Source: Aviation, Space, and Environmental Medicine
1997, VOL 68; NUMBER 9; NUMBER 1, pages 844-857

Helicopter Door and Window Jettison Mechanisms For Underwater Escape: Ergonomic Confusion!

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There are 23 different door, hatch, and window release mechanisms identified in 35 types of helicopters that earn their living over water.

There is no standardization of the mechanism within each cockpit or among helicopter types, nor is there any standardization of the location relative to the operation, whether the mechanism matches the task or in which direction the door/hatch/window is jettisoned. New regulations are needed by military and civilian authorities to address the ergonomic confusion.

THE MORTALITY RATE worldwide across civilian and military helicopter accidents flying over water ranges from 25-35% (1, 3, 5, 9, 13). The dangers of escape from a ditched, rapidly sinking helicopter have already been reviewed (7, 8), and Allan et al. (2) investigated the size of emergency exits for underwater escape from rotorcraft. However, these authors argue that one of the principle causes of death is that passengers and crew have difficulty locating the jettison mechanism and, if they do find it, they experience confusion and difficulty operating it. This hypothesis has recently been supported by Barker and Bellenkes in their review of U.S. Naval helicopter mishaps (4).

They found that there was significant difficulty opening and jettisoning hatches, particularly in the H-60 and H-3 helicopters. The problem is compounded by being inverted, underwater, in semi-darkness, hampered by equipment, and possibly being injured. In 1993, Brooks et al. (6) conducted an experiment to examine the ability of a person to locate and operate a jettison mechanism. There were 48 Canadian aircrew who conducted a series of escapes in a Survival Systems' Modular Egress Training Simulator with all the doors, windows and hatches in place. The emergency exit components were replicas of, and were operated like, the four Canadian Air Force helicopters then in service.

During the experiment, it was noted that the helicopter escape route appeared to have been designed for emergency ground egress and not for underwater egress. There was no standardization of the door, hatch, window, or escape route, and little thought had been given to the design of the jettison mechanism, or whether the door, hatch or window should pull in or push out. In addition, many levers did not match the task, i.e., they did not depart the helicopter with the door after jettison as would be expected, and many levers would not work in either direction; therefore, many rotation errors were noted during the escape sequence. The recommendation from this experiment was that a more in-depth study of helicopters operating over water worldwide should be conducted to examine the whole fleet problem. This has now been completed and is reported in this paper.

METHOD

Over a period of 24 mo, the doors, hatches, windows and escape mechanisms of 35 military and civilian helicopters were examined directly or through published review. Whenever possible, the mechanisms were physically handled and operated; when this was not possible, they were examined from: a) photographs; b) references in the Aircraft Operating Instructions; c) the Boarding Card or a training video; d) a new U.S. Army report on helicopter egress (14); or e) a preliminary draft of a U.S. Navy report on helicopter crashworthiness (12). The helicopters were deliberately chosen because their task was specifically to fly over water. Because there are significant differences between the military and civilian versions of the Sikorsky/Westlands Sea King/S-61 and the Boeing Chinook H-46, H-47 and Chinook 234, they were reviewed as separate helicopters. The Canadian Labrador

Helicopter has similar doors, .windows and hatches to the Boeing CH-46 and they have been grouped together. Similarly, the Aerospatiale AS-365 has been grouped with the U.S. Coast Guard H-65 version, and the Bell OH-57, -58 and Canadian Kiowa have been grouped together. The helicopters are listed below:

Wessex	
Wasp	OH-57
Scout	OH-58
Lynx Kaman	SH-2
Alouette II	Sea King SH-3
Alouette III	S-61
Super Frelon	S-76
Super Puma	UH-60 Black Hawk
RAF Puma	SH-60 (USN and USeC)
USGCH-65	CH-53
AS-365	Labrador
BO-105	H-46 Chinook
Bell 206B	CH-47 Chinook
Bell 206L	Boeing 234 Chinook
Bell 214ST	AH-1 Cobra
Bell 412	AH-64 Apache
Bell UH-1 Huey	MI-24
Kiowa	EH-101

The doors, hatches and windows were categorized into three groups: a) all pilot doors or windows; b) all doors aft of the pilot's door used for general access by military and/or civilian personnel, for cargo or for hoisting; and c) all other escape hatches or windows that were designed for emergency escape only.

Each door, hatch, or window was then identified as to whether it pulled inboard or was pushed out or, as in one case, first pulled half-way in and then pushed out. The operating mechanism was categorized by shape if denoted by a lever and by length if denoted by a tab or a tape. The direction of mechanical operation (i.e., rotate, pivot, push, pull, or, in some cases, rotate and pull or rotate and push) were listed.

The relation of the lever to the seated position of the person required to operate it was noted; whether it departed the helicopter with the door or window, or whether it remained on the fuselage, was also recorded. The objective was to identify both good and poor systems and to give advice to helicopter manufacturers on which type(s) to standardize.

RESULTS

The jettison mechanisms of 35 helicopter pilot doors, 29 helicopter passenger/cargo/ main access doors and 27 emergency windows and escape hatches were examined. For the sake of space and clarity, only the starboard side will be described unless it was found that the port side equivalent is significantly different in position and operation, or if there is only one sliding door or airstairs on the port side. For the three attack helicopters (AH-l, AH64 and Mi-24) both forward (co-pilot! gunner) and aft cockpit (pilot) will be discussed.

Overall, 23 different mechanisms for clearing the path for escape through a door, hatch or window were identified. A brief description is included with each illustration in Fig. 1. The illustrations show typical examples of each category. In several cases the mechanism is protected by a cap, but some mechanisms are doubly protected with the addition of a button or a witness wire. These cases are identified and discussed later in the paper. *Pilots' Doors and Windows*

There are 11 different mechanisms for pilot doors and windows. Each is listed in **Table I** and illustrated in order from left to right and from top to bottom in Fig. 2. The manner and order of discussion is similar for all categories of mechanisms. The numerical designator for each mechanism identified in Fig. 1 is shown in the bottom left hand corner of each block. All doors and windows pushed out; none pulled in.

There were a greater number of levers that remained fixed to the fuselage and did not depart the helicopter when the door or window was jettisoned (24 compared to 11 cases). In the three attack helicopters, the mechanism triggered a system that caused the canopy to be blown off ballistically, shattered by a line charge or caused the retaining pins to be blown off. The lever itself still remained inside the cockpit.

The mechanisms operated from a wide range of physical positions, but predominantly from a mid-chest and lower chest seated position relative to the operator (13 and 12 cases, respectively). Nine mechanisms operated from shoulder or above shoulder level, two at knee level, and one from behind the hip. The Super Frelon and AH1 were included twice in these figures because they were in different positions for the pilot (behind left shoulder) and co-pilot (at right knee).

