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SYSTEMS DIVISION

whirlpool CORPORATION

300 BROAD STREET, ST. JOSEPH, MICHIGAN

PHASE I REPORT

DEVELOPMENT OF FLEXIBLE FOAMED FILLED STRUCTURES

NASA-HOUSTON CONTRACT NAS 9-2031

18 SEPTEMBER 1963 TO 18 DECEMBER 1963

SYSTEMS DIVISION

WHIRLPOOL CORPORATION
300 BROAD ST. • ST. JOSEPH, MICHIGAN 49085

SUBJECT: Development of Flexible Foamed Filled Structures

CONTRACT NO. NAS 9-2031

DESCRIPTION OF WORK: Development of a urethane formulation and drawings of the foam machine and double walled life raft for Phase I.

PREPARED FOR: National Aeronautics & Space Administration
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Houston 1, Texas

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Director, Life Support Department

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DEVELOPMENT OF FLEXIBLE FOAMED FILLED STRUCTURES

Phase I Report, Progress During 18 September 1963 to 18 December 1963

SUMMARY

24056

During the first phase of the contract period a suitable urethane foam formulation was developed that would meet the necessary requirements for storage life and foaming the life raft.

A static head for mixing this particular formulation was developed and tested. The head was incorporated in the schematic drawing of the proposed portable, static foam machine.

Several types of raft design and construction were tried and a finalized design was developed that incorporates an inner CO_2 gas chamber with an outer concentric tube for foaming in place and the two tubes spaced in position with narrow tapes of the raft material. A prototype of this design was fabricated and foamed in place. Buoyancy of the raft was tried in the inflated condition and the foamed condition.

Author

Reports on the various components called for in the contract follow:

I. FORMULATION DEVELOPMENT

The formulation of the foaming components should be such that the following properties are achieved in order that the requirements of the contract can be fulfilled:

A. Stable over the required temperature range.

B. Of suitable viscosity over the temperature range that will allow adequate mixing.

C. Of minimum number, preferably only two components.

D. Of such physical and chemical nature that when the components are mixed together, the resulting mix will be of a low enough viscosity so that it will flow along the length of the raft, and upon turning into foam will allow itself to be pushed along the length of the raft into and around all of the construction protuberances before hardening or setting up.

E. The resulting foam should, after curing, have good stability and not shrink in cold temperatures or expand greatly in hot temperatures; it should also be non-fryable and resiliant with good adherance to the raft walls.

F. The cure should be reasonably fast after foaming.

For preliminary formulation screening, the machine used was a Whirlpool Urethane Foam Machine with a 35 pound per minute delivery. This machine was equipped with a Martin-Sweets, Model No. VMD 225 mixing head. So that the foam performance could be evaluated visually, heat sealed tubes made from polyethylene film 4 mil in thickness were used as molds. Each tube was 8½ inches in diameter and 120 inches long with an internal volume of 3.94 cubic feet. It was felt that any foam formulation satisfactorily filling this large structure would also fill the raft cavity under almost any circumstances. In addition, simulated rafts heat sealed out of the same material, with an internal volume of 1.7 cubic feet, were used to test the circular flow of the foam material in both directions. The following are the prepolymer type foam combinations evaluated in the early period of this investigation:

Formulation No. 1	Parts By Weight
Atlas Chemical Company G-2410 Resin	35.00
Trichloromonofluoromethane (R_1 in other formulas)	18.00
Tetramethylbutanediamine	0.50
Triethylenediamine	0.20
General Electric Silicone 1079	0.75
Isocyanate Products, Inc., PE-2 Prepolymer	45.60

Machine Rate: 0.525 lbs/sec.

Foam Characteristics: Poor flowability in both tube and raft models.

Formulation No. 2	Parts By Weight
Atlas Chemical Company G-2571 Resin	36.00
Union Carbide Corp. LA-475 Resin	6.45
Dimethylethylamine	1.00
Triethylenediamine	0.10
R_1	17.00
Allied Chemical Co. Nacconate 4040	38.70
General Electric Co. Silicone 1079	0.75

Machine Rate: 0.474 lbs/sec.

Foam Characteristics: Good flowability in both raft and tube molds, filled tube with 8.25 lbs. of foam.

Formulation No. 3

Same as No. 1, except that 0.30 parts of triethylenediamine were added.

Machine Rate: 0.470 lbs/sec.

Foam Characteristics: Poor flowability, did not fill tube, raft was not tried.

Formulation No. 4	Parts By Weight
Atlas Chemical Co. G-2410 Resin	34.38
R_1	20.00
Tetramethylbutanediamine	1.00
Triethylenediamine	0.02
General Electric Silicone 1079	0.50
Isocyanate Products, Inc. PE-2 Prepolymer	40.10

Machine Rate: 0.489 lbs/sec.

Foam Characteristics: Very poor flowability, slow cure, did not fill tube molds, raft was not tried.

Formulation No. 5	Parts By Weight
Atlas Chemical Co. G-2410 Resin	31.10
R_1	25.00
Tetramethylbutanediamine	1.00
Dimethylethanolamine	1.00
General Electric Silicone 1079	0.50
Isocyanate Products, Inc. PE-2 Prepolymer	41.40

Machine Rate: 0.468 lbs/sec.

Foam Characteristics: Good flowability, filled tube with 7.4 lbs., tube of foam shrank badly when placed outdoors in 40°F air temperature, raft was not tried.

Experiments with prepolymer form formulations were concluded with this run because of the poor physical properties. These systems were tried originally because data available shows excellent long term storage life stability of the components.

The following formulations are of the "one-shot" type where the toluene diisocyanate is used without first cooking it with some of the resin to form a prepolymer. It is believed that the long term storage stability can be achieved by the elimination of the Union Carbide LA-475 from Formulation No. 7.

