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DISABLED SUBMARINE. REQUIREMENTS FOR EMPLOYMENT OF U.S. NAVY SU--ETC(U)
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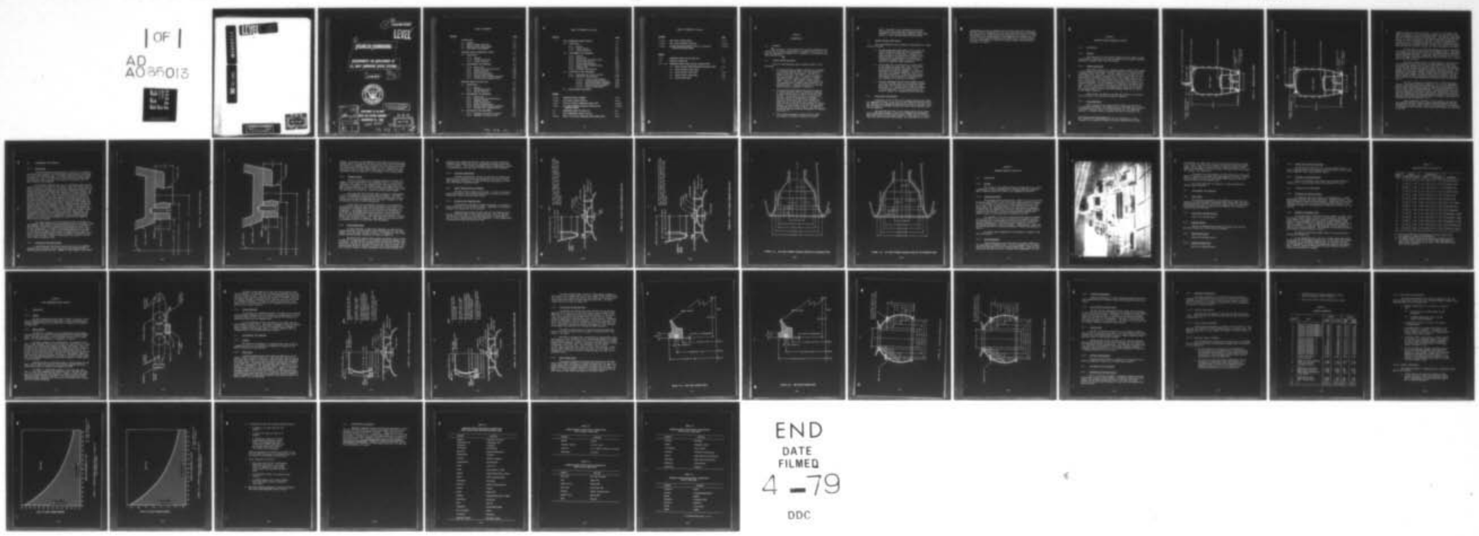

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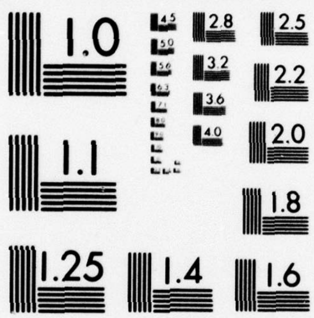

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LEVEL II

DISABLED SUBMARINE

REQUIREMENTS FOR EMPLOYMENT OF U.S. NAVY SUBMARINE RESCUE SYSTEMS

JUNE 1978

47 p.

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

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SECTION 1

INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide information concerning the U.S. Navy's capabilities in submarine rescue and to outline the requirements necessary for a submarine to be compatible with these capabilities.

1.2 RESCUE SYSTEMS AVAILABLE

The U.S. Navy submarine rescue systems consist of the following:

- The Submarine Rescue Chamber (SRC) which is capable or rescuing personnel from a stricken submarine to depths of 850 feet (259 meters). The SRC is a McCann Diving Bell, with life support provided by the surface support ship. (The SRC is normally operated from U.S. Navy Submarine Rescue Ships (ASR). Rescue by SRC requires a mating surface on the submarine and a downhaul cable attached to the submarine hatch. Detailed information on the SRC Rescue System is presented in Section 2.

- The single Submarine Rescue Fly-Away Kit which is an air-transportable SRC with necessary equipment to conduct rescue work to depths of 400 feet (122 meters). The Fly-Away Kit can be operated from any ship capable of on-loading the equipment. In the event the selected ship is not equipped to handle an 11-ton (10 metric tons) load over the side, the SRC in the kit could be rigged for towing. However, to avoid damage to the SRC, towing should be employed only as a last resort. The Submarine Rescue Fly-Away Kit detailed information is contained in Section 3.

- The two Deep Submergence Rescue Vehicles (DSRV) are capable of rescues to submarine collapse depth. The DSRV can be transferred to the scene and operated from a specially configured mother submarine or from ASR-21 Class Submarine Rescue Ships. Section 4 covers the DSRV Rescue System details.

1.3 RESCUE SYSTEMS ALERT STATUS

The three submarine rescue systems are maintained in a ready status as follows:

- The SRC aboard ASR-class ships is fully ready for rescue operations unless the ASR is undergoing a period of refit or maintenance. Generally, at least one ASR on the east and west coasts of the United States is maintained in a condition of readiness to respond within 24 hours of notification for submarine rescue operations.

- The Fly-Away Kit is maintained in a ready status at the Submarine Rescue Unit, Naval Air Station North Island, San Diego, California. It is palletized and ready for shipment to a port near the scene of a disabled submarine. The kit is exercised periodically. During exercise periods some delays could be expected in re-palletizing the equipment and preparing for shipment.

- The Deep Submergence Rescue System (DSRV) is maintained in a standby status at the Submarine Rescue Unit, Naval Air Station, North Island, San Diego, California. In a standby status a DSRV is capable of being loaded into a C-141 aircraft within 24 hours to respond to a disabled submarine incident.

1.4 PRELIMINARY REQUIREMENTS

Utilization of any of the rescue systems requires that physical compatibility exist in the areas of the submarine's mating surface, the submarine hatch dimensions and operations, and, in the case of the SRC, the means of connection between the rescue system downhaul cable and the submarine.

The submarine must have a flat mating surface large enough and of sufficient strength to accept the candidate rescue system's mating surface with its attendant loading. There must be no obstructions that would interfere with mating. The hatch must be of such a configuration as not to interfere with the rescue unit and it must permit exit from the submarine into the rescue unit when the two are mated. Safe operation of the SRC System also requires that at least four clamps be located on the circumference of the submarine hatch sealing area in order to install special turnbuckle hold-down rods. Details of these and other requirements of each of the rescue systems are delineated in Sections 2, 3, and 4.

SECTION 2

SUBMARINE RESCUE CHAMBER/ASR SYSTEM

2.1 DESCRIPTION

2.1.1 Mission

The mission of the ASR-carried Submarine Rescue Chamber System is to provide a capability to rescue personnel from a disabled submarine submerged at depths to 850 feet (259 meters).

2.1.2 System Description

This system consists of a Submarine Rescue Chamber (SRC) capable of withstanding the pressures of 850-foot depths and is carried aboard a Submarine Rescue Ship (ASR). The SRC, figure 2-1*, is made up of an upper chamber that houses the operators and rescued personnel in a dry environment at atmospheric pressure, and a lower chamber open to the sea at the bottom. The lower chamber has a flat seating surface fitted with a rubber gasket for making a water-tight seal on the hatch of a disabled submarine. The two chambers are connected by a pressure-tight hatch. Air and other support services are supplied to the SRC by the ASR. The SRC is connected to the submarine by a cable and is capable of vertical movement using an installed downhaul winch and by control of the chamber buoyancy.

Under normal circumstances the SRC can transport six rescuees and two operators per trip from a disabled submarine.

2.1.3 System Operation

After arriving at the scene and upon fixing the position of the distressed submarine, the Submarine Rescue Ship (ASR) will establish a four-point moor so that it is nearly directly over the submarine's position. A downhaul cable is required that may be attached to the

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*All figures where measurements are used are presented in a and b versions so that American standard and metric measures may be shown.