The specific mechanisms and direction of operation are listed in Fig. 2. The most common type with 12 examples is the plain lever with knob that rotates in line with the fuselage (Mechanism 5), followed by five each of the truncated shaped lever (Mechanism 4) and the compound L-shaped bar with knurled handle/knob (Mechanism 10). There are three types of the T-bar that pulled back (Mechanism 14) and two each of a release wire suspended along the length of the forward door jamb (Mechanism 22), a spoon shaped lever that pulled up and aft from the spoon end of the lever (Mechanism 7), and an automobile door type lever (Mechanism 3). Finally, there is one each of a T-bar that requires rotation and pulling out (Mechanism 15), a T-bar that requires rotation and pushing in (Mechanism 16), a ring handle that requires rotation (Mechanism 17), and a compound L-shaped bar that slides up and back parallel to the window sill (Mechanism 8).

Doors, Airstairs & Access/Cargo Doors Aft of the Pilot's Doors

There are 12 different mechanisms on the 29 doors examined. These are listed in Table II and illustrated in Fig. 3. Of the 30 levers, 24 departed the helicopter with the door. Again there is a wide variability in the positioning of the lever relative to the operator. In 13 cases, it is at lower chest height; 8 cases at shoulder height; 7 cases at mid-chest height and, in 1 case, at foot level. Four mechanisms are capped, two are witness wired and, in two doors, it is necessary to operate two levers simultaneously to jettison the door. The doors all push out except in the UH-l/Huey and the CH53, it pulls in, in the CH46 it rolls up into the roof of the helicopter, and in the Scout it remains open on its hinges.

The most common mechanism fitted (with nine examples) was the plain parallel shaped lever which rotated in line with the fuselage (Mechanism 1) followed by five examples of the truncated shaped lever (Mechanism 4), four examples of the plain lever with knob rotating in line with the fuselage (Mechanism 5), three examples of the compound L-shaped bar (Mechanism 8), and two examples of *the automobile* type door handle (Mechanism 3). There are seven other mechanisms represented by one example each-a vertical plastic coated wire, which pulls aft

(Mechanism 22), a chain link fitted horizontally across the hatch (Mechanism 21), a hollow triangular rod (Mechanism 10), a ring handle (Mechanism 17), a plain lever with cranked end (Mechanism 3), a plain lever with knob that pivot up (lifted out) at right angles to the fuselage (Mechanism 6) and a plain rectangular shaped lever that lifted at right angles to the fuselage (Mechanism 11).

Emergency Windows and Hatches

In the 27 different hatches and windows examined, there are nine different mechanisms. These are listed in Table **III** and illustrated in Fig. 4.

In 11 cases, the most frequently chosen type of mechanism is a hatch or window seal removal mechanism which, once activated, allows the hatch or window to become free. This group is made up of eight examples of a short pull tab or tag (Mechanism 19), two examples of a pull tab/tag with a long tape (Mechanism 18), and one example of a lanyard with a buckle on the end of it (Mechanism 20).

There are six examples of the plain parallel-shaped lever that rotates in line with the fuselage (Mechanism 1), five examples of the plain push out window (Mechanism 23), three examples of the rectangular shaped bar or plain lever that lifted at right angles to the door or window (Mechanism 11), and one example each of the forged plate with center rod for gripping (Mechanism 9), a D-shaped rod (Mechanism 12), and a plain lever with knob(Mechanism 5).

DISCUSSION

There were 35 helicopter pilots' door jettison mechanisms examined and, where possible, the associated doors or access hatches and emergency windows aft of the pilot were also examined. There are 23 types of jettison mechanisms on them and the arc of rotation or direction of pull is highly variable.

For the pilots' doors there are 11 different types of levers. The majority operated in line with the fuselage, but the EH-10l, UH-60 and Mi-24 pivot out at right angles potentially increasing the chance of snagging; and the Bell series of 214/412/UH-1 have a T-bar that pulls straight aft from the lateral edge of the dashboard. Unique to the AH-1 and AH-64 is a T-bar which requires two actions: the first to arm the device and the second to jettison the canopy. In the AH-l gunner's position, the lever rotates counter-clockwise with the left hand to arm and pulls aft to fire. In the pilot's position the lever rotates counter-clockwise with the right hand to arm and pulls up to fire. In the AH-64, the lever is situated in the same place for gunner and pilot, it can be rotated in either direction for arming, but pushes in for firing.

Except in the cases of the Canadian Labrador, CH-46 and AH-64, all the levers operate in one direction only, thus making them potentially prone to reversal errors by the operator. The final 12 o'clock position of the lever on the lower sill in the Sea King, 5-61 and 5-76 create a potential snagging problem (6). In only the case of the Super Puma was the lever protected by a cap.

In 70% of cases the lever does not match the task and does not depart the helicopter with the door. The position of the lever is quite inconsistent; it ranges from above the shoulder to behind the hip. The Super Frelon is unique because the lever is located in entirely different positions in pilot and co-pilot seats. The only consistency is that all the pilot doors and windows jettison outboard.

For the doors, airstairs and access hatches aft of the pilots' doors, there are 12 different mechanisms. Again, the majority of levers rotate in line with the fuselage, but the ones on the 5-76, Wasp, Boeing 234, and the top lever of the Mi-24 pivot at right angles to the fuselage. In a complete reversal to the findings in the pilot's doors, 80% of the levers depart the helicopter with the door. Positioning of the levers was inconsistent and the AS365

N is the only helicopter to have a lever mounted on the floor. This was witnessed wired as is the hatch and airstairs lever in the EH-1O1. There are three helicopters that have a protective cap over the lever (RAF Puma, Super Puma and 5-76).

For the emergency windows and hatches, the predominant method (40%) of jettison is by removal of the seal between the glass and the fuselage frame. The position of the short tab is inconsistent; i.e., it can be installed on the same helicopter in three different positions as in the case of the CH-53. Where levers are used, six operate by lifting up at right angles to the fuselage, five operate in line with the fuselage, and the one in the ramp of the Boeing 234 rotates in line with the hatch. The windows of the CH-53 and SH-60 pull in, the hatch in the CH-53 pulls in, and the emergency windows in the EH-1O1 first pull in and then push out. All the remainders push out. In 15 cases, the lever or tape does not depart the helicopter with the hatch/window.

For a hatch that is used in an emergency, the least number of operations should be necessary to release it. This is not the case in the Wessex, Super Puma, 5-61, and CH-53, where two actions are needed; in the case of the 5-76 three actions are needed; or the Chinook 234 where access to the rear hatch is only gained by opening an intermediate door!