Formulation No. 6	Parts By Weight
Atlas Chemical Co. G-2571 Resin	36.00
Union Carbide Corp., LA-475 resin	6.45
General Electric Corp., Silicone 1079	0.75
Dimethylethanolamine	1.00
Triethylenediamine	0.20
R_1 -B	17.00
Allied Chemical Co., Naccanate 4040	38.60

Machine Rate: 0.399 lbs/sec.

Foam Characteristics: Poor flow, tube did not fill with 9 pounds of material, raft was not tried. The same formulation was tried after aging the mixture for 24 hours.

Machine Rate: 0.390 lbs/sec.

Foam Characteristics: Good looking material, but the tube did not fill with 8.2 pounds of foam, raft was not tried.

Formulation No. 7	Parts By Weight
Atlas Chemical Co., G-2571 Resin	100.00
Dimethylethanolamine	3.00
Triethylenediamine	0.50
R_1	50.00
General Electric, Silicone 1079	3.00
Allied Chemical Co., Naccanate 4040	91.00

Machine Rate: 0.395 lbs/sec.

Foam Characteristics: Foam looked very poor in cell structure, did not fill tube. Same formulation aged 48 hours was tried.

Machine Rate: 0.472 lbs/sec.

Foam Characteristics: Foam looked good and filled tube with 7.25 lbs. of foam, raft filled with 3.5 lbs. of foam, tried to fill full scale raft, but the exotherm caused the heat sealed joints of the polyehtylene to fail.

Formulation No. 7 looks good when the master batch is properly aged. This mix will be used in the preliminary development of the static mixing head. Several more scale rafts of polyehtylene were foamed with Formulation No. 7, and it was found that the best flow characteristics were obtained when the application port in the raft was located at the center of the radius in the small end (the end with the least thickness). This is believed to be the result of the ever increasing diameter that the foam flows through during the process when the mix is delivered at the small end.

II. FOAM MACHINE DEVELOPMENT

At the beginning of this project all of the currently available foam machines used a rotating mixing blade to mix the components. The machine used in the formulation development had a mixer blade that rotated about 5000 rpm. While a rotating blade type machine is possible in the small size required by this project, it was determined that considerable weight and size would be eliminated if a static type mixer could be made to work with the required formulation, or a modified version of it.

Three small heads about six inches long and one inch in diameter were built. The static mixing core of the first head was a standard DuPont type helical mixing blade; the second head had six 1/8" diameter rods running lengthwise through the core; the third head left the rods out and the holes that contained the rods were open. This head weighed 4 lbs. 2 oz. with housing.

<u>Blade No. 1</u>

Machine Rate: 0.1785 lbs/sec.
Resin Tip: 1/16" Dia., pressure at 75 psi
TDI tip: 3/64" Dia., pressure at 50 psi

Foam did not look very satisfactory.

<u>Blade No. 2</u>

Tips the same as above.

<u>Tube No. 1</u>
Machine Rate: 0.185 lbs/sec.
Fill Time: 40.0 sec.
Wt. of Foam in Tube: 5.31 lbs.

Tube did not fill.

Tube No. 2
Machine Rate: 0.185 lbs/sec.
Fill Time: 51. sec.
Wt. of Foam in Tube: 6.31 lbs.
Tube did not fill.

Tube No. 3
Machine Rate: 0.1475 lbs/sec.
Fill Time: 60.0 sec.
Wt. of Foam: 9.12 lbs.
This tube overfilled.

Tube No. 4
Machine Rate: 0.1475 lbs/sec.
Fill Time: 51.0 sec.
Wt. of Foam: 7.31 lbs.
This tube filled.

Two gallon commercially available type pressure paint tanks were used to supply the components to the mixing head. While these will not work in any position, they will supply the resin for satisfactory development of the mixing heads.

Tube No. 5
Machine Rate: 0.0926 lbs/sec.
Fill Time: 81. sec.
Wt. of Foam: 4.2 lbs.
Tube did not fill

Tube No. 6
Machine Rate: 0.0926 lbs/sec.
Fill Time 160.0 sec.
Wt. of Foam: 5.0 lbs.
Tube did not fill.

Blade No. 3

Tube No. 7
Tank pressure constant 65 psi
Machine Rate: 0.1375 lbs/sec.
Fill Time: 40.0 sec.
Wt. of Foam: 5.5 lbs.
Tube did not fill.

<u>Tube No. 8</u>
Tank pressure sealed at 70 psi.
Machine Rate: 0.1018 lbs/sec.
Fill Time: 54. sec.
Wt. of Foam: 5.5 lbs.
Tube did not fill and air pressure dropped to 50 psi on both tanks.

<u>Tube No. 9</u>
Tank pressure preset at 90 psi.
Machine Rate: 0.1214 lbs/sec., figured at 70 psi.
Fill Time: 54.0 sec.
Wt. of Foam: 6.56 lbs.
Tube lacked filling by 15 inches from end.

<u>Tube No. 10</u>
Same conditions as tube no. 9.
Fill Time: 63 sec.
Wt. of Foam: 8.0 lbs.
Tube did not fill and flow was very unsatisfactory and stopped 10 inches from end.

<u>Tube No. 11</u>
Same conditions as above, except small tip on head.
Fill Time: 63 sec.
Wt. of Foam: 7.5 lbs.
Tube did not fill although foam looked very good with poor flow.

All of the runs were made with the blade core as shown in Figure 1. The blade is resting on a cross section of a foam sample that it made. Notice that the cell structure is excellent.