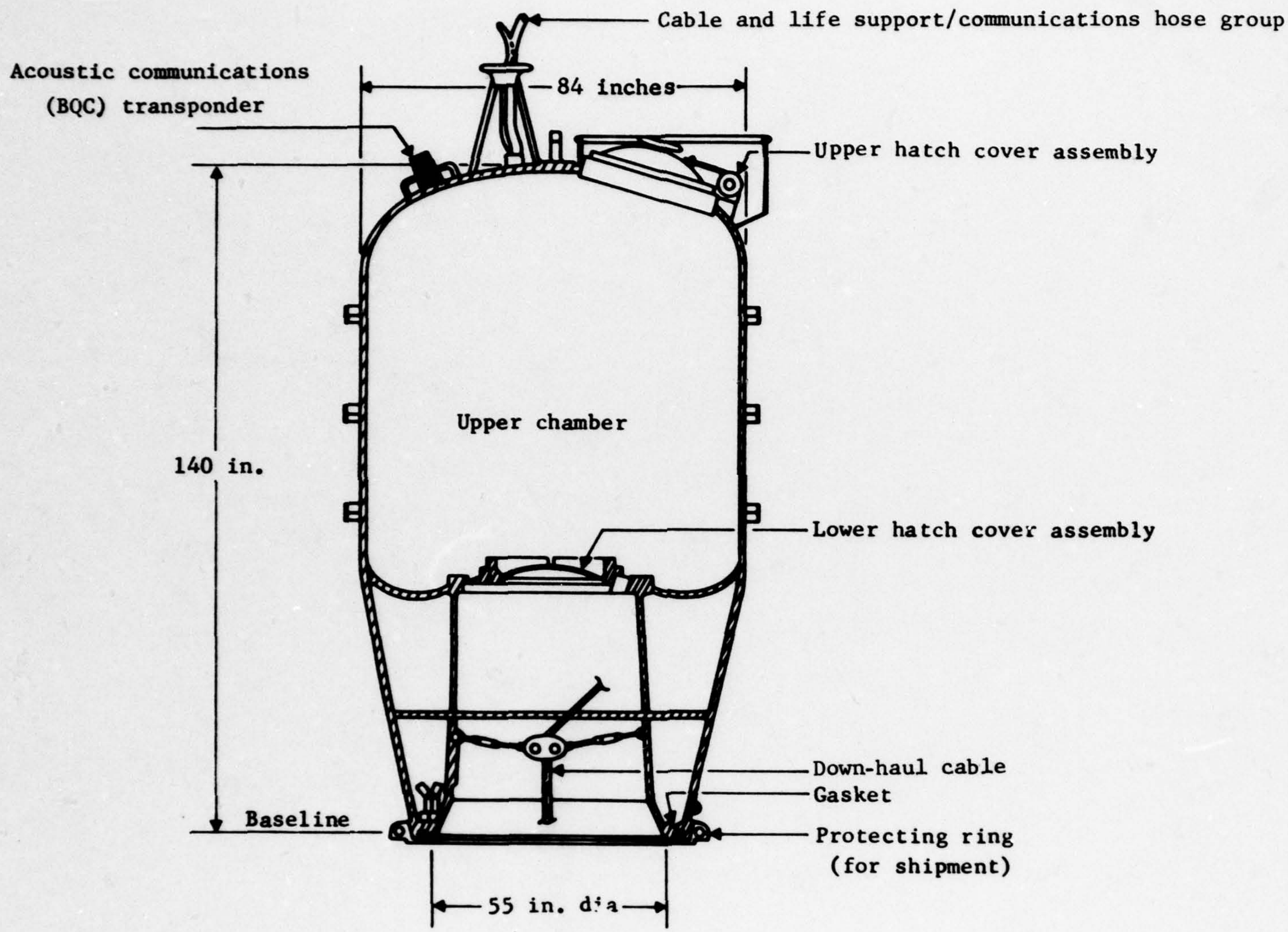


FIGURE 2-1a. SUBMARINE RESCUE CHAMBER

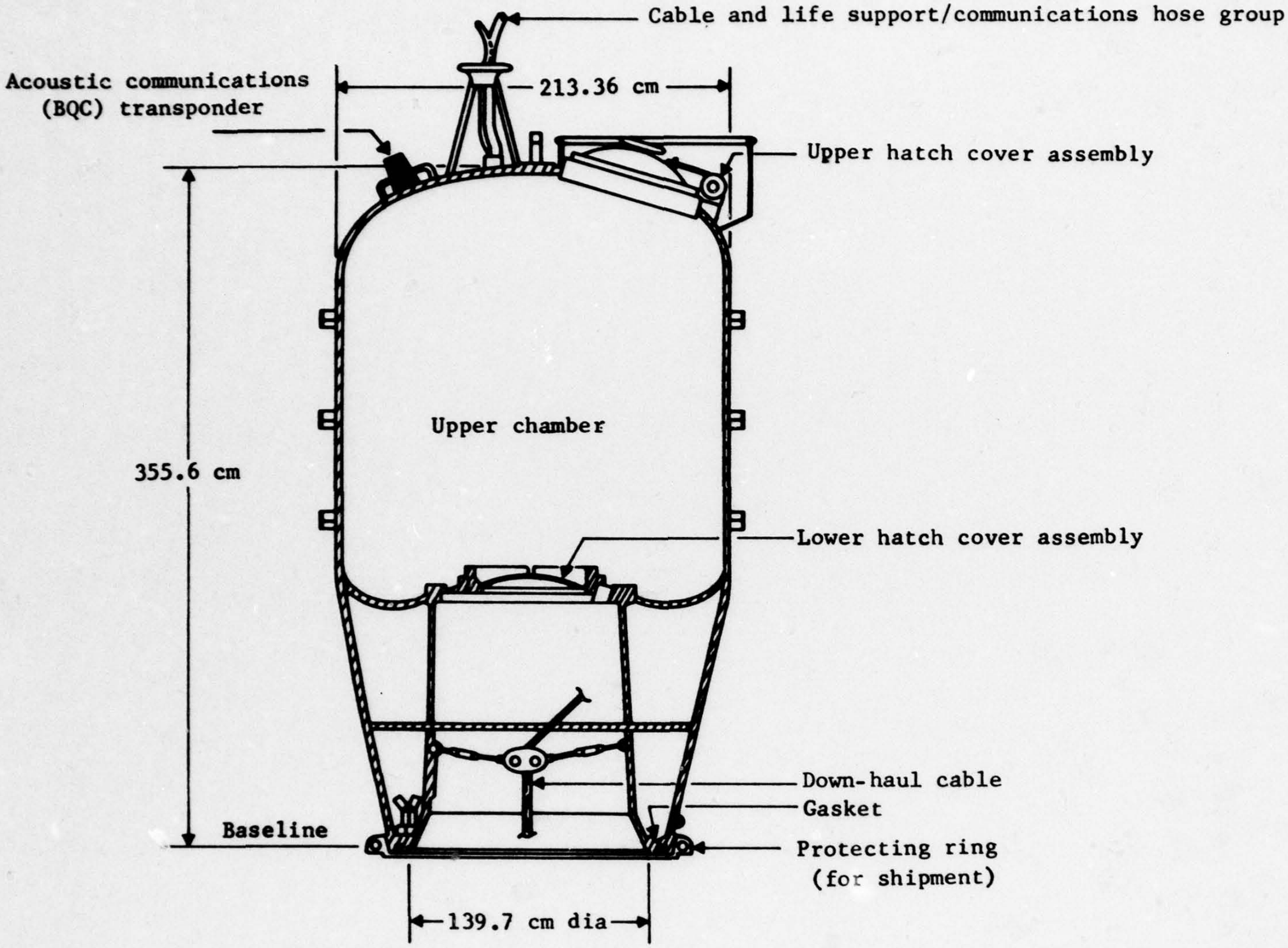


FIGURE 2-1b. SUBMARINE RESCUE CHAMBER

submarine hatch to be used for escape. On most U.S. submarines this cable is installed in the distressed submarine and sent to the surface when the submarine releases a messenger buoy. The messenger buoy upper end of the cable is retrieved by the ASR and attached to the SRC winch as part of the SRC preparation. Details of cable and downhaul are covered in 2.2.3. Following preparation, the SRC is lowered into the water and secured alongside the ASR. At this point the SRC operators board through the top hatch, secure the hatch, and prepare for descent.

The SRC dives to the distressed submarine hatch by decreasing its buoyancy and pulling itself down on the downhaul cable. The boom/crane supporting cable used to lift the SRC from the ASR is slacked during the downhaul operation. Additional cables and hoses for SRC air, electrical power, and communications are paid out by the surface support ship as the SRC descends.

The SRC is winched down to a mating position, centering over the submarine's hatch, after which the lower chamber of the SRC is blown with high pressure air to remove the water. The lower chamber is then vented, causing the greater external pressure to force the SRC against the rescue seat, compress the gasket, and effect a seal. The pressures in the upper and lower chambers are then equalized and the lower SRC hatch opened. The SRC is then further secured to the submarine using hold-down turnbuckle rods which are carried in the SRC and connected to fittings permanently installed around the submarine hatch.

The SRC is primarily intended for use in rescue operations in which the pressure within the submarine is at or near atmospheric. However, under emergency conditions the SRC can be pressurized to effect a rescue from a disabled submarine with internal pressures up to 290 feet (88.4 meters) equivalent depth. Pressures greater than this could be harmful or cause loss of the system. Therefore it is necessary that atmospheric and gas contamination conditions within the submarine be known before the submarine hatch is opened. This subject is discussed further in subsection 2.2.5.

After atmospheric conditions in the submarine are verified, the submarine hatch is opened to permit personnel transfer from the submarine into the SRC. Under control of the operators, the sequence is reversed; the SRC returns to the surface and rescuees are transferred to the ASR.

2.2 REQUIREMENTS FOR SUBMARINE

2.2.1 Rescue Seat

The SRC-to-submarine mating surface on the SRC is a construction around the bottom of the lower chamber consisting of a rubber gasket and a steel retaining ring. The mating surface details are shown in figure 2-2. The 1-3/4-inch wide (4.445 centimeters) rubber gasket at the mating surface provides a seal against sea pressure when the SRC is mated to the submarine.

The disabled submarine must have an equivalent mating surface around its hatch to be used for the rescue. This flat "rescue seat" on which the SRC will rest must be a reinforced steel area around the submarine hatch opening extending over the area intended for mating. The strength required of the rescue seat depends on the depth at which the mating will be performed. Since the system has a depth capability of 850 feet (259 meters), the static load on the rescue seat after dewatering and venting of the lower chamber of the SRC will be the hydrostatic pressure at 850 feet acting over the corresponding area exposed to the lower pressure, plus the net buoyancy of the chamber and the force exerted by the downhaul cable. This load may be as great as 893,000 pounds (405,065 kilograms). Seat loading of 3640 pounds per square inch (psi) (251 bars) will therefore result if the mating surfaces are perfectly flat. A safety factor should be utilized to allow for surface irregularities, corrosion, and minor impact loads. The strengthened area of the rescue seat should have a minimum outside diameter of 70 inches (177.8 centimeters), and a maximum inside diameter of 46 inches (116.8 centimeters), centered on the submarine hatch vertical centerline.

The rubber gasket at the SRC mating surfaces is designed to seal against rescue seat surface irregularities such as scratches, nicks, and waviness. The gasket is capable of sealing gaps up to 1/8-inch (0.3175 centimeters). The seal limitation requires the rescue seat to be flat within 1/8-inch. That is, the maximum departure of any part of the rescue seat mating surface must not exceed 1/8-inch from the plane of the SRC mating surface (which is assumed to be perfectly flat) in its mated attitude. Figure 2-3 illustrates the mating of the SRC with a typical submarine hatch.

2.2.2 Projections and Obstructions

Projections and obstructions above the hull of the disabled submarine in the vicinity of the rescue seat can present hazards to the SRC mating surface and seal. Damage to these systems could prevent

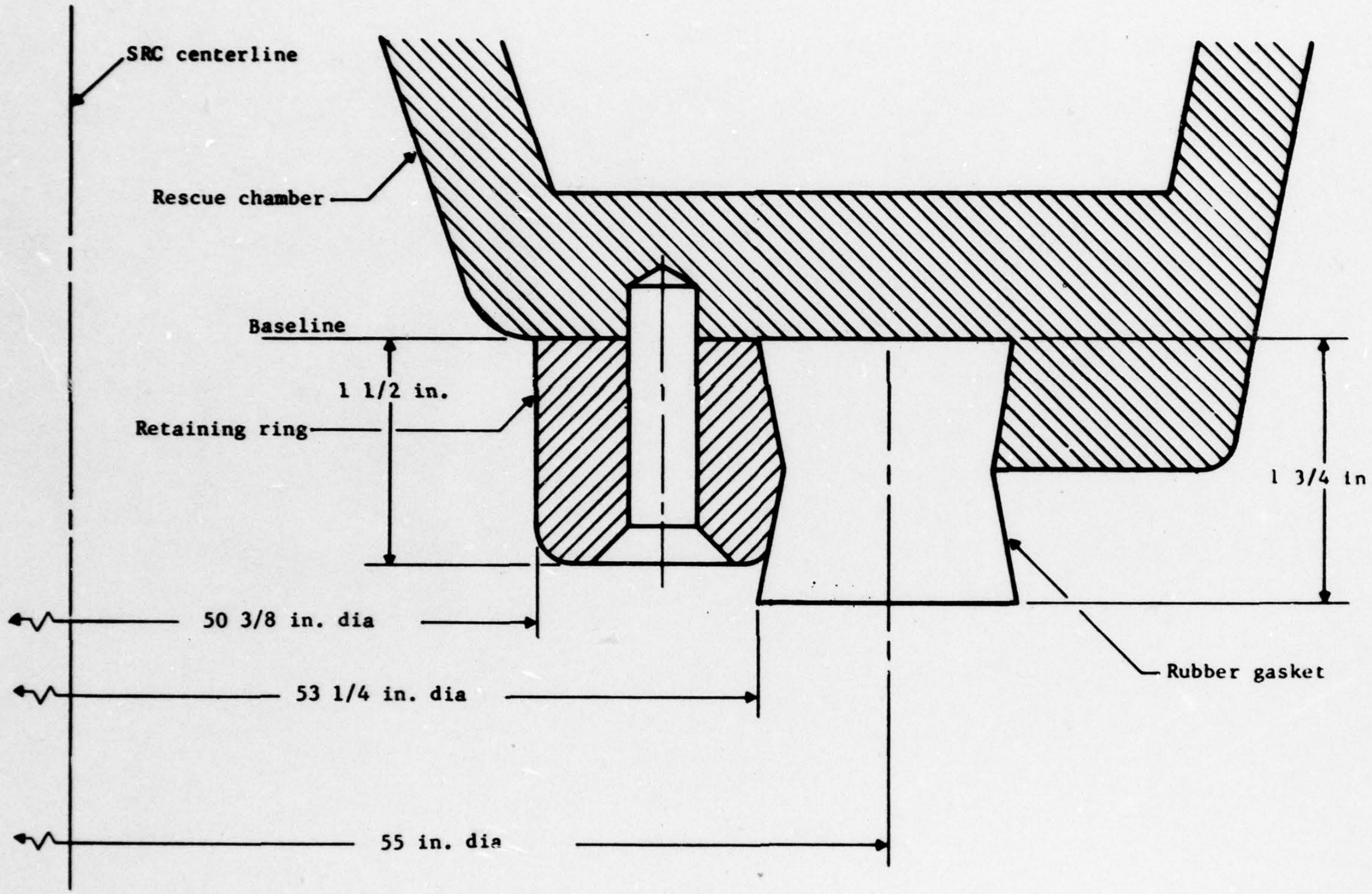


FIGURE 2-2a. SRC MATING SURFACE DETAILS

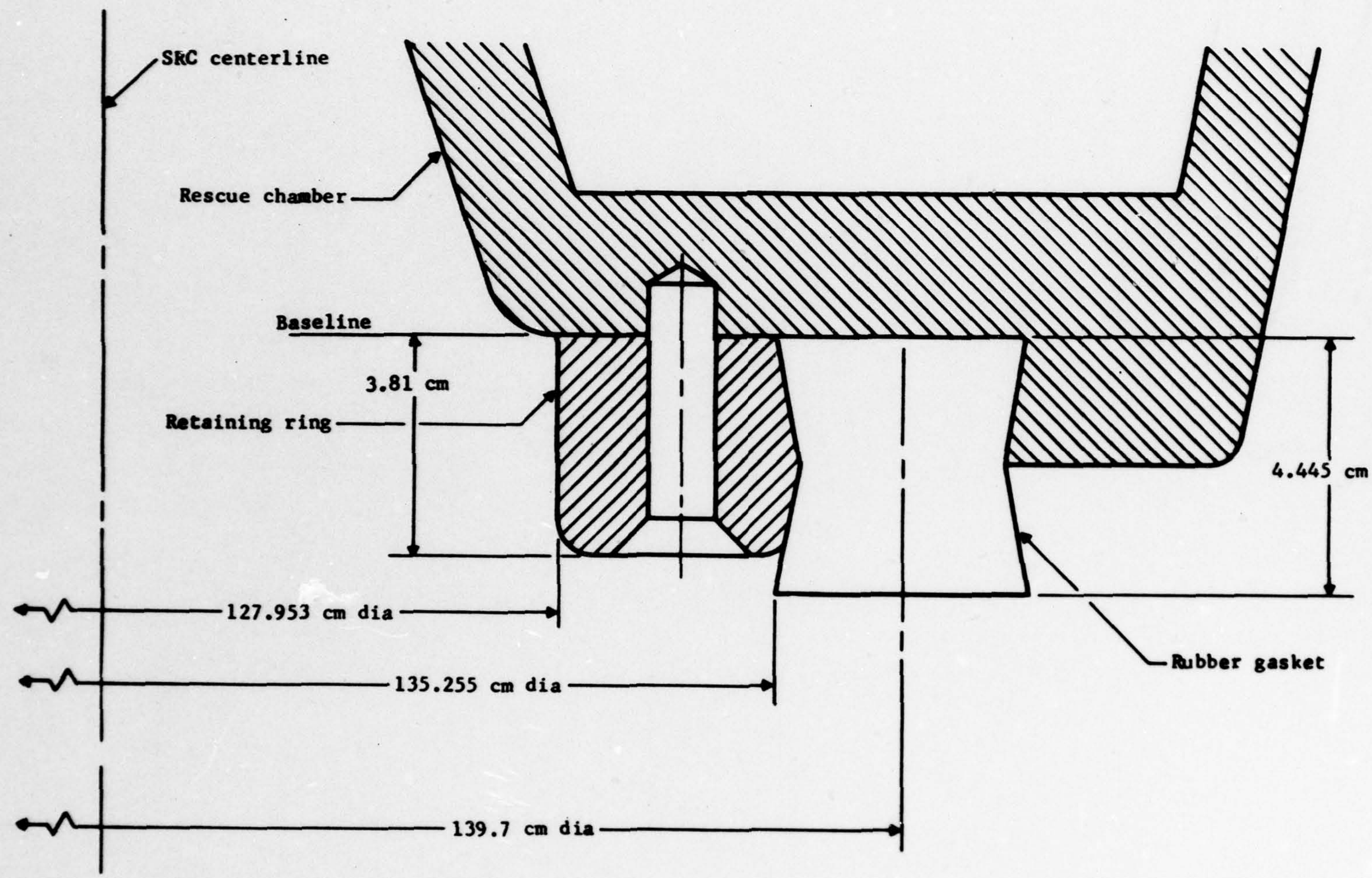


FIGURE 2-2b. SRC MATING SURFACE DETAILS

mating. In the area of the submarine rescue hatch there can be no projections above the submarine hull which would impact an SRC descending vertically to a submarine that is inclined 30° from vertical in either the fore-and-aft or athwartships planes, or both. Information on obstructions outside of this cleared area must be available to the SRC operators so they can maneuver to avoid damage to the sealing gasket.