Reviewing the shape of the mechanical levers for all doors, hatches, and windows, there is again considerable variation. It is not easy to insert the index and middle finger behind the T-bar with a wet gloved hand. The ring handle is equally difficult to grasp, either with a whole hand or to slip a finger through the loop, and the various L-shaped bars with or without knurled handles are not easy to grasp. The glove slips off a parallel-shaped lever and a truncated shaped lever, and it is hard to locate, insert the fingers inside and pull the triangular-shaped rod. Adding a protective cap and, in one case, a protective button as well, only adds to the escapee's confusion. Ability to visually locate a door, hatch, or window mechanism underwater is very difficult. It must function more by touch than vision. Therefore, the lever must work in either direction from a central detent. The best example of a lever that worked well was the plain shape with a knob (Mechanism 4) that rotated in line with the fuselage. This provides the least chance for the hand to slip off the end, but it must be designed to function with rotation in either direction and its final position should not snag the escapee.

These results confirm our hypothesis of no standardization in the type of jettison mechanism, the position of the mechanism in relation to the human body (either when seated normally or in the extreme condition of being inverted under water with poor illumination); nor has there been standardization of whether the door, hatch, or window should pull in or push out. Indeed, in one case the window must first be pulled in and then pushed out! Not only has there been no standardization among helicopter manufacturers, but there has been no standardization within each helicopter manufacturer or even on a single helicopter. Moreover, little or no progress has been made in recent years to ameliorate these concerns. We note that an old design of helicopter has at least three mechanisms; whereas a new design has four mechanisms!

Helicopter designers have not realized that a mechanism for emergency ground egress is not necessarily acceptable for underwater egress. The regulations are nonspecific and leave a lot of leeway for interpretation by the manufacturers. For instance, the Federal Aviation Administration regulation (11) for an emergency exit states it ''be readily accessible, require no exceptional agility of a person using it, and be located so as to allow ready use, without crowding, in any probable attitudes that may result from a crash; have a simple and obvious method of opening and be arranged and marked so as to be readily located and operated, even in darkness; doors and hatches shall be quick-opening, easily operated, and have a standard mode of latch-handle operation throughout the vehicle; and this operation should be possible using either hand and shall require no more than two distinct and different motions." (11; Section 27.807)

The U.S. Air Force military specification for aircraft emergency escape (15) is non-specific in some areas and more specific in others. For instance, the requirement for exit actuation states that the direction of the release lever rotation "should be obvious and natural to the operator" (nothing is obvious and natural to an inverted, submerged human). It specifies that the lever should be T or L-shaped with stops to prevent rotation in the wrong direction (to avoid a reversal error the lever should be able to rotate in either direction). It denies witness wiring but "does not preclude the use of an easily removable, non-tampering, non-jamming protection cover." (15; Paragraph f)

The Civil Aviation Authority notice (10) on helicopter emergency escape facilities is equally non-specific. It states that "the means of opening an escape window should be rapid and obvious." (10; Paragraph 2.1)

None of the standards mention that all the doors, hatches, and windows should push out or that there should be a common system throughout the helicopter. Post crash, the survivor may be injured, submerged in cold water, totally disorientated, and near to death from drowning. In our opinion, a basis for a standard must be that the jettison mechanism is simple; there should be no doubt about how it operates and it should not be open to reversal errors. It should be easily accessible, requiring no reach by the pilot or a passenger, be easy to grasp with a wet gloved hand, and most important, there should be no difficulty in locating it. It should not be protected by a cap. The operation of the mechanism should match the task and there should be positive feedback that the door, hatch, or window has been jettisoned. There should be no confusion about which way the hatch should be jettisoned, all should push out. Finally, on all doors (e.g., pilots', cargo, airstairs, etc.) the mechanism should work from the same principle and be located in the same place. Similarly for all emergency hatches or windows, the mechanism should be standard in position and method of operation and work on the same principle as the one on the doors and hatches.

This study has shown that a lot of progress will have to be made. The first step is to revise the regulations and standards; the second step is to encourage helicopter design engineers to undergo a helicopter underwater escape training course to familiarize themselves with the gravity of the problem; and third, commence to redesign the jettison mechanisms of doors, hatches, and windows on helicopters.

CONCLUSIONS AND RECOMMENDATIONS

The door, hatch, or window mechanism was examined on 35 different helicopters that earn their living flying over water. Neither within each cockpit nor among helicopter types is there any standardization of the mechanism, of the position relative to the operator, whether the operating mechanism matches the task, or whether the door, hatch, or window is jettisoned outboard or pulled inboard.

Only two mechanisms are required: a common one that fits all doors whether they be pilots' doors or passenger / cargo doors aft of the pilot, and a second one that works on the same principal for emergency hatches and windows. A basis for a standard is described in the discussion section. Finally, regulatory bodies should revise their standards to reflect these findings.

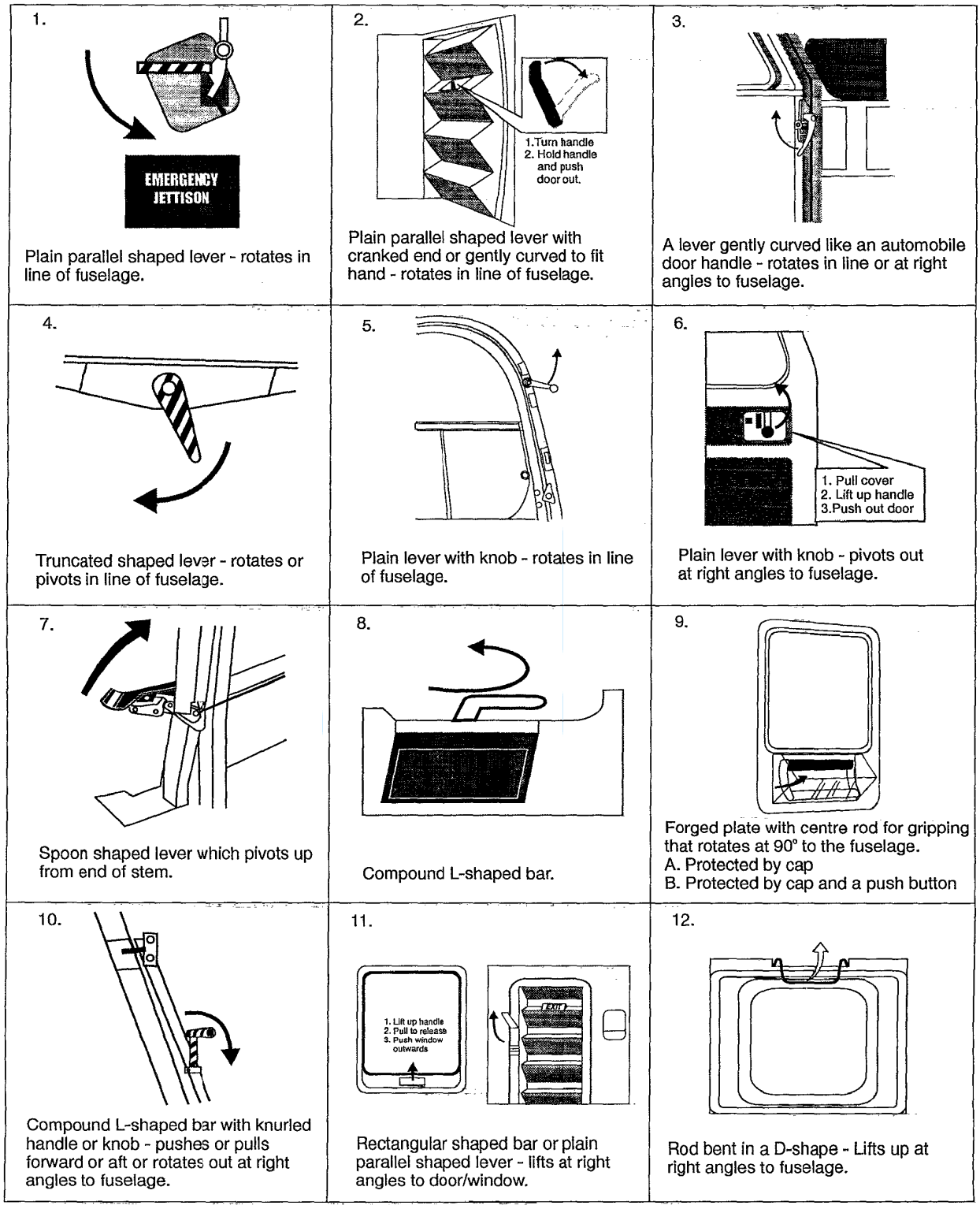
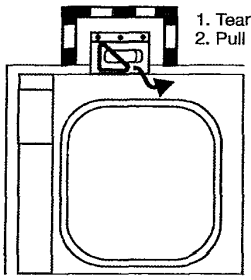