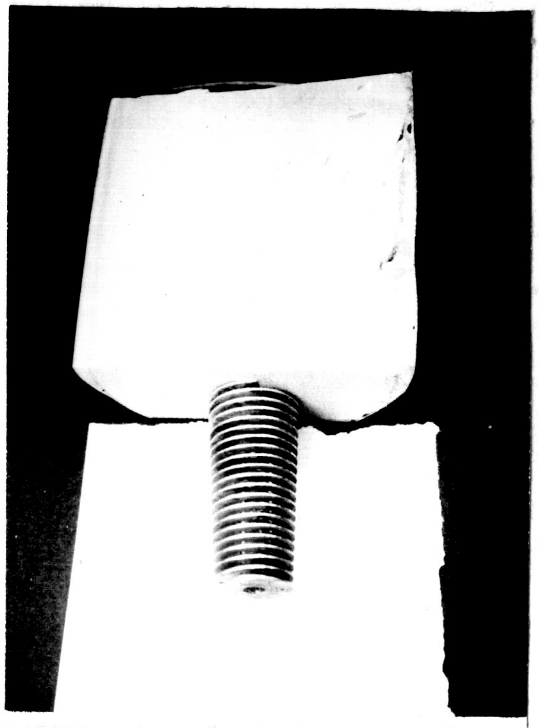


Figure 1
Helical Blade With Six Sets of Holes Running Axially

Next a series of mixing blades were made up consisting of differently shaped disks stacked on 1/4 inch diameter rods. The first is shown in Figure 2 and consists of 15 flat disks with a notch cut out of each one, and so stacked on the rod that the notches are not adjacent. Although this mixer worked quite well, the foam lacked strength.

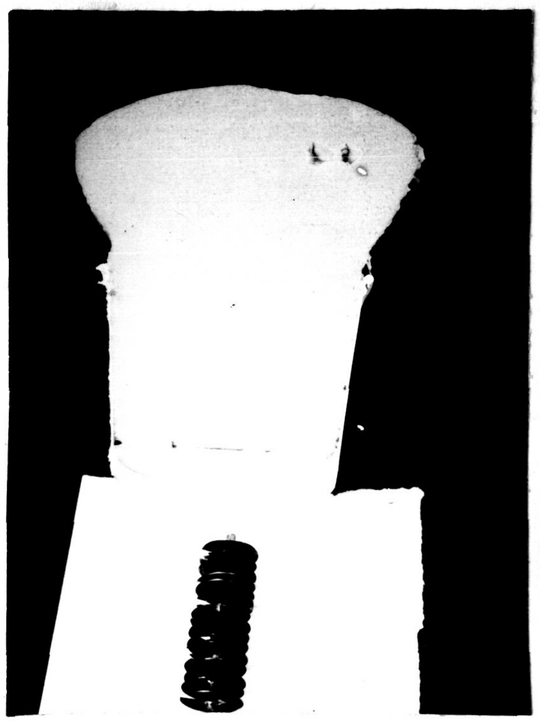


Figure 2
Notched Circular Disks Mixing Blade

In Figure 3, the mixing blade consists of 16 disks of wire wesh stacked on the rod. As can be seen from the photograph of the cross section of the foam sample, the cell structure is large and the foam porous.

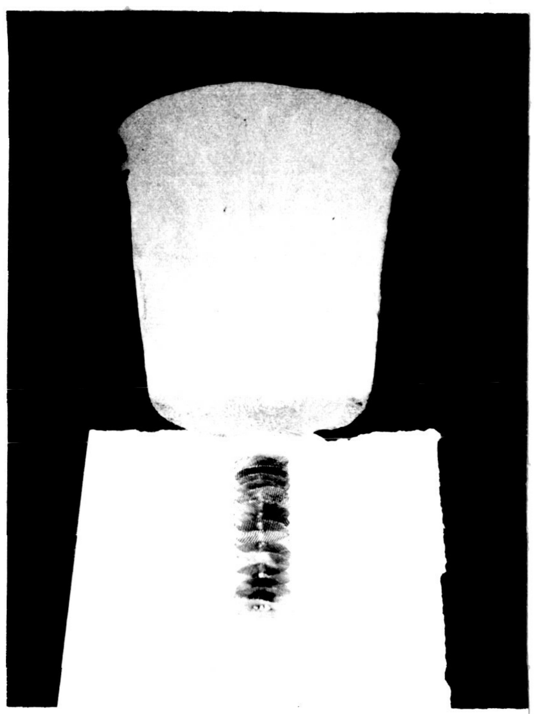


Figure 3
Wire Screen Disks Mixing Blade

Twelve metal disks were then V-notched in four places on each disk at 90 degree intervals and stacked on the rod for a mixing blade, which is shown in Figure 4. This foam did not look good either.

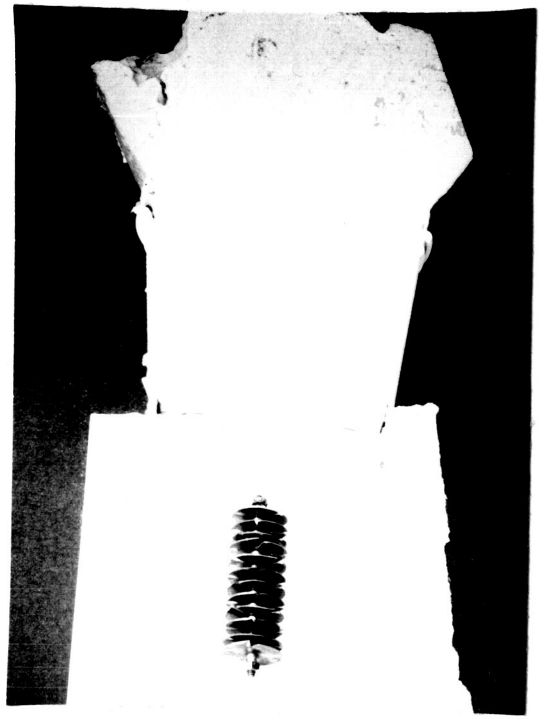


Figure 4
Blade of Disks With Four Notches

The disks in Figures 3 and 4 were then combined so that each solid disk was immediately backed with a wire cloth disk. This did not seem to improve the foam as shown in the sample in Figure 5.