2.2.3 Downhaul System

The SRC is equipped with a downhaul mechanism to permit the chamber to winch itself down to the submarine hatch. A cable must be attached to the center of the submarine hatch; the upper end of the cable must be available to the surface support ship (ASR) before the SRC is lowered into the water. The Rescue System personnel will attach the upper end of the cable to a winch in the SRC's lower chamber.

The cable and cable fixtures must be capable of withstanding a load of approximately 15,000 pounds (6804 kilograms). The cable must be of corrosion resistant material without splices that could interfere with the haul-in mechanisms and must have a diameter of 7/16 ± 1/16-inch (1.11125 ± 0.15875 centimeters).

If the cable is not permanently installed on the submarine, a strengthened connection point must be available at the hatch to permit hook-up of a downhaul cable by external means using divers or a submersible. The maximum depth at which this can be accomplished is a function of ASR maximum deep diving capability, and is generally about 360 feet (110 meters) for mixed gas divers and 850 feet (259 meters) for saturation divers. The connection point should be centered on the hatch as nearly as possible. This padeye or bail must be able to withstand a load of 12,500 pounds (5670 kilograms).

2.2.4 Hatch Construction

To allow survivors to leave the submarine, its hatch must be of such size that it can be opened without interference into the lower chamber of the SRC while the SRC is mated to the submarine. SRC's lower chamber minimum internal clearances are shown in figure 2-4.

The hatch area should include tiedown attachment points so that the SRC can be firmly secured to the submarine before the downhaul cable is slacked. The SRC has four hold-down rods with shackles on their ends which will be secured by the operators before the hatch is opened. The tiedown points should be padeyes or staples with openings through which the 1-1/8-inch diameter (2.858 centimeters) pins of the hold-down rod shackles can be passed and secured. They must be placed around the submarine hatch inside the area of SRC/submarine mating (orientation is not critical). The tiedown attachments must be individually capable of withstanding a hold-down load of 10,000 pounds (4536 kilograms).

2.2.5 Pressure Equalization

Pressure differentials between the SRC and the disabled submarine must be equalized before the submarine's hatch can be opened. Under emergency conditions, the SRC can equalize pressures up to 290 feet (88.4 meters) equivalent depth.

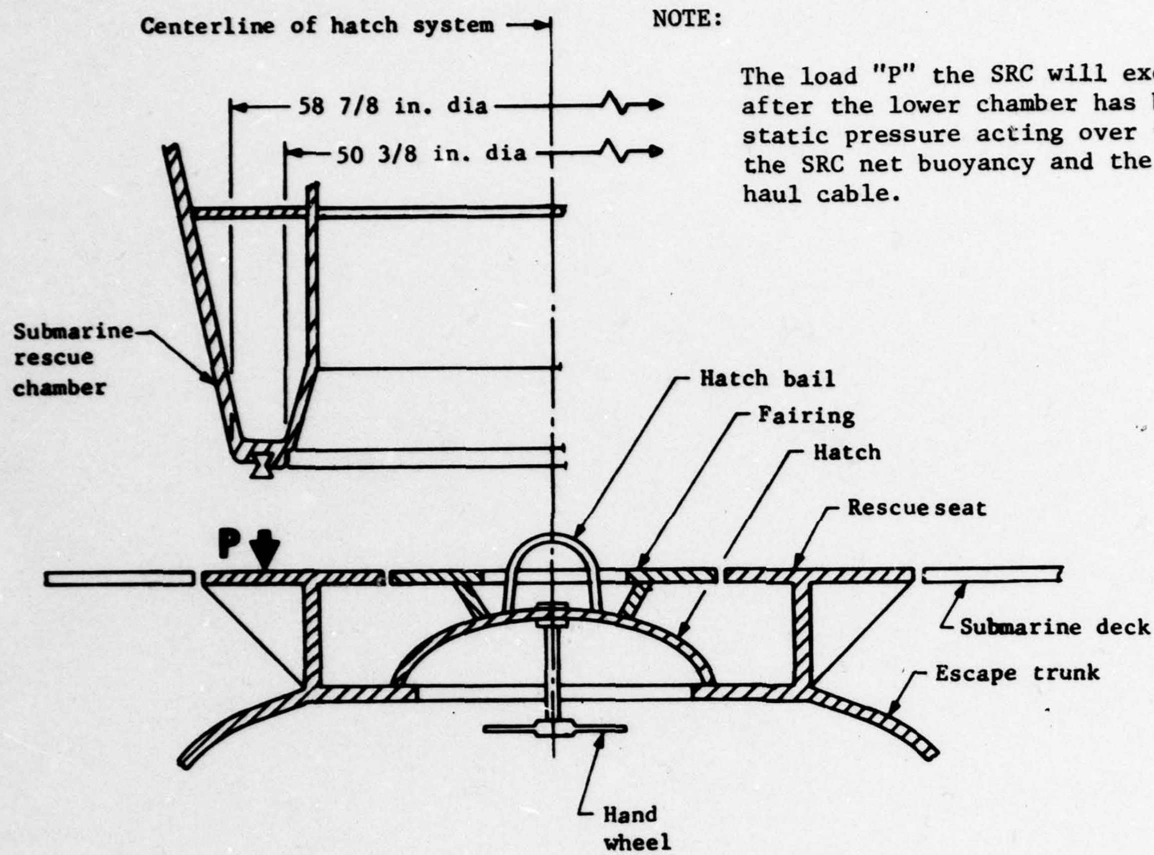
2.2.6 Rescue Vehicle Ballast Exchange

The SRC carries portable lead ballast. In order to maintain proper SRC buoyancy, the portable ballast will be placed in the submarine after the rescuees are taken aboard.

2.2.7 Personnel and Communications

No specialized training of submarine personnel is required in order to make use of the SRC Rescue System. Knowledge of the English language is preferred but is not required.

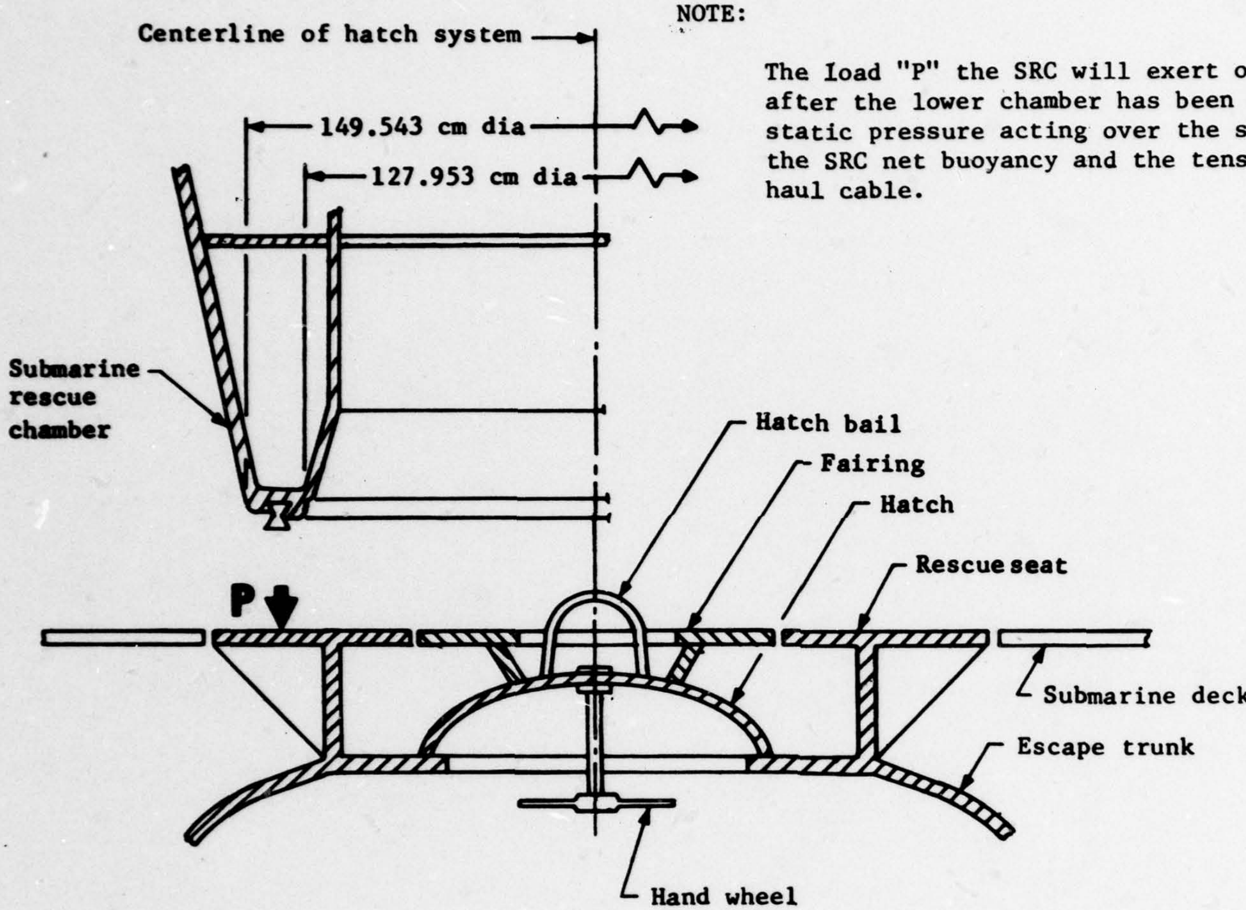
Communications between the SRC, ASR, and the disabled submarine is a valuable asset to the rescue operation. Both the ASR and the SRC have a U.S. Navy 8.3 KHz underwater acoustic system which is used for voice communications with the submarine. A wire communication is maintained between the ASR and the SRC.



NOTE:

The load "P" the SRC will exert on the rescue seat after the lower chamber has been dewatered is hydrostatic pressure acting over the sealed area plus the SRC net buoyancy and the tension in the downhaul cable.

FIGURE 2-3a. TYPICAL DISABLED SUBMARINE RESCUE SEAT



NOTE:

The Ioad "P" the SRC will exert on the rescue seat after the lower chamber has been dewatered is hydrostatic pressure acting over the sealed area plus the SRC net buoyancy and the tension in the downhaul cable.

