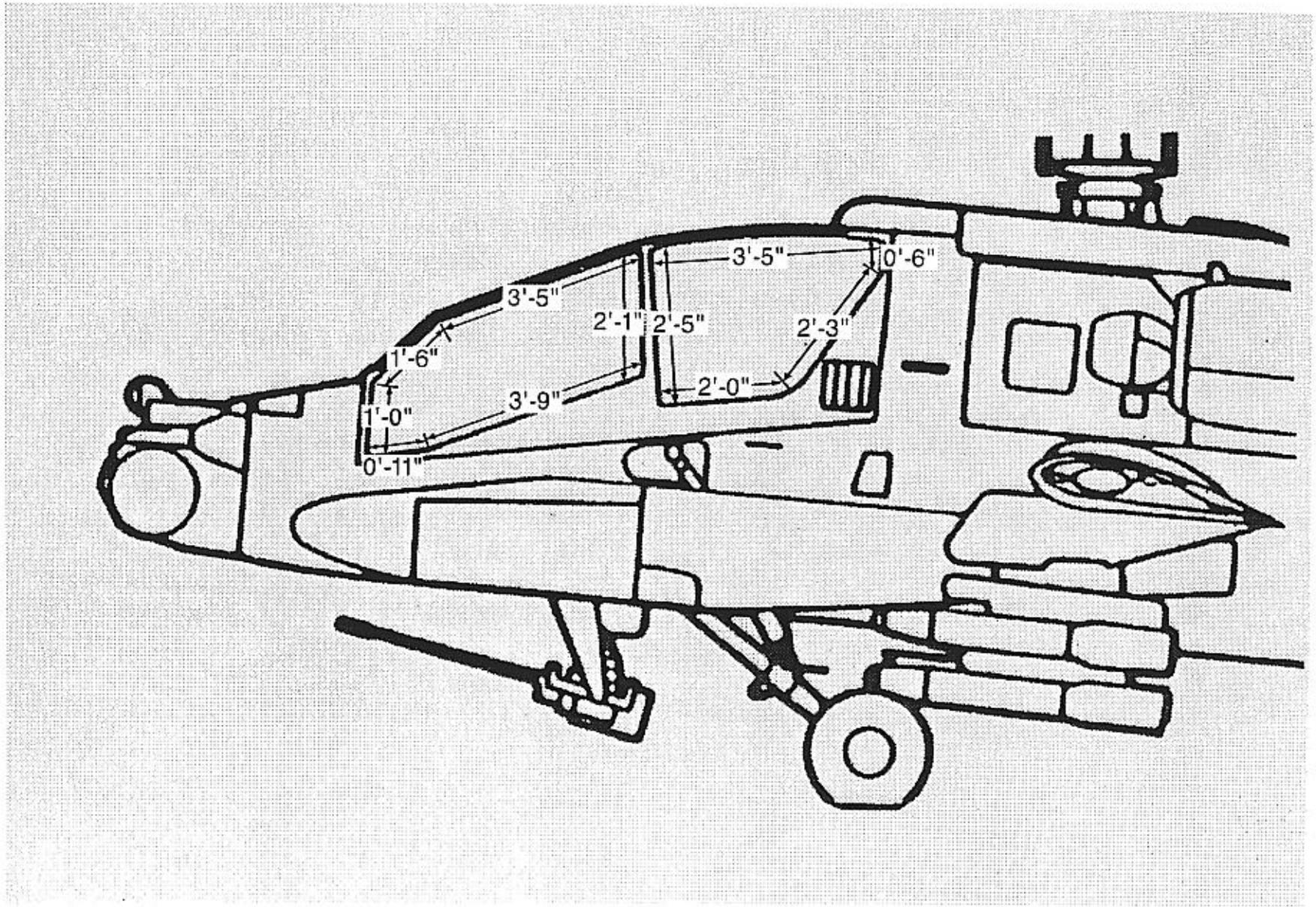


Figure 39. AH-64 Apache schematic showing dimensions of egress areas.