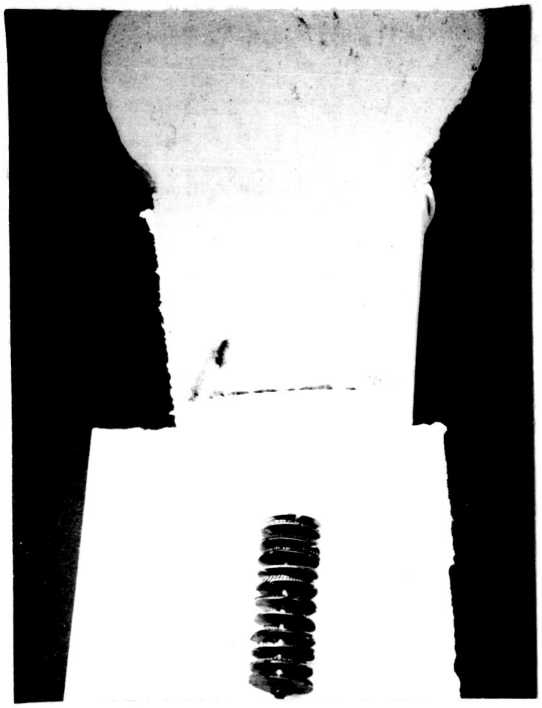


Figure 5
Notched Metal and Wire Cloth
Combination Blade

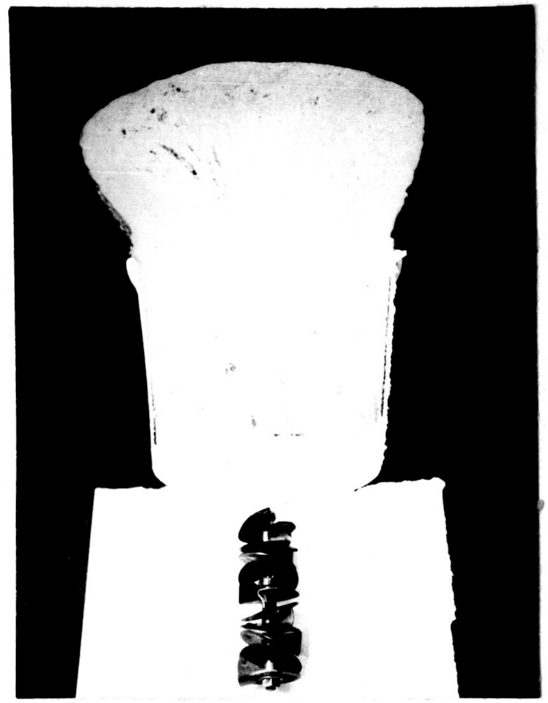


Figure 6
Mixing Blade of Disks With Corners Of
Notches Bent at 90 Degrees.

Likewise, the use of 12 disks with the corners of the notches bent at a right angle, so that each disk touched the adjacent one, did not seem to produce a satisfactory foam.

At present, a satisfactory mixing blade is in use in the static head. This mixing blade, which has evolved from the above experiments, consists of a series of one inch diameter aluminum disks of about 20 gauge. Four 1/16 inch diameter holes are punched in one half of the disk and 48 of these stacked on a 1/8 inch diameter aluminum rod, with about two thicknesses of material between each disk taken up by small 1/4 inch diameter washers. The holes in the halves of each disk alternate from side to side due to the way in which the disks are stacked (Figure 7). The theory is that the material is extruded through the hole obtaining mixing as it goes through somewhat like a homogenizer. It then hits the flat metal of the next disk and obtains more mixing as it sprays in all directions on the metal surface, before flowing across the disk and through the holes on the disk.

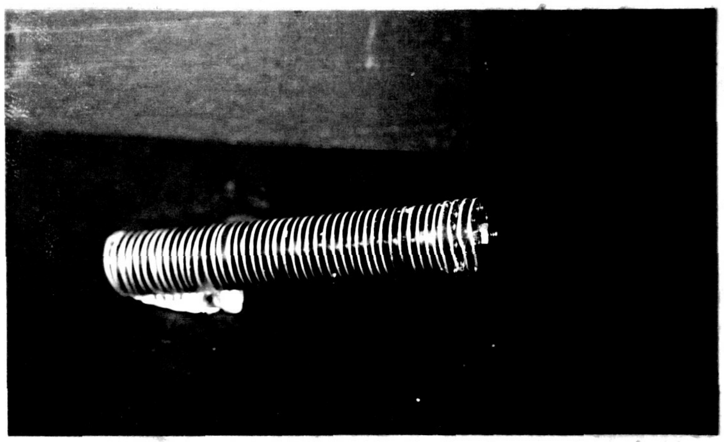


Figure 7
Present Mixing Blade for Static Head Mixer

Efforts will be made to reduce the size of the head by use of different materials. Since the final head will be used on the raft as a one-use piece of equipment and then thrown away, it is conceivable that the whole head could be made of plastic, such as polypropylene.

The portable foam machine to incorporate the mixing head is shown in the accompanying drawing, No. 9203-2. This is the size approximately necessary to foam the raft of the present design with allowances for adverse foaming conditions. Each tank holding a foam component is of aluminum and of a size corresponding to the ratio of the materials used in the formulation. Each component tank has a urethane elastomer bladder or diaphragm so that it may be pressurized on one end in the manner of an accumulator. Thus the tanks and foam machine will function in any position. One end has a small air valve for use in pressurizing and the other has a filling and shut-off valve that would be used in storage until the tank is activated in the foam machine. The shut-off vlave is in the form of a small rotary ball cock and the whole valve can be removed by unscrewing from the tank to give an opening for filling. The third small tank in the drawing contains air that has been found necessary to be introduced into the foam head for the formulation of good foam, It too, has a small air valve at one end for filling and a shut-off valve of the rotary type on the other end. Non-collapsible plastic tubing connects the three tanks to the central rotary valve, also of plastic, and thence to the foaming head. The end of the foaming head will be connected to the raft by another piece of plastic tubing. To foam the raft, the operator will first arm the machine by opening the three shut-off cocks on the tanks and then pull the lever on the main rotary valve, allowing the air and foam components to rush into the head, mix, and flow out into the raft where the mixture will foam up, gel and cure. A vent in the opposite end of the raft from the foaming machine opening will allow excess air and R_1 gas to escape.