FIGURE 2-3b. TYPICAL DISABLED SUBMARINE RESCUE SEAT

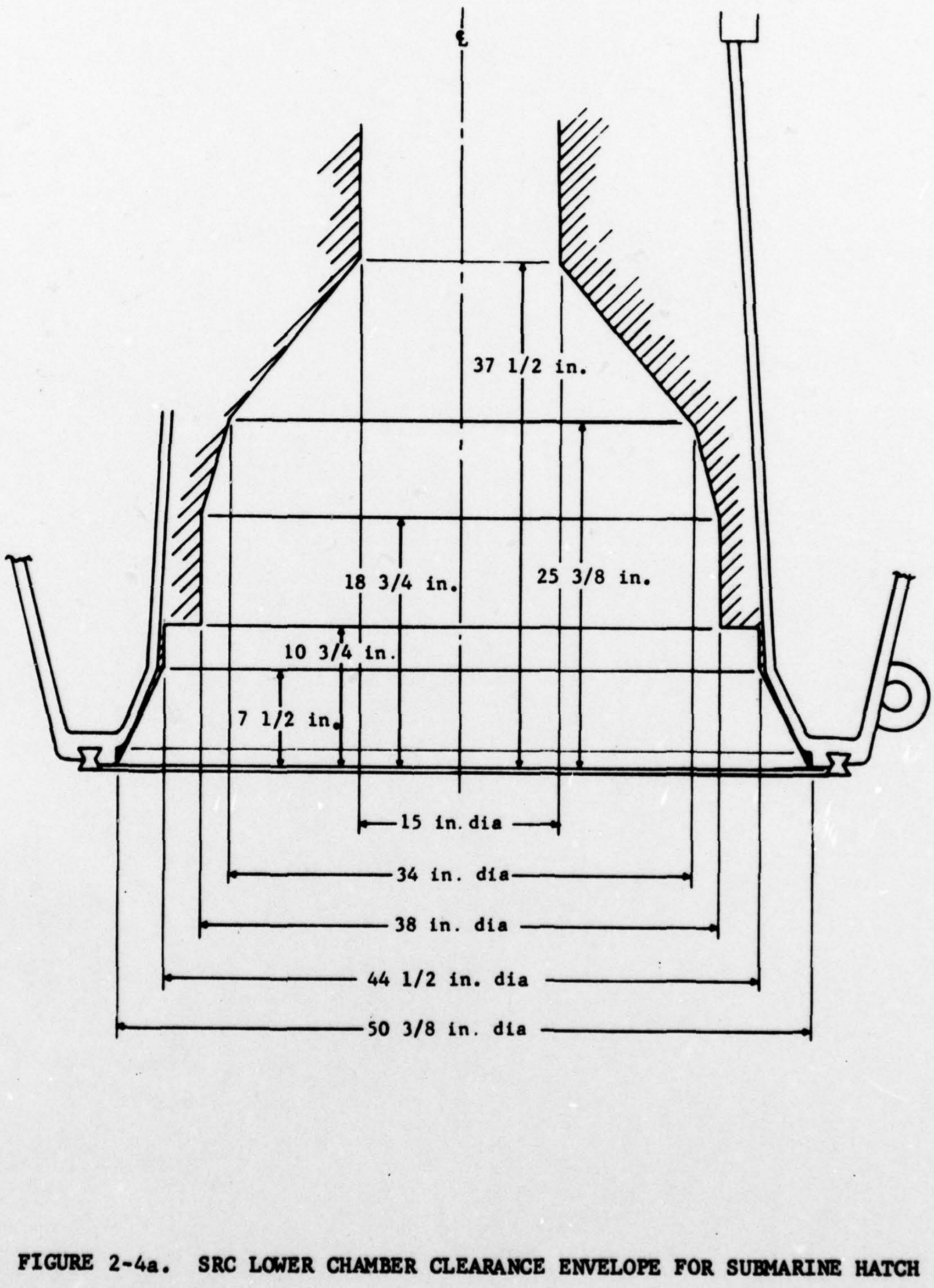


FIGURE 2-4a. SRC LOWER CHAMBER CLEARANCE ENVELOPE FOR SUBMARINE HATCH

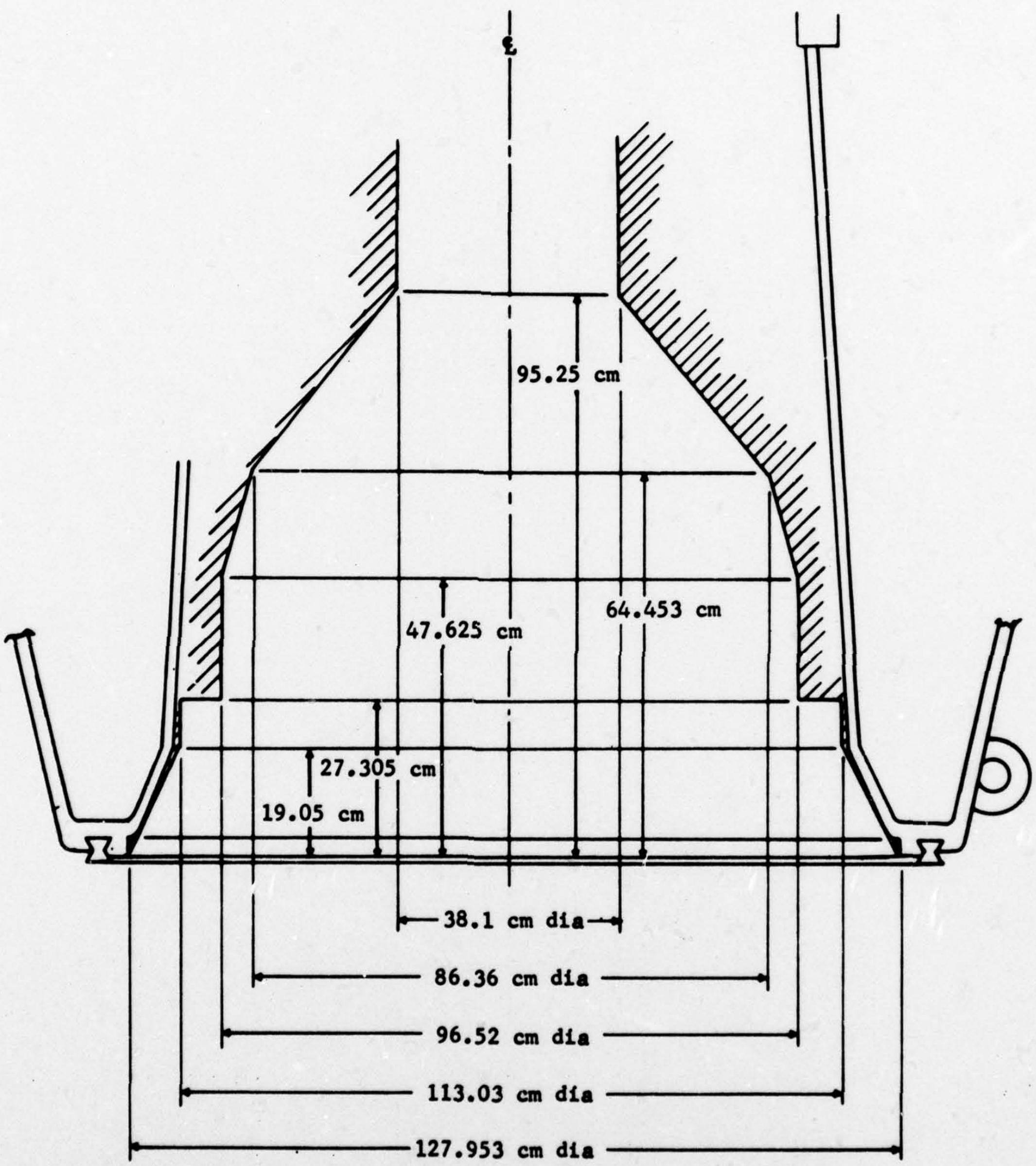


FIGURE 2-4b. SRC LOWER CHAMBER CLEARANCE ENVELOPE FOR SUBMARINE HATCH

SECTION 3

SUBMARINE RESCUE FLY-AWAY KIT

3.1 DESCRIPTION

3.1.1 Mission

The mission of the Submarine Rescue Fly-Away Kit is to provide a capability to rescue personnel from a disabled submerged submarine when a Submarine Rescue Ship (ASR) is not immediately available.

3.1.2 System Description

The Submarine Rescue Fly-Away Kit, figure 3-1, is an air-transportable system similar to that of the SRC system described in Section 2. In the absence of an ASR as the surface support ship, most ships can be used. This is made possible by the inclusion in the kit of a diesel-powered air compressor, hoses, and other ancillary equipment. To ensure that the support ship is able to maintain a proper position during the rescue work, a four-point mooring system complete with anchors, buoys, and mooring lines is included in the kit.

All equipment in the kit is palletized and ready for shipment in U.S. aircraft to a port near the scene of the submarine incident. An operating crew of approximately 18 officers and men is dispatched with the equipment kit. Airfield facilities should be capable of landing and unloading C-141/C-5A aircraft. Transportation, roads, and pier facilities must be surveyed beforehand to ensure safe handling of the kit.

The rescue depth capability of this system is limited to 400 feet (122 meters).

3.1.3 System Operation

System operation on the scene will be virtually identical to that described for SRC/ASR rescue. The kit equipment will be loaded aboard the ship selected as the surface support ship. Using the mooring system provided in the kit, the ship will independently, or with

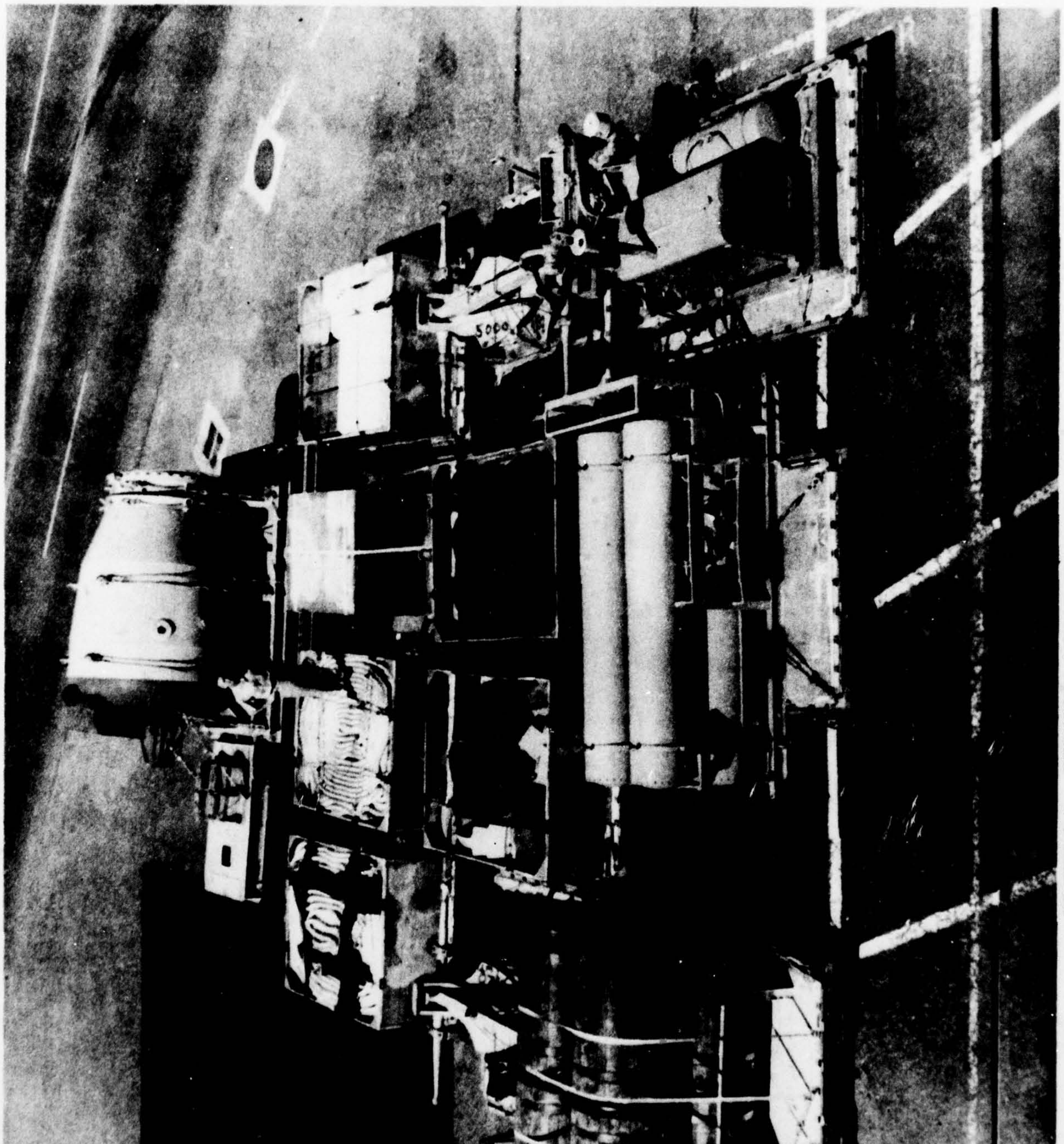


FIGURE 3-1. SUBMARINE RESCUE FLY-AWAY KIT

the assistance of other craft, set up a four-point moor after arriving at the scene. The SRC will be lowered into the water using the ship's booms. In the event the selected ship is unable to handle a 22,000-pound (9979 kilograms) load over the side, the SRC may have to be rigged for towing to the rescue site.

The system is self-sufficient with the exception of electrical power for lighting in the upper and lower chambers of the SRC. Approximately 10 amperes of 110-volt 60-Hz single-phase electrical power is required from the surface support ship.

All other operations are identical to those described for SRC/ASR rescue scenarios.

3.2 REQUIREMENTS FOR SUBMARINE

3.2.1 Rescue Seat

The physical requirements of the submarine's rescue seat are identical to those described for SRC/ASR rescue, except that the rescue depth limitation of 400 feet (122 meters) requires that the rescue seat be capable of supporting a loading of only 1800 psi (124.1 bars) instead of 3640 psi (251 bars).

3.2.2 Projections and Obstructions

Same as for SRC/ASR rescue.

3.2.3 Downhaul System

Same as for SRC/ASR rescue except that divers with the Fly-Away Kit can dive only to 250 feet (76.2 meters).