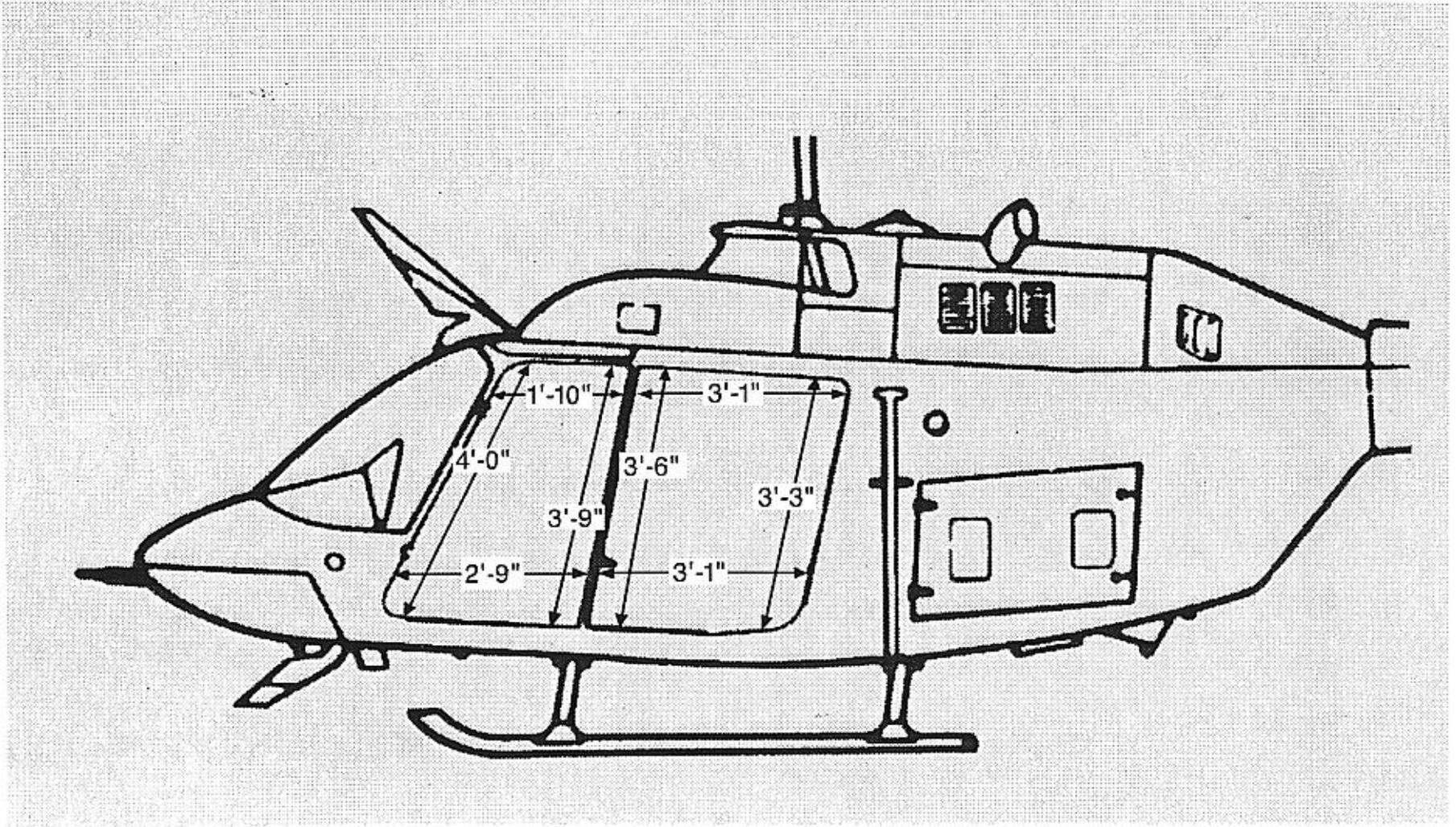


Figure 40. OH-58 Kiowa schematic showing dimensions of egress areas.