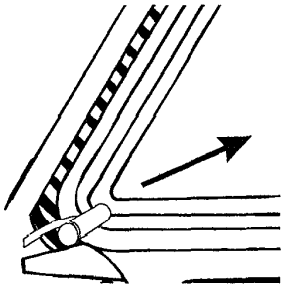
Fig. 1. A line drawing of a typical example of each of the 23 jettison mechanisms with description of how each one operates.

13.



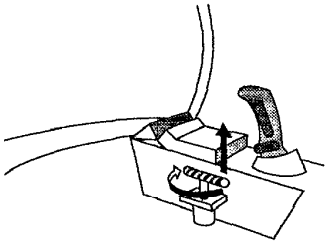
Rod bent in a hollow triangular shape - pulls at right angles to door/window.

14.



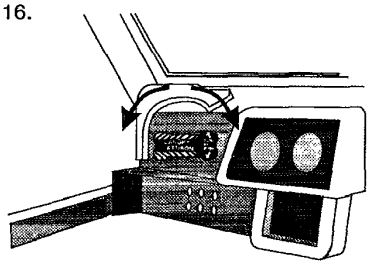
T-bar shape - pulls aft

15.



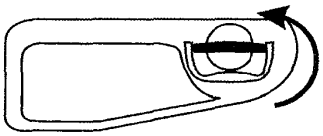
T-handle - has double action, rotation through 90° and pulls up or pulls aft.

16.



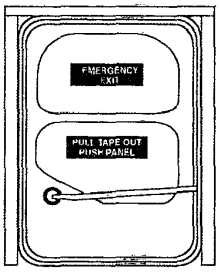
T-handle - has double action, rotation through 90° and pushes forward or in.

17.



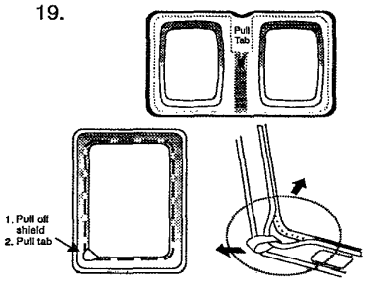
Ring handle - rotates in line of fuselage.

18.



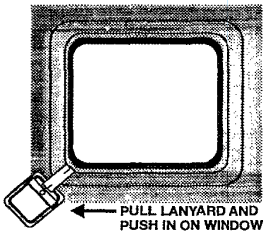
Long tape or strap - pulls at right angles to window/door and pulls out window seal.

19.



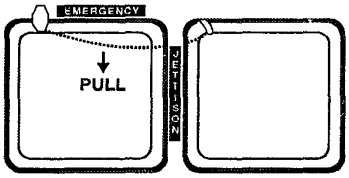
Short tab/tag or plastic plate - pulls out at right angles to door/window and pulls out window seal.

20.



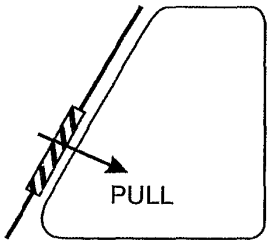
Lanyard with buckle - pulls at right angles to door/window and pulls out window seal.

21.



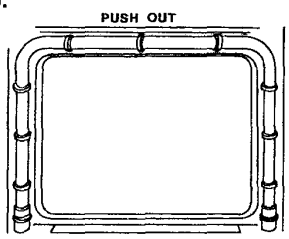
Chain link fitted horizontally across the hatch - operates by pulling down.

22.