3.2.4 Hatch Construction

Same as for SRC/ASR rescue.

3.2.5 Pressure Equalization

Same as for SRC/ASR rescue.

3.2.6 Rescue Vehicle Ballast Exchange

The Fly-Away Kit utilizes water cans as portable ballast. In order to maintain proper SRC buoyancy, the ballast water will be placed in the submarine after taking rescuees aboard.

3.2.7 Personnel and Communications

Same as for SRC/ASR rescue except that an AN/BQC underwater telephone for a surface support ship is not included in the kit.

3.3 AVAILABILITY AND DEPLOYMENT

3.3.1 Readiness and Initial Actions

The Submarine Rescue Fly-Away Kit is maintained by Submarine Development Group One, San Diego, California. Standard procedures have been established to permit rapid deployment. Preparation for deployment commences with the first alert that the system may be required. The palletized Fly-Away Kit is transported on either four C-141 or one C-5A aircraft.

3.3.2 Movement to Disaster Scene

At the destination airfield the rescue chamber is placed on its own trailer, which is part of the kit, for transport to the ship. The total weight of the chamber and its trailer is approximately 35,000 pounds (15,876 kilograms) with a length of 21 feet 10 inches (6,654 meters), a width of 10 feet 8 inches (3.251 meters), and a height of 13 feet (3.96 meters). A truck for towing the SRC trailer must be provided at the receiving airfield. The remainder of the palletized equipment requires tractor-trailers or trucks.

In addition to the SRC trailer, table 3-1 lists the pallets forming the Fly-Away Kit.

At the embarkation port, the kit is loaded aboard and secured on the deck of the designated support ship. If the ship is not capable of handling the 11-ton (9979 kilograms) SRC over the side, the Fly-Away Kit personnel will prepare the chamber for towing to the disaster site. However, towing the SRC should be avoided whenever possible to prevent the possibility of damage.

TABLE 3-1

PALLETIZED UNITS OF FLY-AWAY KIT

PALLET 1/ NUMBER	WEIGHT		DIMENSIONS 2/		EQUIPMENT
	POUNDS	KILOGRAMS	INCHES	CENTIMETERS	
1	7,320	3,321	84 x 108	213.4 x 274.3	Mooring Lines
2	7,320	3,321	84 x 108	213.4 x 274.3	Mooring Lines
3	10,870	4,932	84 x 108	213.4 x 274.3	Mooring Wire
4	5,530	2,509	84 x 108	213.4 x 274.3	General Cargo
5	9,440	4,283	108 x 108	274.3 x 274.3	Anchor Pack
6	9,440	4,283	108 x 108	274.3 x 274.3	Anchor Pack
7	6,650	3,017	108 x 132	274.3 x 335.3	H.P. Air Flasks
8	8,840	4.011	108 x 144	274.3 x 365.8	Mooring Buoys
9	6,160	2,795	84 x 108	213.4 x 274.3	Air Compressor
10	2,000	907	84 x 108	213.4 x 274.3	Passengers & Bags
11	2,000	907	84 x 108	213.4 x 274.3	Passengers & Bags
12	2,000	907	84 x 108	213.4 x 274.3	Passengers & Bags
13	4,770	2,164	84 x 108	213.4 x 274.3	Poly Mooring Line
14	6,420	2,913	84 x 108	213.4 x 274.3	R/C Hose & Cable

1/ Four tractor/trailers (with minimum of 35-foot trailer bed) are required to transport these pallets.

2/ The maximum height of concern is the rescue chamber mounted on its trailer with a height of 156 inches (396.2 centimeters). (This trailer requires a tractor with a fifth wheel and 35,000-pound towing capability.)

SECTION 4

DEEP SUBMERGENCE RESCUE VEHICLE

4.1 DESCRIPTION

4.1.1 Mission

The Deep Submergence Rescue Vehicle (DSRV) is designed to provide a worldwide quick-reaction capability to rescue personnel from a disabled submarine lying on the ocean floor to depths up to submarine collapse depth.

4.1.2 Rescue System

The DSRV is a component of a Deep Submergence Rescue System developed by the U.S. Navy for rescuing personnel from disabled submarines. The DSRV descends as a self-propelled vehicle from a support ship to the disabled submarine to accomplish the rescue.

The rescue system is air transportable. It consists of the DSRV, a Land Transport Vehicle (LTV) on which the DSRV is moved on land, a support van, miscellaneous support equipment, and spares. Four U.S. Air Force C-141 aircraft are required to transport it from its home to an airfield near the port from which the rescue mission will be conducted. As an alternative, one C-141 and one C-5A aircraft can be used in lieu of four C-141 aircrafts. Certain U.S. Navy mother submarines (MS) have been specially equipped to transport the DSRV from the rescue port to the disabled submarine location and to support the DSRV system at that location.

Although the MS is the primary means of onsite support for the DSRV, the U.S. Navy has also built two specially equipped submarine rescue ships (ASR) to transport and support the DSRV.

The DSRV is a submersible designed to mate with the rescue seat of a U.S. Navy submarine and remove the crew. The DSRV can carry up to 24 rescuees and its three-man crew. Figure 4-1 shows the basic shape and certain details of the DSRV. The rescuees enter the DSRV through the skirt extending from the bottom of the DSRV after it mates with the disabled submarine.

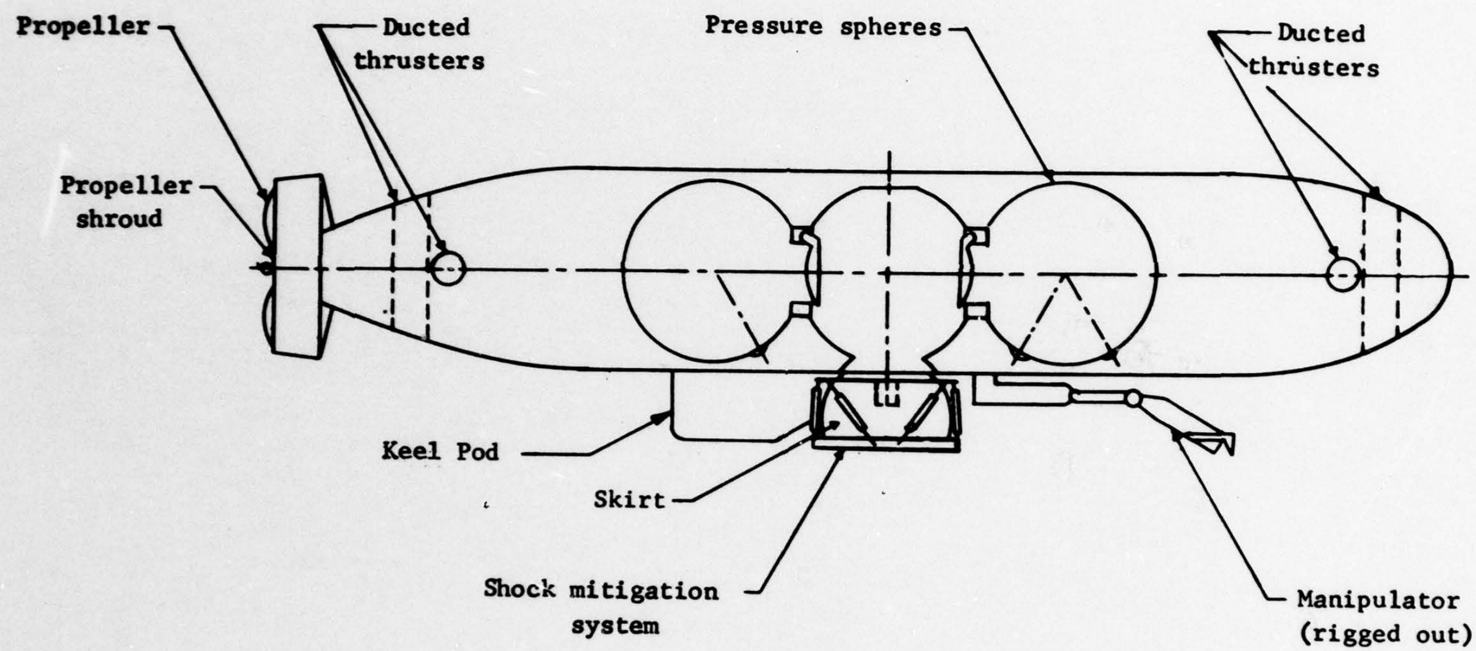


FIGURE 4-1. DEEP SUBMERGENCE RESCUE VEHICLE

The DSRV is approximately 50 feet long (15.24 meters) and 8 feet in diameter (2.44 meters), and it weighs approximately 37.4 short tons (34.03 metric tons). Thrusters and a conventional propeller with a movable shroud provide propulsion and control of the DSRV. This system permits the DSRV to maneuver, hover, and mate with the rescue seat of a disabled submarine. The DSRV is capable of mating with a submarine lying at inclination angles up to 45 degrees in both roll and pitch and in a 1-knot current.

4.1.3 System Operation

In the event of a submarine disaster, the DSRV and its crew and fly-away support equipment will be alerted, then transferred to an airfield and flown by four C-141 or one C-141 and one C-5A aircraft to a selected airfield near the disaster site.

At the destination airfield the DSRV is off-loaded onto its Land Transport Vehicle (LTV). The support equipment is also off-loaded, and the system is moved to the port and to dockside for transfer to either a Submarine Rescue Ship (ASR) or a Mother Submarine (MS) for transportation to the disabled submarine location.

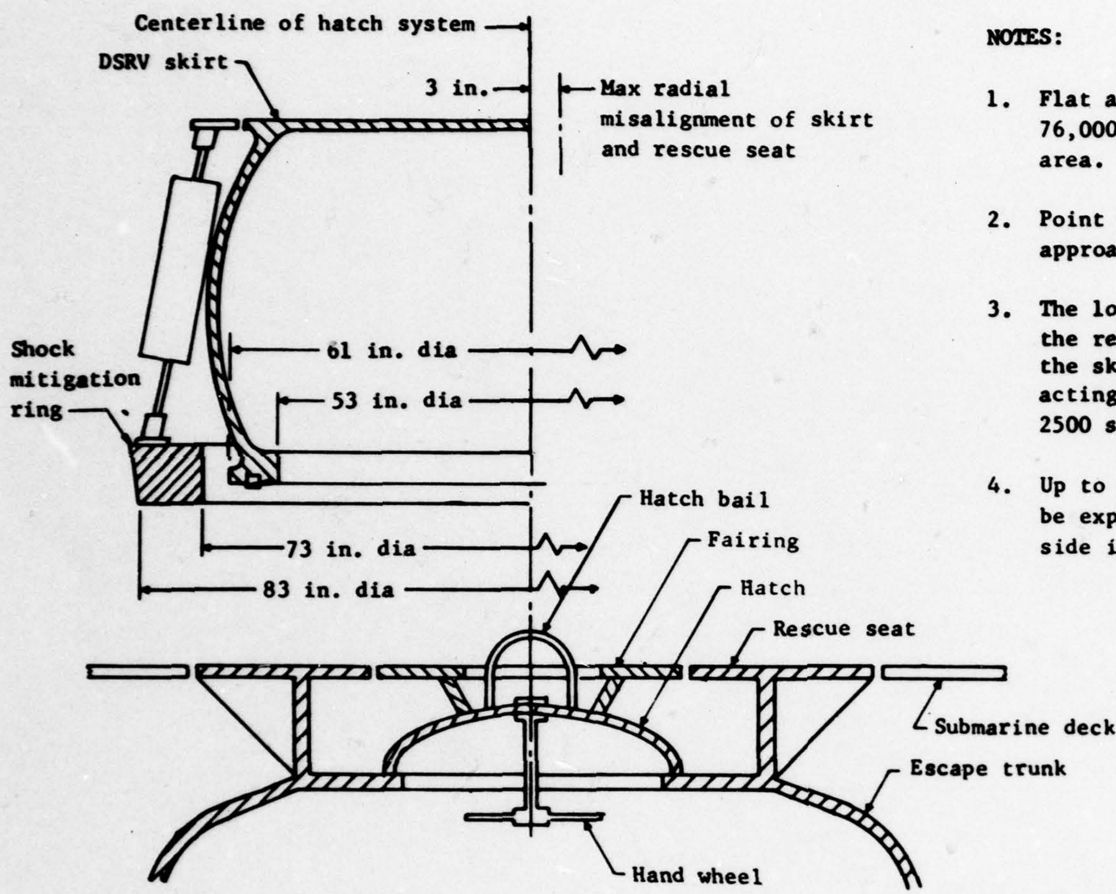
4.2 REQUIREMENTS FOR SUBMARINE

4.2.1 General

The specific requirements or conditions which must be met by a submarine for it to be accepted as a candidate for rescue by the DSRV are presented in this section.

4.2.2 Rescue Seat

A typical submarine hatch with which the DSRV skirt was designed to mate is shown in figure 4-2. The skirt will come to rest on the rescue seat, which is a circular reinforced steel area surrounding the escape hatch. The rescue seat must have a minimum outer diameter of 65 inches (165 centimeters) and a maximum inner diameter of 44.50 inches (113 centimeters). The strength required of the rescue seat is dependent on the depth of the rescue operation. Figure 4-2 describes the loads applied to the disabled submarine. In addition to the requirements placed on the rescue seat, the deck of the disabled submarine beyond the rescue seat must be of sufficient size and strength to safely accommodate the DSRV shock mitigation ring loading (figure 4-2, Notes 1 and 2) for all approaches.