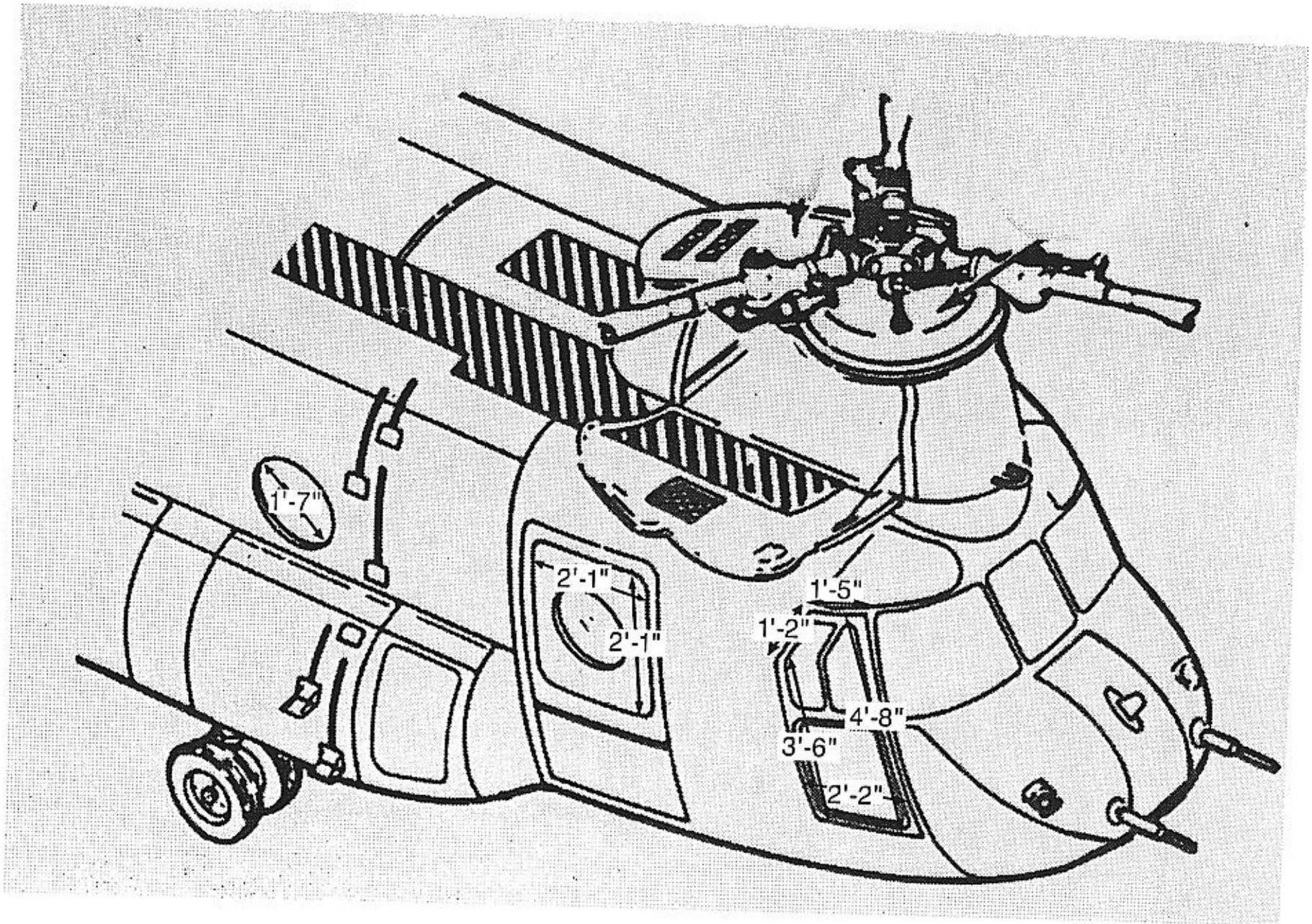


Figure 41. CH-47 Chinook schematic showing dimensions of egress areas.