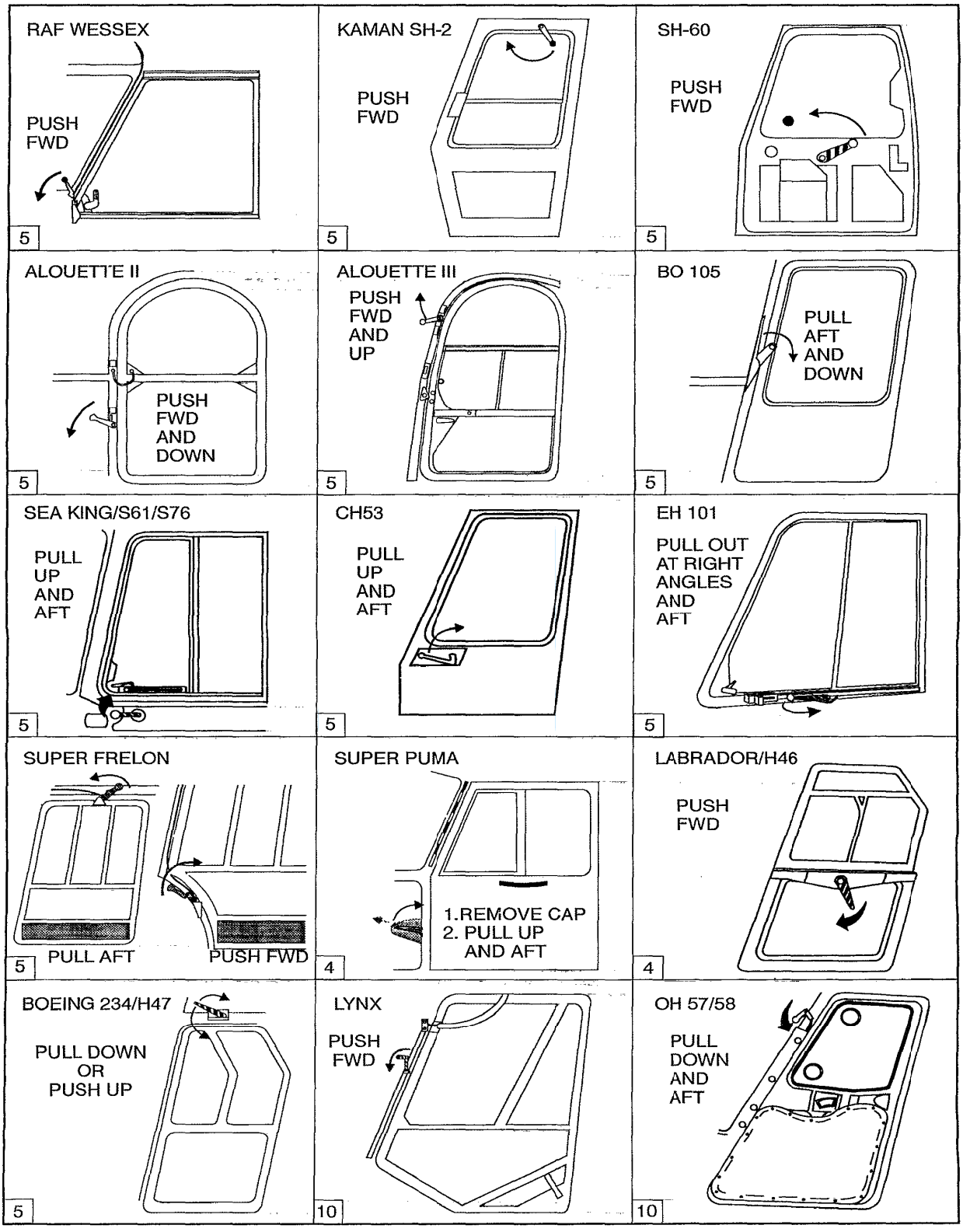
Vertical Wire - plastic covered - pulls aft.

23.



No mechanism, simple push out, there may or may not be an indicated position to push from.

Fig. 1. Continued.



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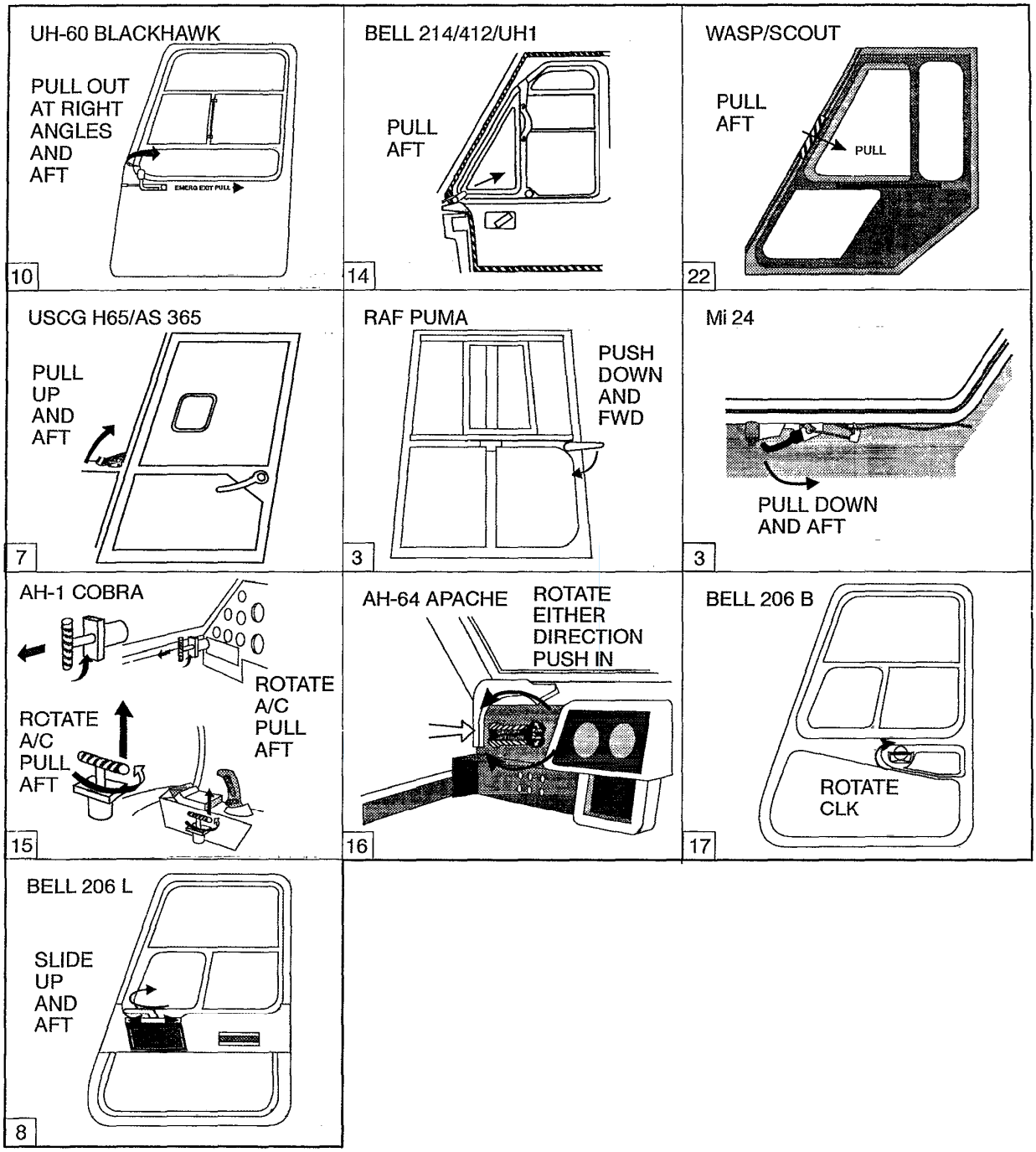

Fig. 2. A line drawing of each pilot door showing jettison mechanism and direction of operation. The type of mechanism is depicted in the box in the left-hand corner of each illustration.

HELICOPTER DOOR & WINDOW JETTISON MECHANISM—BROOKS & BOHEMIER

TABLE I. HELICOPTER PILOT DOORS.