NOTES:

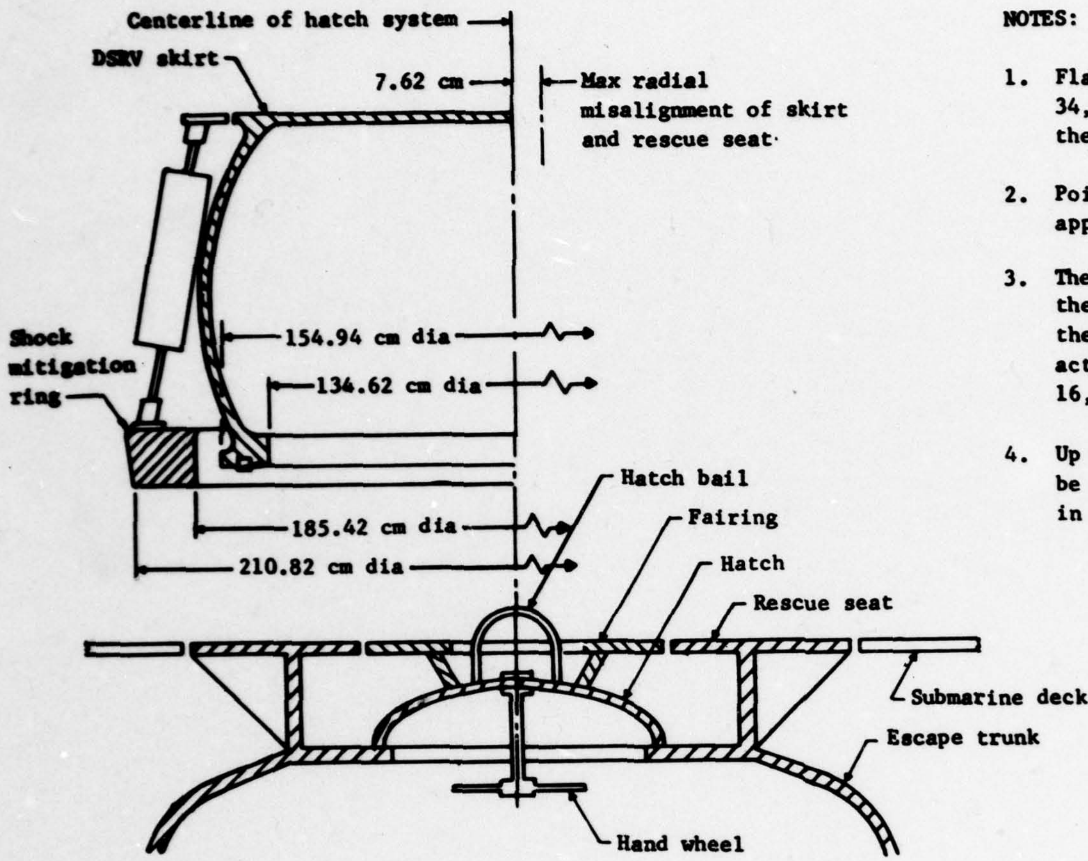
1. Flat approach max load impact 76,000 pounds total over the contact area.

2. Point impact load at angular approach is 30,000 psi max.

3. The load the skirt will exert on the rescue seat after dewatering the skirt is hydrostatic pressure acting over the sealed area of 2500 square inches.

4. Up to 290 psi additional loading may be expected on the downstream side in lateral currents.

FIGURE 4-2a. DETAIL OF TYPICAL SUBMARINE HATCH RESCUE SEAT



NOTES:

1. Flat approach max load impact 34,473.6 kilograms total over the contact area.

2. Point impact load at angular approach is 2070 bars max.

3. The load the skirt will exert on the rescue seat after dewatering the skirt is hydrostatic pressure acting over the sealed area of 16,130 square centimeters.

4. Up to 20 bars additional loading may be expected on the downstream side in lateral currents.

FIGURE 4-2b. DETAIL OF TYPICAL SUBMARINE HATCH RESCUE SEAT

The skirt mating flange contains a rubber gasket designed to seal rescue seat irregularities up to 0.125 inches (0.3175 centimeters). The surface of the rescue seat must be flat within 0.125 inches at all rescue depths and under the loads imparted by the DSRV. The skirt flange details are shown in figure 4-3.

4.2.3 Projections and Obstructions

Projections and obstructions above the hull of the disabled submarine in the vicinity of the escape hatch present hazards to the DSRV when it is maneuvering during the mating operation. The obstructions could interfere with the DSRV skirt or keel pod, and damage caused by impacting the obstructions could prevent mating. Therefore an area encompassing a 220-inch diameter (5.59 meters) centered on the rescue seat should be clear of obstructions and projections above the hull. Unavoidable obstructions within and adjacent to this area must be documented and available for briefing the DSRV operators.

The DSRV is 98.50 inches (2.5 meters) wide and extends 280 inches (7.11 meters) forward and 312 inches (7.92 meters) aft of the center of the skirt.

The DSRV is equipped with a mechanical arm (manipulator) which can be used to clear the hatch area of the disabled submarine of debris. The manipulator also has a cable cutter with a cutting force of 20,000 pounds (9072 kilograms), capable of cutting a 5/8-inch diameter (1.5875 centimeters) steel wire rope. The manipulator can be used to cut and clear a messenger buoy cable if such a cable is used. In the event a cable passes over the rescue seat area, a 3-inch high (7.62 centimeters) by 3-inch wide space is required under the cable for manipulator access.

4.2.4 Hatch Construction

The disabled submarine hatch must open upward into the skirt cavity while mated; therefore its opened dimensions must be such as to permit egress from the submarine through the skirt into the DSRV. The minimum internal all-around clearances of the DSRV skirt are shown in figure 4-4. These clearances indicate the greatest protrusion of any skirt interior item toward the center of the skirt cavity.