A prototype machine is under construction and continuous efforts will be made to reduce both the size and weight of the different parts to a minimum in keeping with good safety practices. The greatest item of weight in the machine will be the foam components themselves, with a weight of 4.5 pounds as presently designed. Part weights will depend on the extent that plastic is utilized, as even the tanks could be of a filament wound glass reinforced epoxy for a weight savings.

III. RAFT DESIGN

As originally stated in the contract, the raft was to be designed so that the inflated partial portion would support a load of 200 pounds and the foam in place portion would also support the same amount without any buoyancy contributed from the air inflated section. Based on this requirement, the inflated section was then taken as to have the same volume as the present one-man Gemini raft and the foam section to have an equal volume.

With these limitations, all possible designs were considered from a practical construction and foaming standpoint. Three main types of design evolved from this.

The first design considered the most practical from a foaming and construction point of view was similar to a figure eight in a vertical position with the lower circle the air inflated portion and the upper the foam in place portion. The floor was located in between the two. The main advantages of this design were that it allowed the overall dimensions to stay the same except for height, the construction was easy and simple and the foam had an uninterupted flow path around the raft tube.

The second design utilized a concentric tube design with the inner one being the air inflated portion and the outer one the foam in place portion. Besides being difficult to construct, this design increased the overall dimensions (it was assumed that the inner dimensions of the raft floor would have to stay about the same in size) and impeded the flow of the foam around the raft tube since there would have to be some sort of positioning devices between the two concentric walls of the two tubes to hold them in relative positions until the foam cured.

The third design was the converse of the second, that of having the inner concentric tube of foam and the outer tube inflated. This design has good flow for the foam but would not be as strong structurally as the second and would likewise increase the dimensions and be difficult to construct.

Figure 8 shows the cross sections of the three types of designs.

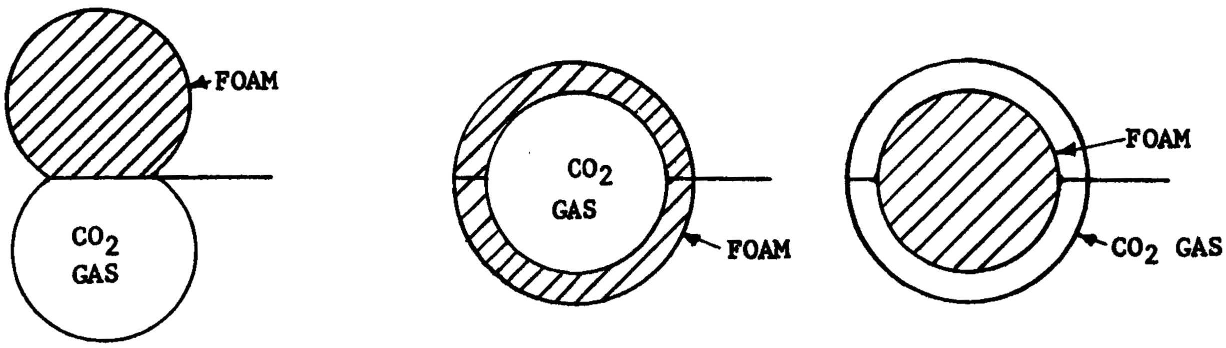


Figure 8
Three Proposed Raft Designs

The three rafts shown in Figure 9 are test rafts made of polyethylene film and foamed in place for testing foam flow. The center raft has the prepolymer type of formulation for the foam and the other two are of the one-shot type of formulation.

The raft shown in Figure 10 and afloat in Figure 11 is a solid foam in place formulation test raft of 1.7 cubic foot volume. It will support a 200 lb. man as illustrated by the means of allowing a portion of the body to be in the water and thus gain additional buoyancy from the body's flotation.

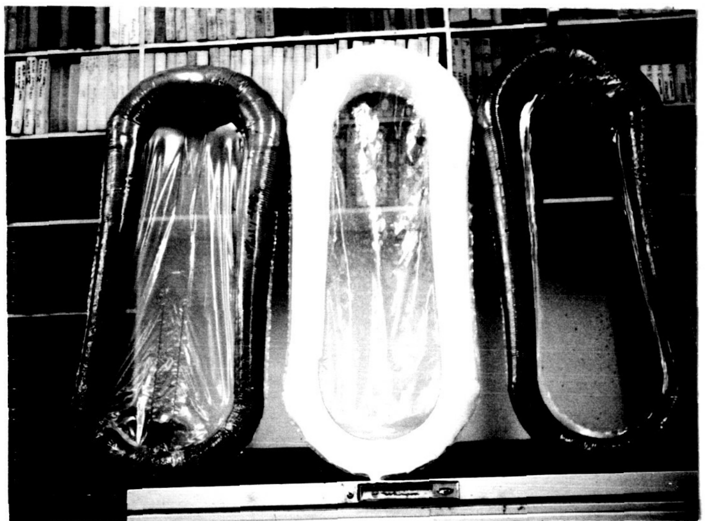


Figure 9
Foam Flow Test Rafts

Cross sections of the three proposed raft designs were constructed and demonstrated to the NASA technical monitor. The second design was selected by NASA. It was agreed that the total buoyancy of the raft with both the foam in place and the air inflation approximate that of the former one man Gemini raft and that the total over all dimensions not appreciably exceed those of the Gemini one man raft. The fact that the occupant would be sitting in some water when the inflated portion was used before the foam in place portion was filled was to be neglected. Contract revisions reflecting these changes were requested.