Helo Type	Mechanism	Direction Of Operation	Goes With Door (Y/N)	Height	Door (In/Out)	Comments
Wessex	5	Pushes fwd; rotates clk 10-12	N	Mid chest	O	
Wasp	22	Pulls aft	N	Mid chest	O	
Scout	22	Pulls aft	N	Mid chest	O	
Lynx	10	Push fwd; rotates ac 12-9	N	Mid chest	O	
Alouette II	5	Push fwd and down; rotates ac 10-7	N	Mid chest	O	
Alouette III	5	Push fwd and up; rotates clk 9-12	N	Shoulder	O	
Super Frelon	5	Pulls aft; rotates clk 10-12	N	Right knee	O	Different in left and right seat
		Pulls fwd; rotates clk 10-2		Left Shoulder	O	
Super Puma	4	Pull up and aft; rotates clk 9-12	N	Knee	O	Capped
RAF Puma	3	Pushes down; rotates clk 3-6	Y	Behind hip	O	
USCG H-65	7	Pulls up and aft	N	Lower chest	O	
AS-365	7		N		O	
BO-105	5	Pushes fwd and down; rotates ac 11-9	N	Mid chest	O	
Bell 206B	17	Rotates ac	Y	Lower chest	O	
Bell 206L	8	Slides horiz aft	Y	Mid chest	O	
Bell 214ST	14	Pulls aft	N	Mid chest	O	
Bell 412	14	Pulls aft	N	Mid chest	O	
Bell UH-1 Huey	14	Pulls aft	N	Mid chest	O	
OH-57	10	Pulls down and aft	N	Shoulder	O	
OH-58	10		N		O	
Kiowa	10		N		O	
Kaman SH-2	5	Pushes fwd; rotates clk 5-7	Y	Above shoulder	O	
Sea King SH-3	5	Pulls up and aft; rotates clk 9-12	N	Lower chest	O	
S-61	5	Pulls up and aft; rotates clk 9-12	N	Lower chest	O	
S-76	5	Pulls up and aft; rotates clk 9-12	N	Lower chest	O	
UH-60	10	Pulls back rotates aft at 90° to door	Y	Lower chest	O	
SH-60	5	Pushes fwd; rotates ac 2-10	N	Lower chest	O	
CH-53	5	Pulls up and aft; rotates clk 9-12	Y	Lower chest	O	
Labrador	4	Pushes fwd; rotates clk 5-7	Y	Lower chest	O	
H-46	4	Pushes fwd; rotates clk 7-9	Y		O	
H-47	4	Pushes up or pulls down; rotates either way	Y	Above shoulder	O	Lever can rotate either way
Chinook 234	4	Pushes up or pulls down; rotates either way	Y	Above shoulder	O	Lever can rotate either way
AH-1 Cobra	15	Rotates ac and pulls up for gunner but pulls aft for pilot	N	Lower chest rhs for gunner; Mid-chest lhs for pilot	O	
AH-64 Apache	16	Rotates either way and pushes in	N	Mid chest	O	In same relative position for gunner and pilot
Mi-24	3	Pulls up; rotates clk 9-12	N	Shoulder	O	Same for pilot and co-pilot
EH-101	5	Pulls out and aft 90° angles to fuselage	Y	Mid chest	O	

fwd = forward; ac = counter clockwise; clk = clockwise; rhs = right-hand side; lhs = left hand side.

TABLE II. ALL DOORS AND ACCESS HATCHES AFT OF THE PILOT'S DOORS.

Helo Type	Mechanism	Operates	Goes With Door (Y/N)	Height	Door (In/Out)	Comments
Wessex	8	Pushes down; rotates clk 1-4	Y	Above right shoulder	O	
Wasp	1	Pulls aft rotates ac 9-6	Y	Above left shoulder	O	
	22		N	Shoulder	O	
Scout	3	Rotates up 6-9 at 90° to fuselage	N	Lower chest	O	Door is hinged and does not fall free
Lynx	21	Pulls down; rotates fwd clk 5-7	Y	Shoulder	O	
	1		Y	Lower chest	O	
Super Puma	1	Pulls down; rotates clk 4-6	Y	Mid chest	O	
	10	Pull down	N	Above shoulder	O	Capped
RAF Puma	1	Pulls down; rotates clk 3-6	Y	Lower chest	O	Capped
USCG H-65	4	Pushes fwd; rotates clk 3-6	Y	Lower chest	O	This is sliding door on lhs similar on rhs hinged
AS-365	5	Pulls back; rotates ac 2-12	Y	Foot level	O	door witness wired
BO-105	1	Pushes up; rotates ac 3-12	Y	Lower chest	O	
Bell 206B	17	Rotates clk 9-12	Y	Lower chest	O	
Bell 206L	8	Slides aft	Y	Lower chest	O	
Bell 214 ST	4	Pulls up; rotates clk 9-12	Y	Lower chest	O	
Bell UH-1/ Huey	8	Lifts up and pulls aft	Y	Mid chest	I	
OH-57/OH-58	4	Pushes fwd; rotates ac 12-9	N	Shoulder	O	
Kaman SH-2	5	Pushes fwd; rotates clk 6-9	Y	Shoulder	O	
Sea King/SH-3	5	Pulls aft; rotates clk 3-6	Y	Above shoulder	O	
	4	Pulls aft; rotates ac 7-5	Y	Lower chest	O	
S-61	2	Pushes fwd; rotates clk 10-2	Y	Mid chest	O	Airstairs
S-76	6	Lifts up; pivots 90°	Y	Lower chest	O	Capped
UH-60	1	Either pushes or pulls (rotates) depending on seating position	Y	Lower chest	O	Under back window on rhs. Under front window on lhs. Both capped
CH-53	4 and 1	Two actions; rotates clk 4-6; rotates ac 3-12	Y	Mid chest		Two lever action
				Shoulder		
H-46	5	Pushes up and fwd; rotates ac 3-6	Y	Mid chest	Rolls up Does not jettison	
Chinook 234	11	Pivots/lifts up at 90°	Y	Mid chest	O	Airstairs
Mi-24	3 and 3	Rotates out and fwd at 90°	Y	Lower chest	O	Two lever action and locking button on lower one
		Rotates aft at 6-3	Y			
EH-101	1	Pulls down; rotates ac 10-7	Y	Lower chest		Witness wired
	1	Pulls down; rotates clk 3-6	N	Mid chest		Airstairs

Legend same as Table I.