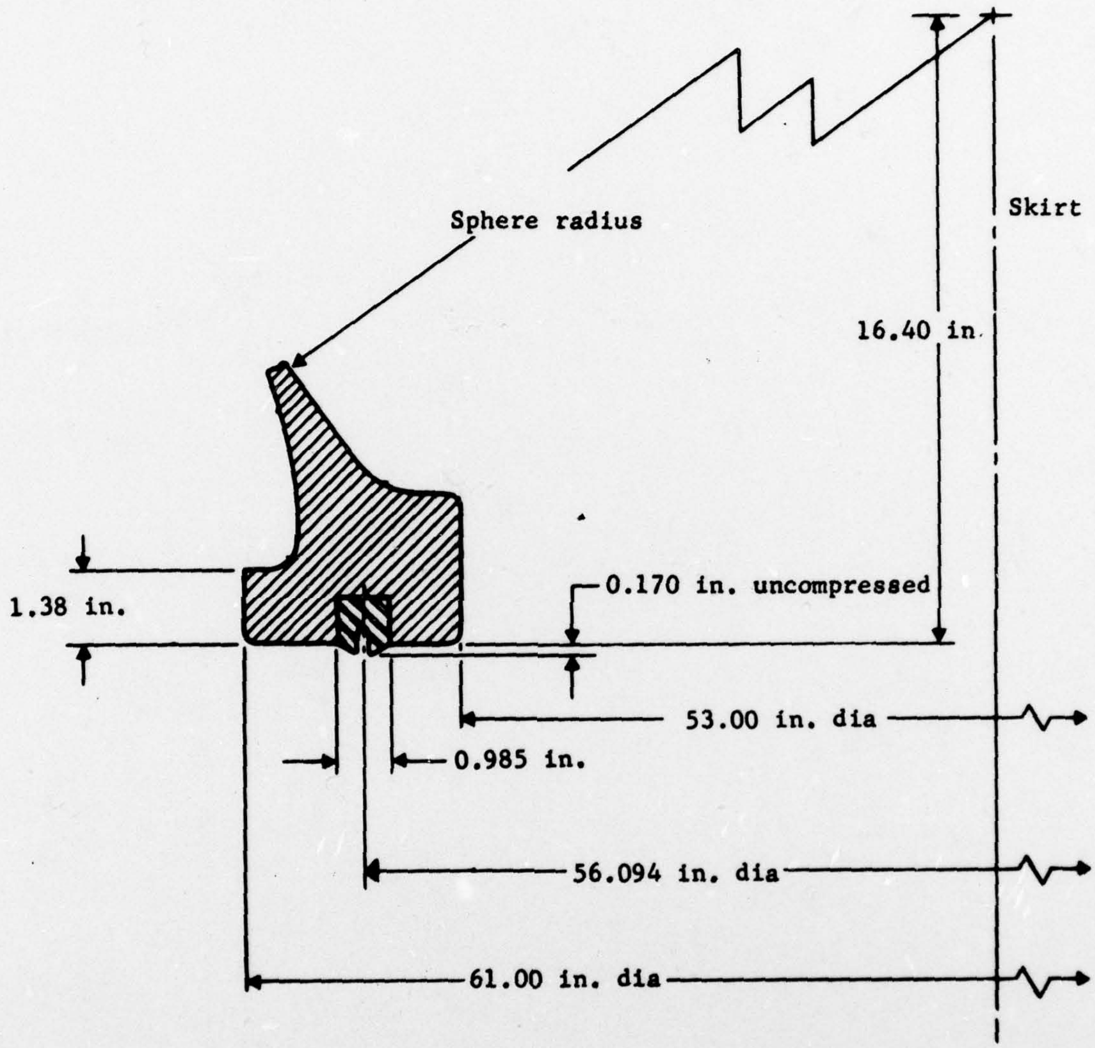


FIGURE 4-3a. DSRV SKIRT FLANGE DETAIL

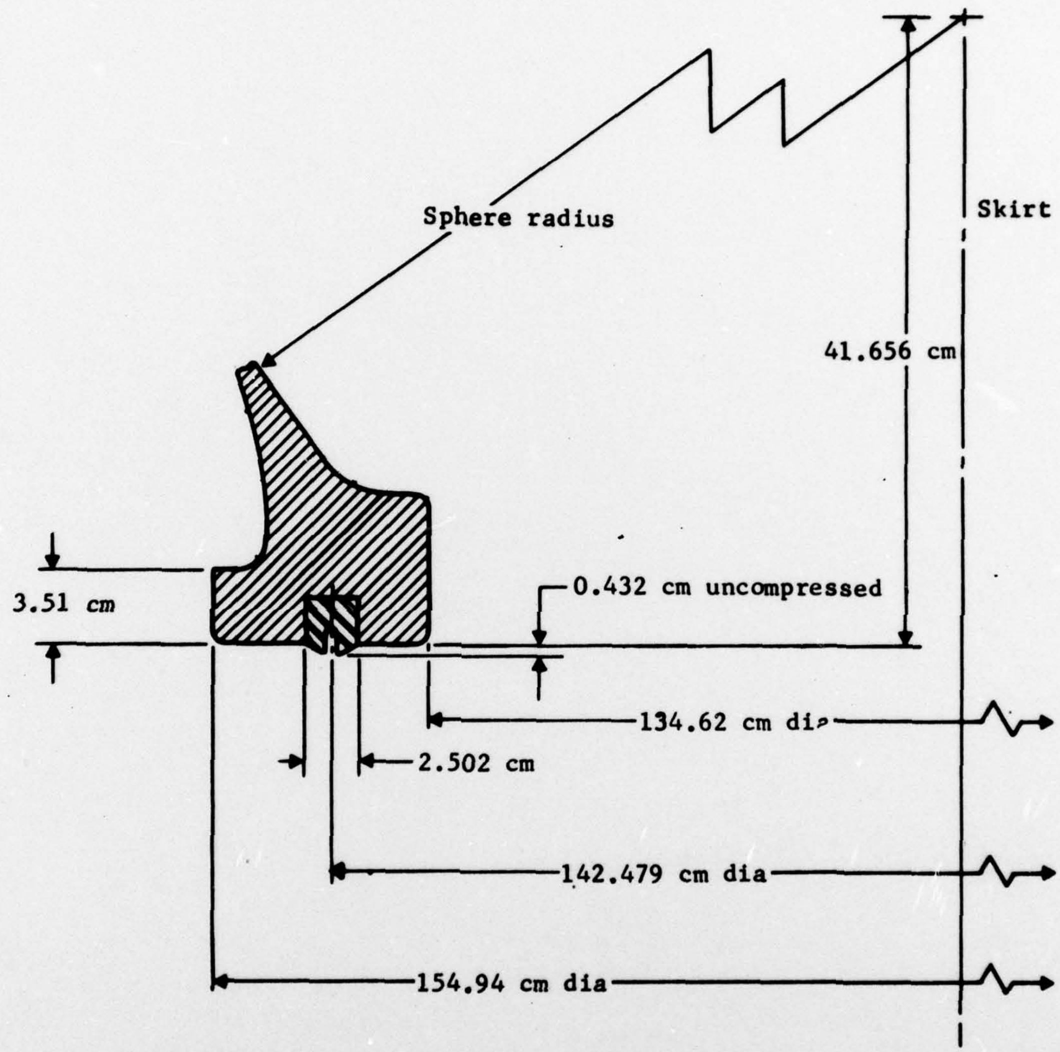


FIGURE 4-3b. DSRV SKIRT FLANGE DETAIL

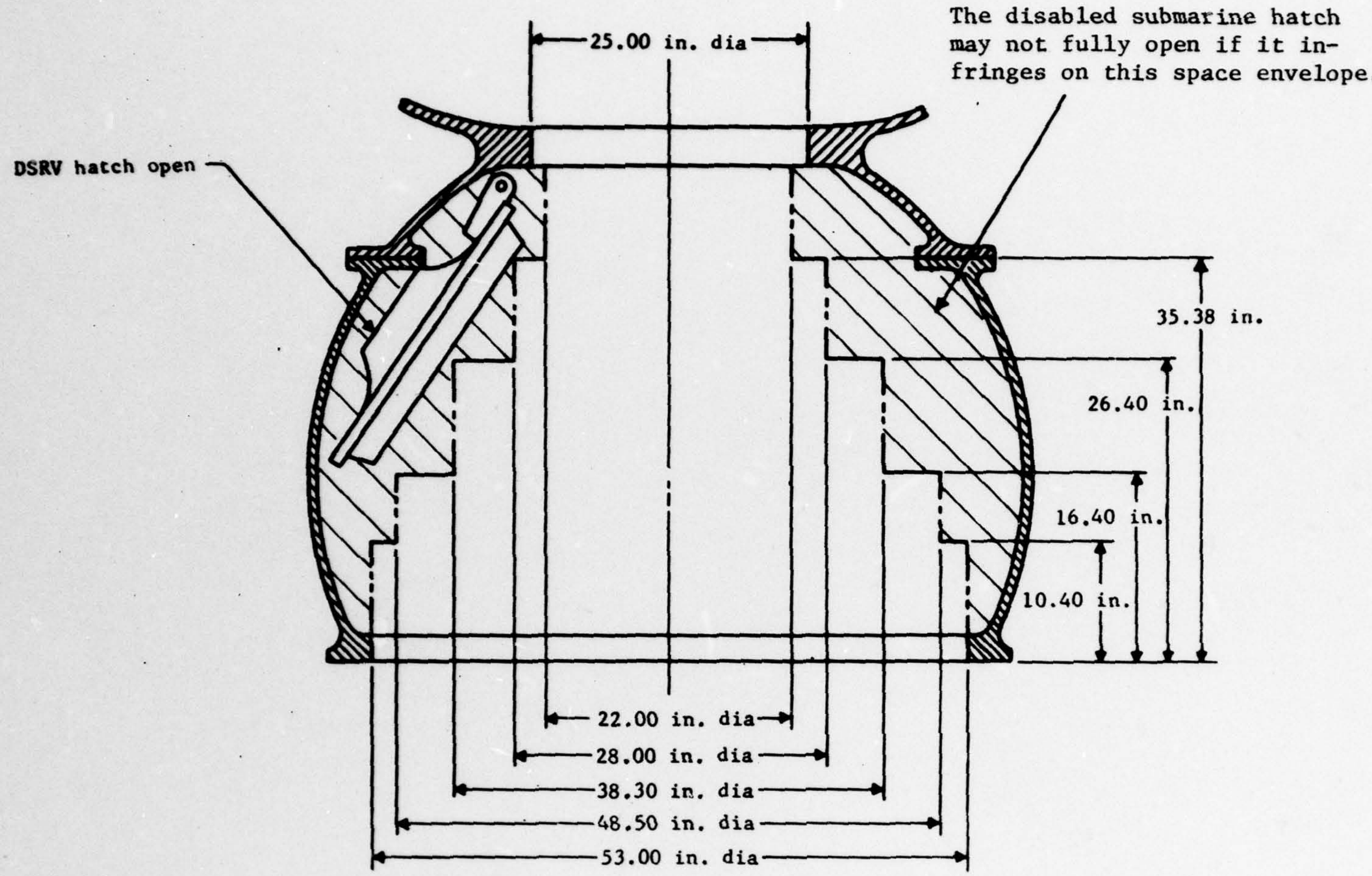


FIGURE 4-4a. DSRV SKIRT EQUIPMENT ENVELOPE

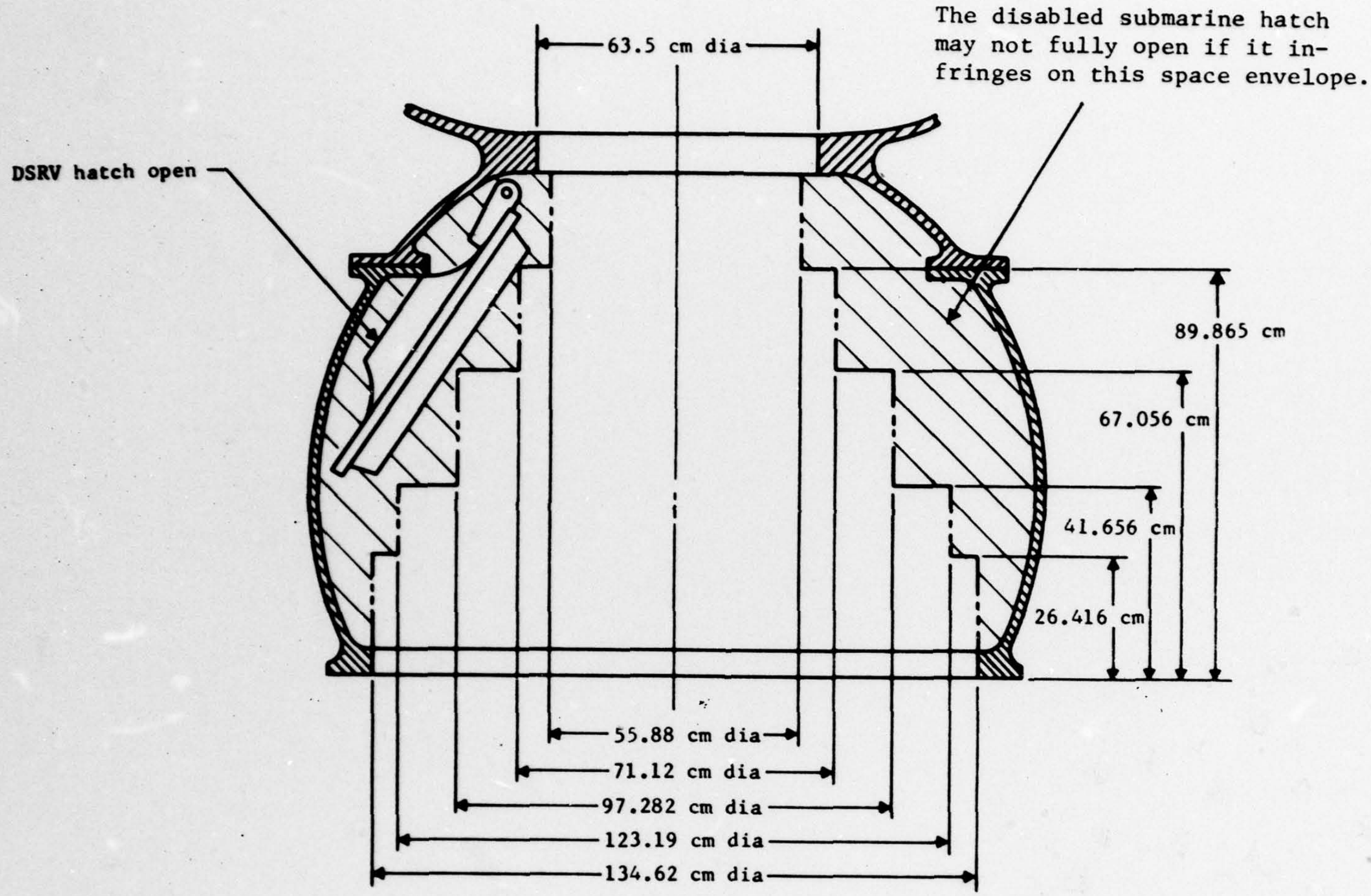


FIGURE 4-4b. DSRV SKIRT EQUIPMENT ENVELOPE

4.2.5 Pressure Equalization

Pressure differential, if any, between the DSRV and the disabled submarine must be equalized before the submarine's hatch can be opened.

4.2.6 Rescue Vehicle Ballast Drain

The DSRV carries approximately 4000 pounds (1814 kilograms) of water ballast which will be drained off to maintain neutral buoyancy after taking rescuees aboard. This water is carried in the rescue spheres of the DSRV and must be drained into the disabled submarine after the DSRV mates to the submarine. The water is metered so that the proper buoyancy can be maintained. This water can be drained into the disabled submarine through the open hatches.

4.2.7 Mission Aids

The use of acoustic transmitters on the disabled submarine would assist in reducing mission time. U.S. Navy submarines are being equipped with dual battery-powered acoustic beacons (pingers) which generate pulsed 3.5 KHz acoustic signals.

Communications between the DSRV and the disabled submarine would be most beneficial to the rescue operation, but the rescue can be accomplished without communication. The DSRV and the support ship will both have the standard U.S. Navy single sideband underwater telephone systems which operate on a carrier frequency of 8 KHz with a sideband modulation out to 11.1 KHz.

4.2.8 Personnel Requirements

No specialized training is required by the personnel of the disabled submarine to make use of the DSRV Rescue System.

4.3 AVAILABILITY AND DEPLOYMENT

4.3.1 Readiness and Initial Actions

The U.S. Navy has two DSRVs. Standard procedures have been established to ensure rapid response to a disabled submarine notification. The system is loaded on board the aircraft and transported with the necessary personnel to a port near the disabled submarine location.

4.3.2 Deployment Requirements

Successful deployment of the DSRV Rescue System requires knowledge of conditions and characteristics of roads to be traversed, airfields and ports to be used, and the attendant support equipment. Proper coordination with cognizant authorities is also a prerequisite for control of system movement.

4.3.2.1 Airfield Requirements

Airfields must be capable of receiving the DSRV system aircraft. Some candidate airfields have been selected and are specified in Subsection 4.4.

4.3.2.2 Ground Handling Equipment

Ground handling equipment is necessary at the airfield to load material onto vehicles for road transportation to the nearby port. The material description, volume, weight, and number of items are shown in Table 4-1.

4.3.2.3 Motorized Support Equipment

The following motor vehicles must be available at the staging area to transport the DSRV and associated equipment from the airfield to the staging port:

a. One truck tractor of 107-inch (271.78 centimeters) maximum height with a 120,000-pound (54,432 kilograms) tow capability and standard U.S. type commercial fifth-wheel having a ground height of 50-60 inches (127-152 centimeters) to tow the loaded LTV.

b. One truck or truck tractor with 25,000-pound (11,340 kilograms) tow capability pintle hook capable of utilization with a 3-inch (7.62 centimeters) inside diameter lunette eye tow bar of 1.625-inch (4.13 centimeters) thickness to tow the support van.

c. Stakebed trucks or flatbed trailers to transport the material listed in table 4-1.

d. Convoy and traffic control vehicles as required.

TABLE 4-1

MATERIAL DIMENSIONS

QUANTITY	ITEM	WEIGHT		VOLUME	
		POUNDS	KILOGRAMS	CUBIC FEET	CUBIC METERS
1	Mission Container(MOSUB 1)	510	231	57.9	1.64
1	Mission Container(MOSUB 2)	834	378	57.9	1.64
1	Mission Container(MOSUB 3)	992	450	57.9	1.64
1	Mission Container(MOSUB 4)	820	372	57.9	1.64
1	Mission Container(MOSUB 5)	730	331	57.9	1.64
1	Mission Container(MOSUB 6)	697	316	57.9	1.64
1	Mission Container(MOSUB 7)	725	329	57.9	1.64
1	Mission Container 1	700	318	57.9	1.64
1	Mission Container 2	812	368	57.9	1.64
1	Mission Container 3	702	319	57.9	1.64
1	Mission Container 4	855	388	57.9	1.64
1	Mission Container 5	1,275	578	57.9	1.64
1	Mission Container 6	1,010	458	57.9	1.64
1	Mission Container 7	1,325	601	57.9	1.64
1	Mission Container 8	1,470	667	57.9	1.64
1	Mission Container 9	1,160	526	57.9	1.64
5	Mission Containers 10-14 (Total)	6,500	2,949	289.5	8.19
1	DSRV Lift Sling Assembly	1,350	613	18.5	0.52
6	DSRV Shoulder Pod Segments (Total)	3,000	1,360.8	300.	8.50
1	DSRV Pylons and Dolly	9,150	4,152	360	10.19
1	DSRV Skirt and Dolly	3,500	1,588	164	4.64
2	DSRV Battery Cover Fairing (Total)	470	213	51.6	1.46
1	DSRV Safety Rails	1,182	536	116	3.28
1	Keel Pod and Dolly	2,500	1,134	200	5.66
34		42,269	19,175.8	2426.	68.68

4.3.2.4 Road Network Requirements

The loadbearing capacity and clearance required of the road network linking the airfield and port, including bridges, tunnels, overhead obstacles, turns and curves, are:

a. Roadway loadbearing capacity equal to or greater than

   (1) A gross load of 125,000 pounds (56,700 kilograms).