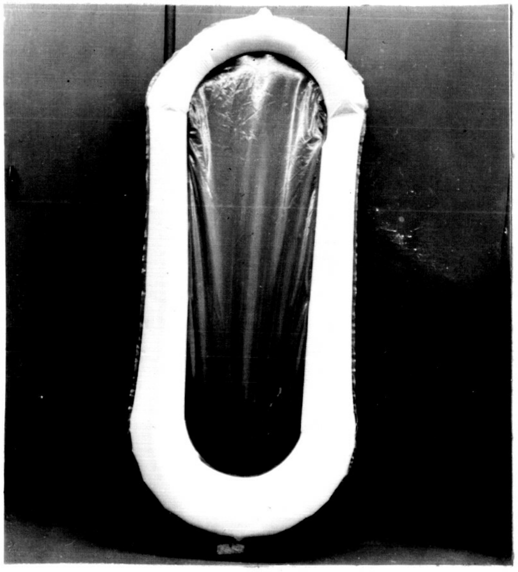


Figure 10
Test Raft of 1.7 Cubic
Foot Volume

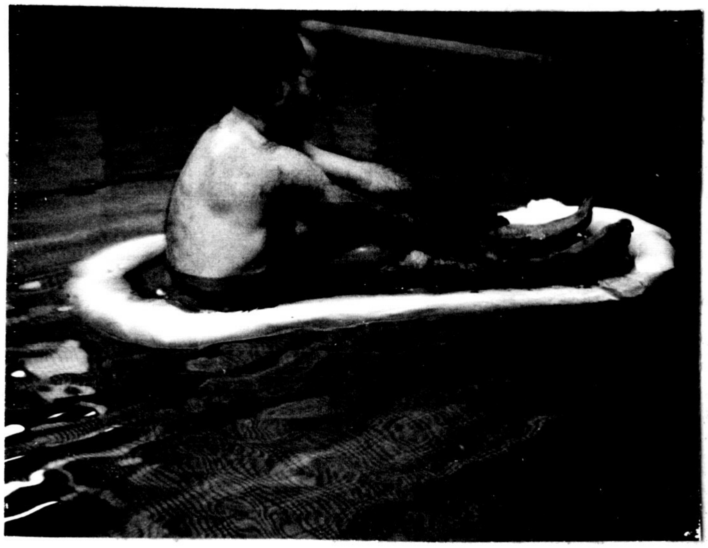


Figure 11
Test Raft Afloat with 200 Pound
Occupant

To facilitate the design of the rafts and eliminate numerous calculations, a graph was made up as shown in Figure 12 from which the total volume of any raft can be read, knowing the diameter of the large end tube and assuming that the diameter of the small end tube will be three inches less. (This has been found to be ideal for buoyancy support of a person.) The inside floor area of the raft remains constant and the volumes are based on calculations assuming each end to be half a torus and the portions between the truncated cones.

An eighteen inch straight section of two concentric tubes of neoprene coated nylon raft material was made up with clear plastic ends that would represent the large end diameter. This was foamed in place and the foam flow viewed very closely. A continuous web was left between the two tubes on a horizontal diameter and the rest of the section was positioned by