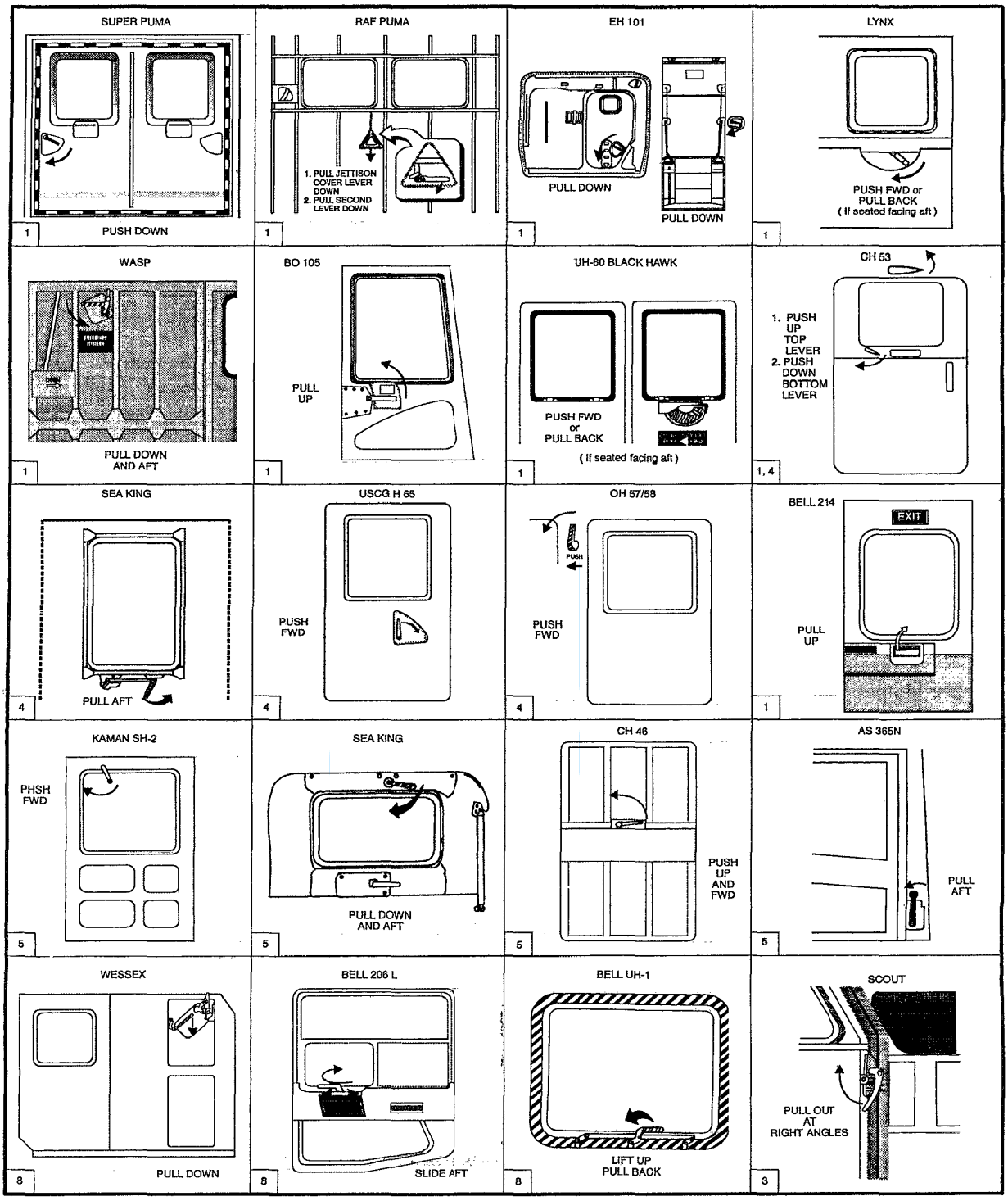

Fig. 3. A line drawing of each door, airstairs and access door aft of pilot's door showing the jettison mechanism and direction of operation. The type of mechanism is depicted in the box in the left-hand corner of each illustration.

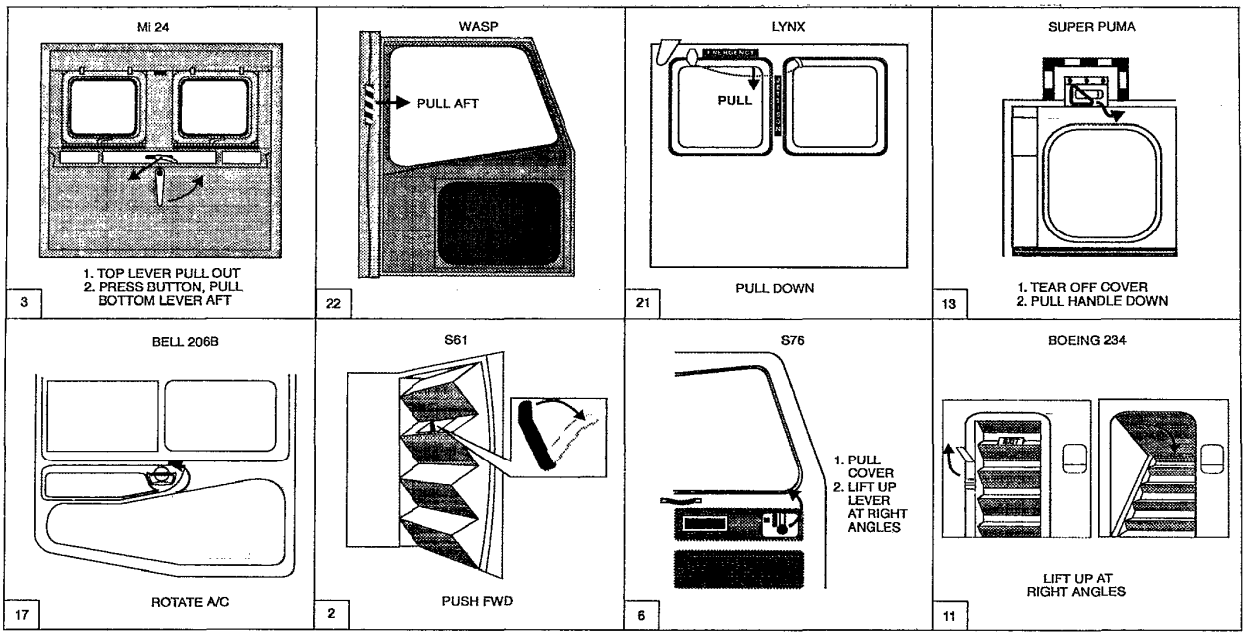

Fig. 3. Continued.

TABLE III. ALL EMERGENCY WINDOWS AND HATCHES.