   (2) A maximum single-axle load of 21,000 pounds (9,526 kilograms).

b. A minimum road width of 12 feet (3.66 meters) on straightaways.

c. A minimum height of overhead obstructions of 13 feet 6 inches (4.11 meters). In addition, any height needed to prevent arcing of overhead wires or power lines must be added.

d. A minimum 34-foot (10.36 meters) roadway width in the vicinity of a 90-degree corner. For corners of over 90 degrees the road width requirement increases 1 foot (0.3048 meters) for each additional 3 degrees of turn.

e. On curving roads the minimum road width requirement of the LTV/DSRV depends on the radius of curvature of the roadway. Figure 4-5a is a graph showing the minimum required road width as a function of the radius of road curvature. Curves falling in the area marked "Safe Zone" are acceptable for LTV/DSRV travel.

4.3.2.5 Seaport Requirements

The seaport serving as a staging area for a submarine rescue mission must provide:

a. A water depth of 30 feet (9.14 meters) or more at mean low water or mean lower low water, whichever is applicable, for rescue missions using an ASR or a mother submarine.

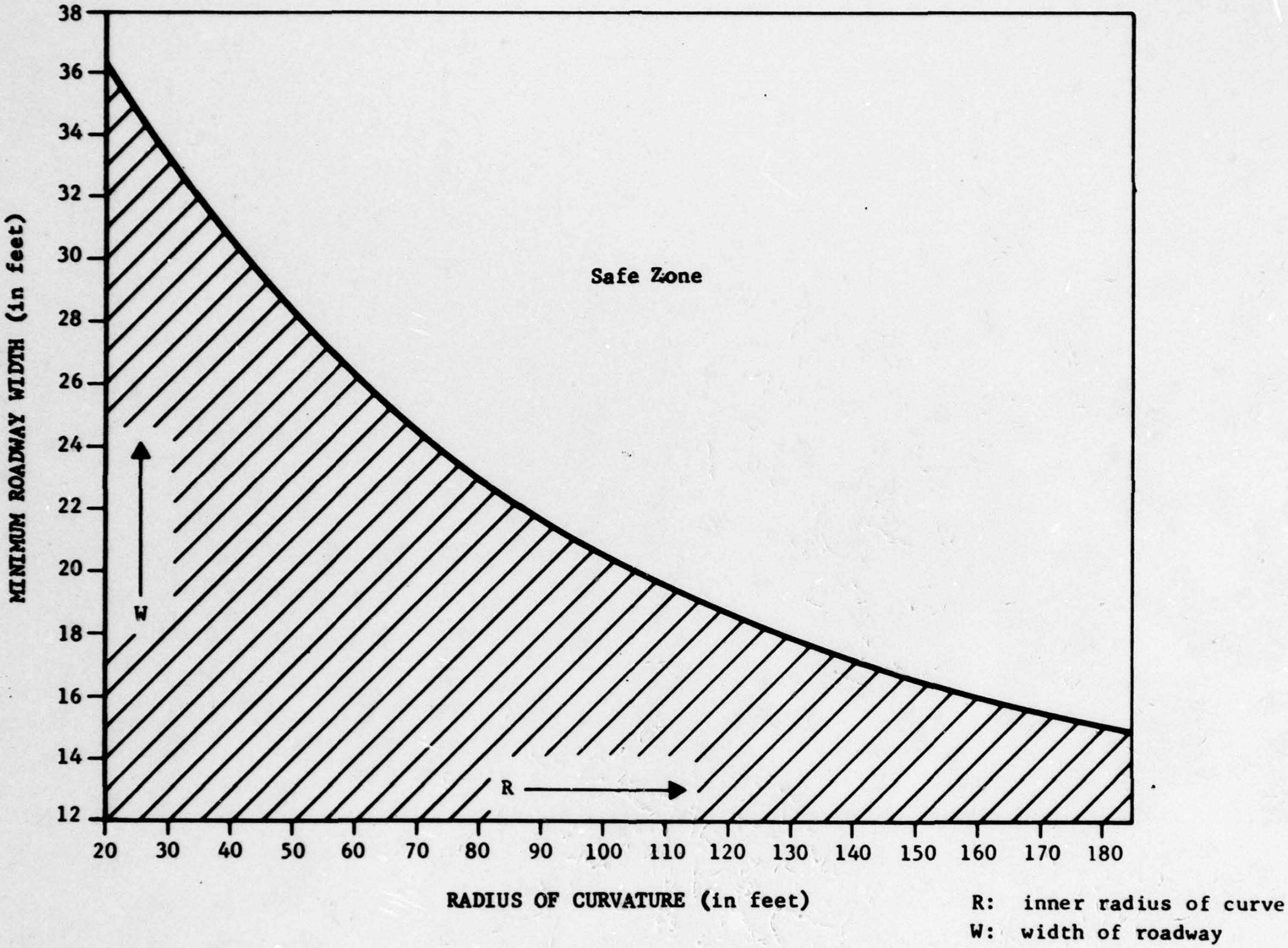


FIGURE 5a. MINIMUM REQUIRED ROADWAY WIDTH AS A FUNCTION OF ROAD CURVATURE RADIUS

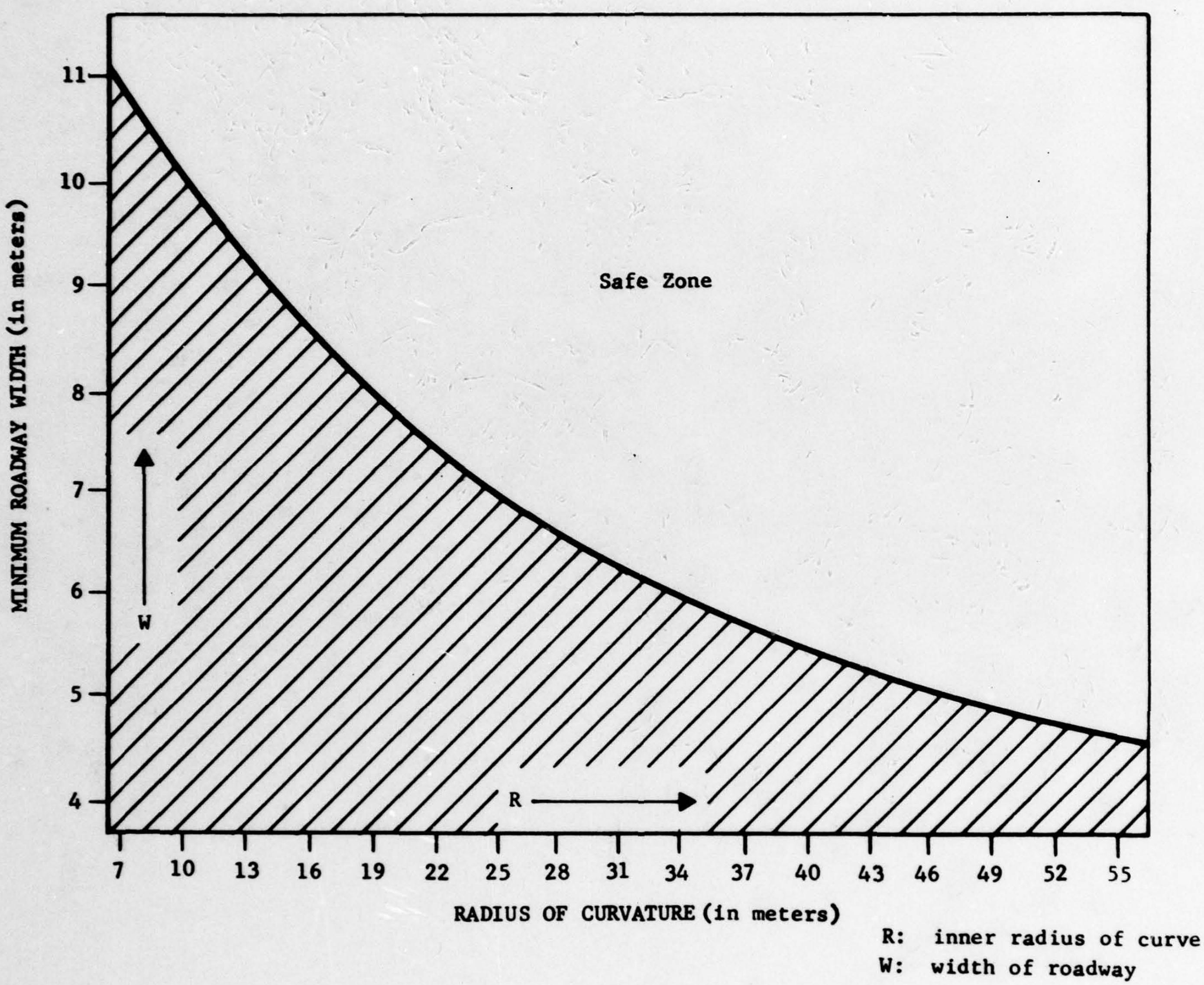


FIGURE 4-5b. MINIMUM REQUIRED ROADWAY WIDTH AS A FUNCTION OF ROAD CURVATURE RADIUS

b. A loading pier with the following characteristics:

- A length of at least 350 feet (107 meters).

- A width of at least 30 feet (9.14 meters).

- A loadbearing capacity of 150,000 pounds (68,040 kilograms) gross load, with a maximum axle load of 21,000 pounds (9526 kilograms) and an average single wheel load of 3875 pounds (1758 kilograms).

These are necessary to withstand the weight of the LTV with DSRV and support van alongside, plus truck or trailer for off-loading crated material.

c. Crane capability as follows:

- Boom reach from 10 feet (3.048 meters) inside the pier apron to the centerline of a submarine or ship 18 feet (5.49 meters) from the pier pilings or camel.

- A hook height 25 feet (7.62 meters) above the pier.

- A lifting capacity of at least 40 short tons (36.3 metric tons) at the above-cited reach.

d. Materials handling equipment to unload containers and crates from equipment trailer to pier.

4.4 PORT/AIRFIELD CANDIDATES

Candidate submarine rescue port/airfield combinations outside the U.S. have been selected and have been divided into five groups according to their geographical locations. These selections are listed in tables 4-2 to 4-6. In addition, a number of U.S. ports may be utilized. Candidate port/airfield combinations may be changed as more facilities become available; therefore, the tables should not be considered final. It is emphasized that these are only candidate port/airfield combinations. Cognizant countries that desire to have the capability of utilizing the DSRV should verify that all DSRV support requirements can be met.

TABLE 4-2

SUBMARINE RESCUE PORT/AIRFIELD COMBINATIONS
NORTH ATLANTIC/MEDITERRANEAN/CARIBBEAN AREAS

SEAPORT	AIRFIELD
Algiers	Alger/Dar El Beida
Guantanamo Bay	Guantanamo NAS
Liverpool	Liverpool
Portsmouth	Farnborough
Marseille	Marseille/Marignane
Bremerhaven	Nordholz
Piraeus	Athinai (Athens)
Thessaloniki	Thessaloniki
Thule	Thule AFB
Genoa	Genova/Sestri ITAFB
Naples	Napoli/Capodichino ITAFB
Beirut	Beirut International
Rotterdam	Rotterdam
Halifax	Halifax International
Lisbon	Lisbon
Dakar	Dakar/Yoff
Palermo	Palermo/Punta Raisi ITAFB
Barcelona	Barcelona
Rota	Rota NS
Stockholm	Stockholm/Arlanda
Port of Spain	Piarco
La Guaira	Maiquetia
Roosevelt Roads	Roosevelt Roads

TABLE 4-3

SUBMARINE RESCUE PORT/AIRFIELD COMBINATIONS
SOUTH ATLANTIC OCEAN AREA

SEAPORT	AIRFIELD
Luanda	Luanda
Salvador (Bahia)	Dois De Julho
Capetown	D. F. Malan (Capetown National)
Montevideo	Carrasco

TABLE 4-4

SUBMARINE RESCUE PORT/AIRFIELD COMBINATIONS
NORTH PACIFIC OCEAN AREA

SEAPORT	AIRFIELD
Hong Kong	Kai Tak (Kowloon)
Apra	Agana NAS
Balboa (C.Z.)	Howard AFB
Subic Bay	Cubi Point NAS
Chilung	Taipei International
Rodman (C.Z.)	Howard AFB
Naha	Naha AB

TABLE 4-5

SUBMARINE RESCUE PORT/AIRFIELD COMBINATIONS
SOUTH PACIFIC OCEAN AREA

SEAPORT	AIRFIELD
Brisbane	Brisbane
Sydney	Kingsford Smith
Antofagasta	Cerro Moreno
Auckland	Auckland International
Callao	Jorge Chavez International
Pago Pago	Pago Pago International
Guayaquil	Simon Bolivar
Valparaiso	Pudahuel

TABLE 4-6

SUBMARINE RESCUE PORT/AIRFIELD COMBINATIONS
INDIAN OCEAN AREA

SEAPORT	AIRFIELD
Fremantle	Perth
Colombo	Colombo/Bandaranaike
Madras	Madras
Singapore	Singapore SDCA
Djibouti	Djibouti
Durban	Louis Botha
Jeddah	Jeddah

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