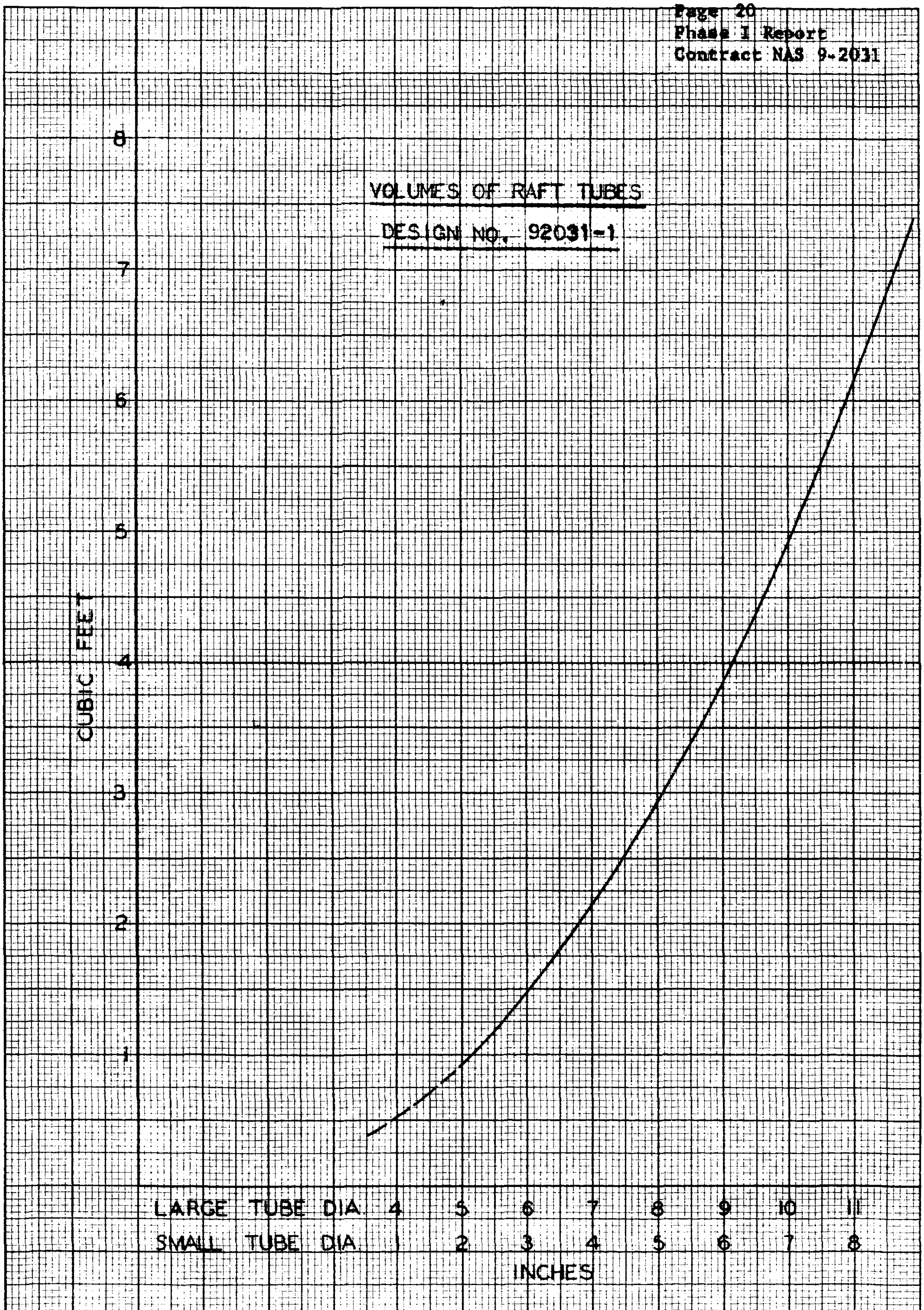

VOLUMES OF RAFT TUBES
DESIGN NO. 92031-1
CUBIC FEET
8
7
6
5
4
3
2
1
LARGE TUBE DIA. 4 5 6 7 8 9 10 11
SMALL TUBE DIA. 1 2 3 4 5 6 7 8
INCHES

FIGURE 12

small tapes of raft material ¼ inch wide and 1-1/8 inches long cemented between the walls of the concentric tubes at a 4 inch spacing. The webs kept the foam from flowing equally around the top and bottom of the section and were eliminated from the design.

The present raft design is shown in accompanying drawing No. 92031-1. This drawing does not show the foam entry nozzle, vent valves, position of the foam machine or canopy. A full scale prototype was constructed of specified raft material to this drawing but without stability buckets. Figure 13 shows a template and the piece of raft material cut out using the template. The finished inner or air inflated tube is pictured in Figure 14 with the positioning tabs cemented in place to it and one half of the outer tube cemented in place.

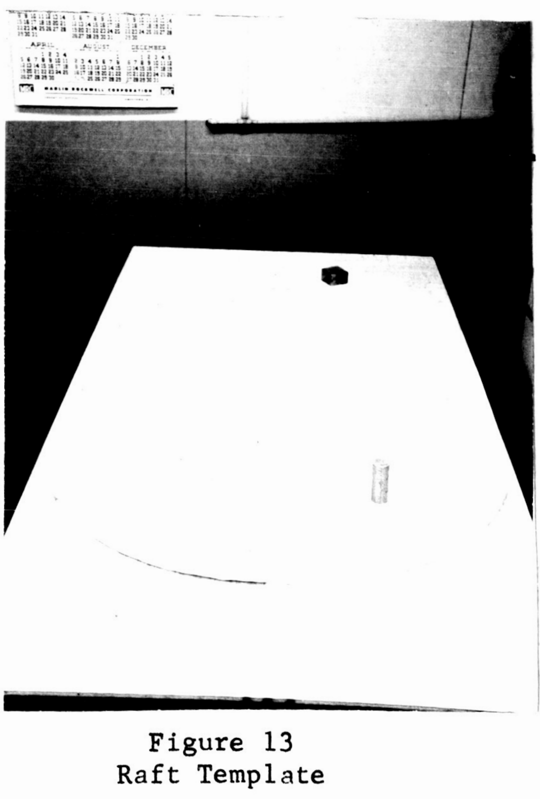


Figure 13
Raft Template

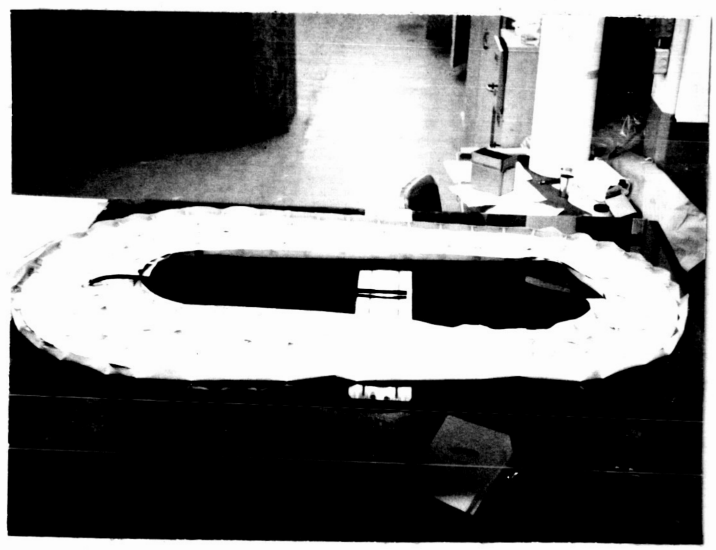


Figure 14
Partially Completed Raft

Before foaming in place, the inner tube of the raft was inflated to 4 pounds pressure and the raft tried out in the water with a 200 pound occupant. Two views of this are shown in Figure 15. Notice the space between the inner and outer tube has been evacuated so no buoyancy is obtained from this portion. Both the inner and outer tubes were then inflated to two pounds pressure as shown in Figure 16. The size of the raft with both sections inflated is compared with the Air Force one man raft in Figure 17.