Helo Type	Mechanism	Operates	Goes With Window/Hatches (Y/N)	Height	Door/Window (In/Out)	Comments
Wessex	1 and 11	Pulls; rotates down 7-5	N	Mid chest	O	Two actions one lever stays (1) One goes (11)
	19	Lifts up at 90°	Y			Port exit
		Medium length pull; push out	N	At any corner	O	Position of tab variable Starboard exit
Wasp	23	Push out; no mechanism	N/A	Mid chest	O	
Super Puma	19	Medium length pull	N	At any corner	O	Two actions position of tab variable; capped
USCG H-65	20	Medium length pull	N	Lower chest	O	Lanyard can be in bottom, center, or in corner
Bell 214	19	Medium length pull	N	At any corner	O	Position of tab variable; Push position written on glass in lhs and rhs corner
	23	Push out	N/A	Mid chest	O	
Bell 412	23	Push out	N/A	Mid chest	O	
Kaman SH-2	23	Push out	N/A	Mid chest	O	
Sea King	23	Push out	N/A	Mid chest	O	
S-61	1	Rotate up and forward; clk 3-12	Y	Lower chest	O	
	11	Lift up at 90°; pull seal out	N	Mid chest	O	
	11	Lift up at 90°	Y	Mid chest	O	Two actions: Pull cap, operate lever; Goes with liferaft
S-76	1	Lift up at 90°; pull seal out	N	Mid chest	O	Three actions: pull cap, press button bar, operate lever
USCG SH-60	19	Medium length pull	N	Mid chest	I	Has tab on window to pull in
USN SH-60	5	Rotates ac 2-10 depending on position	N	Mid chest	O	Three jettison-able windows by same mechanism
CH-53	19	Medium length pull	N	At any corner	O	Position of tab variable
	1 + 1	Pulls; rotates down clk 3-6	Y	Shoulder	I	Necessary to hold second handle below window to pull hatch in
Labrador/	18	Very long pull (door)	N	Lower chest	O	Door
H-46	18	Long pull (window)	N	Shoulder level	O	Window
Chinook 234	19	Medium length pull	N	At any corner	O	
	19	Long pull; starts from plastic cap in mid cabin door	N	Shoulder	O	Mid cabin door
	9	Rotates up at 90° to fuselage	Y	Mid chest or shoulder	O	In two positions on same helo; also capped
	1	Rotates clk 12-3	Y	Shoulder	O	Rear escape hatch. Must open a door to get into compartment
EH-101	19	Medium length pull	N	Shoulder	O	Tab in top center
	1	Pulls down; rotates clk 3-6	Y	Shoulder	O	
	12	Rod lifts up at 90°	Y	Shoulder	O	Window first pulls in then pushes out

Legend same as Table I.

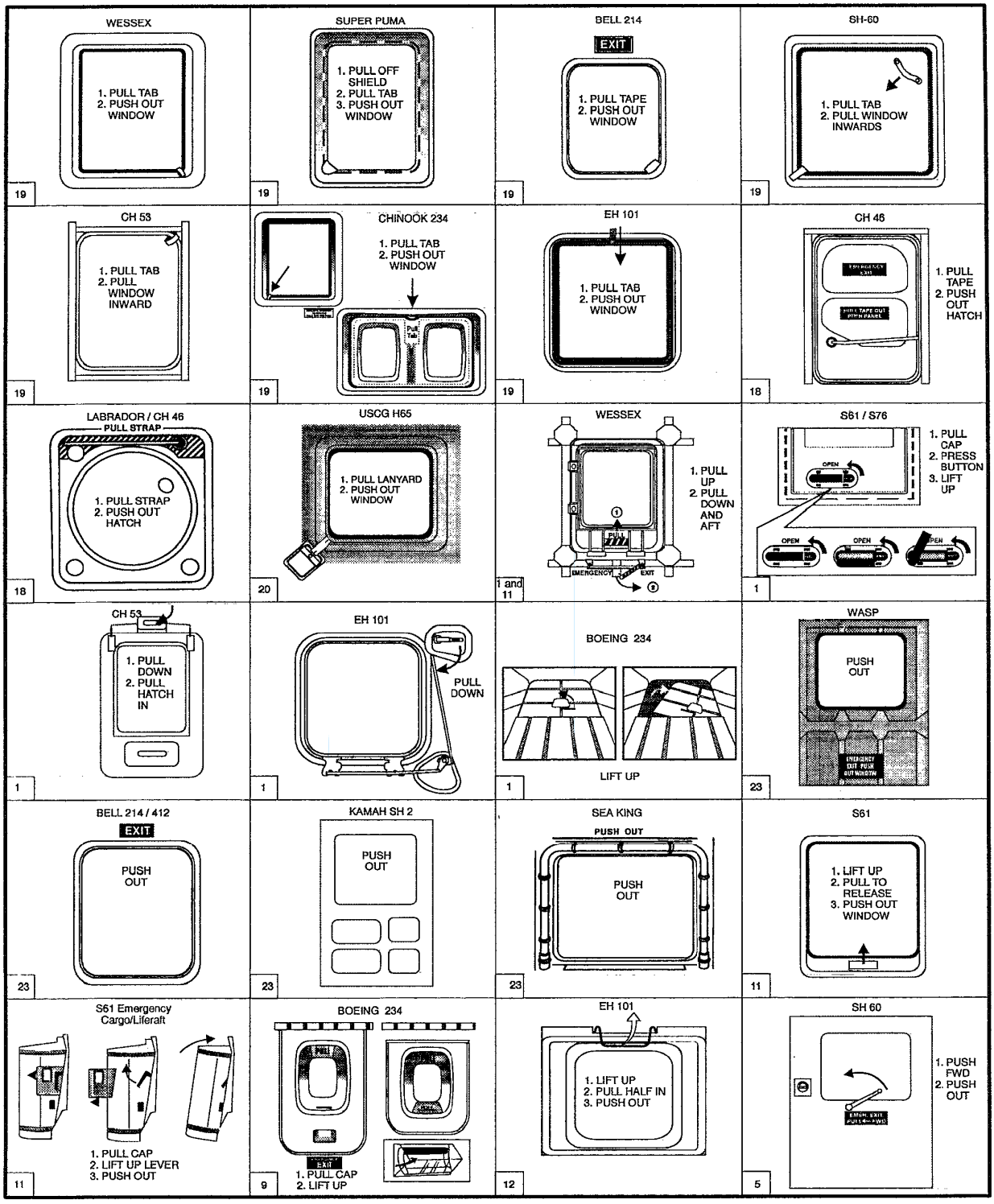

Fig. 4. A line drawing of each emergency window and hatch showing method and direction of operation. The type of mechanism is depicted in the box in the left-hand corner of each illustration.

ACKNOWLEDGMENTS

This paper was only made possible through considerable international help and cooperation. In the U.S. many thanks to Frank Boka from NAWC Warminster; Col. Dennis Shanahan, Fort Rucker, AL; LCDR Karl Baldessari, USCG Aviation Life Support Branch, Washington, DC; Dr. Marty Nerniroff, USCG Stn Alameda. In the U.K., Surg. Cdr. Peter Waugh, R.NA.S. Culdrose; WO Mike Sedgely, HMS SULTAN; Jeremy Tracy, Westiands Helicopters; Group Capt. Sharp, RAF Exchange Officer in the Canadian Air Force Headquarters, Winnipeg and his colleagues; Sqn. Ldr. Cotton and FIt. Lt. Humphreys at RAP Aldergrove; and Dr. Peter Sowood, DRA Farnborough. In Norway, Borge Hognestad from NUTEC; in France, Dr. Pierre Giry from Toulon and Dr. Maugey from BAN St. Raphael; and, in Germany, Col. Hans Pongratz and Guenter Kroh from the Institute of Aerospace Medicine, Furstenfeldbruck.

Finally, thanks must be given to Mr. David Beevis and Bob Michas for their human engineering advice. Mr. George Tanner, Press Praestegaard, and Eugene Rypan did an exceptional job on the graphic art, and Ms. Dale Lawrence and Nancy Wisteard did all the typing and formatting.

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