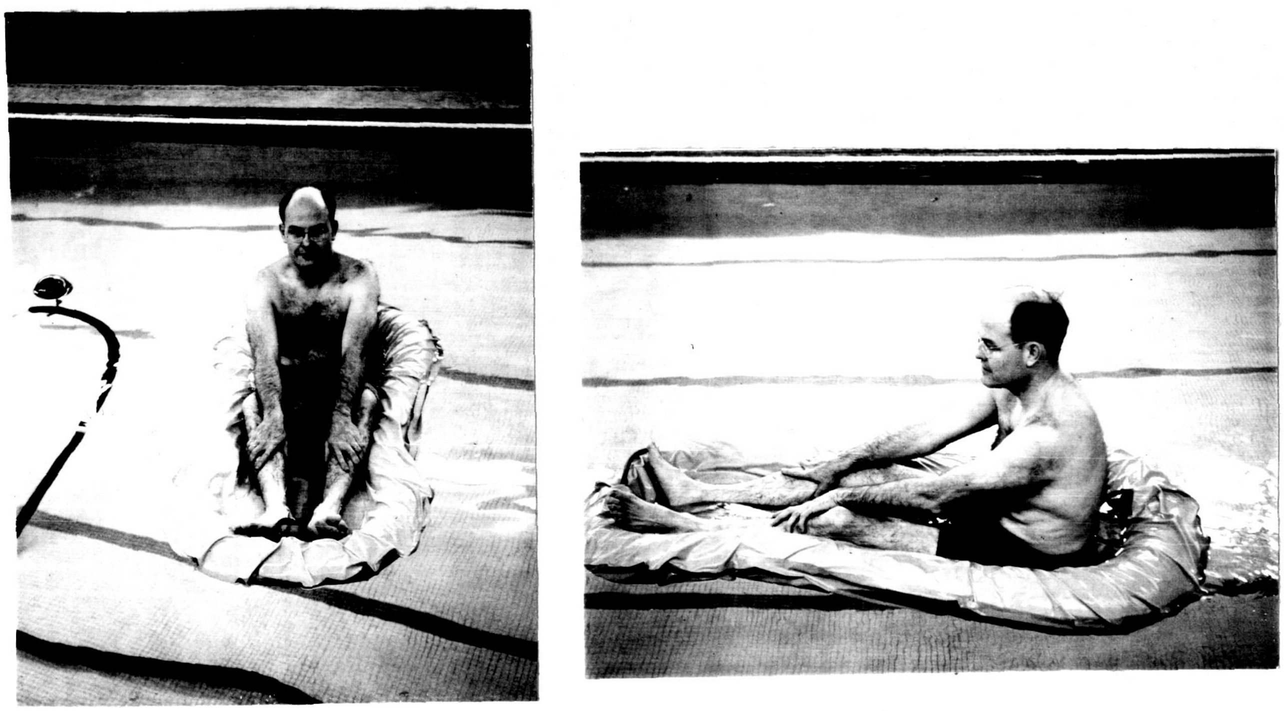


Figure 15
Raft with Inner Tube Inflated and Outer Tube Evacuated

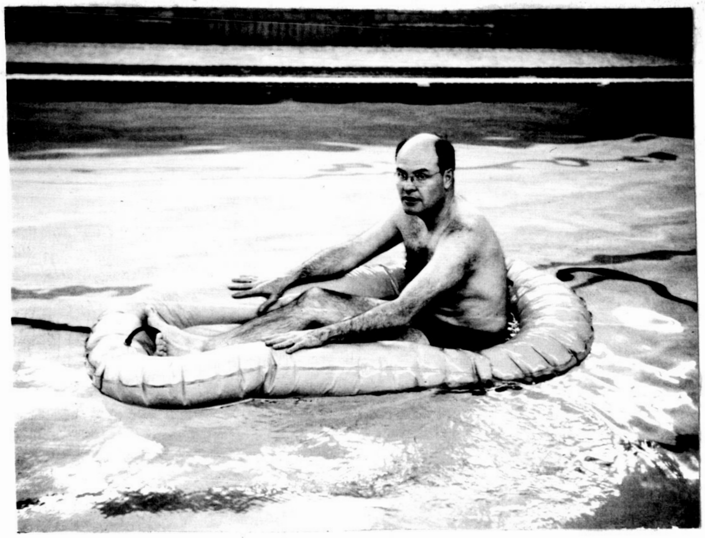


Figure 16
Raft with Both Sections Inflated

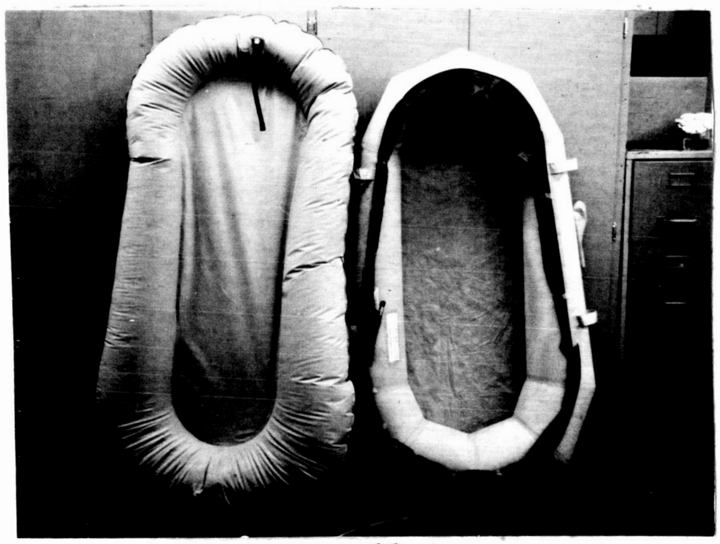


Figure 17
Raft Size Comparison

The volume of the raft and its displacements are shown in Table 1, Figure 18A. The raft was foamed with 8 pounds of foam giving a total weight of 11.12 pounds. There was some wrinkling in the ends and along the side seams but this cannot be helped when the flat sheet type of construction is used. Mitered tube type of construction would eliminate this but would result in much more difficult construction and would occupy a larger space when packed in the collasped condition. The raft was foamed through the

TABLE 1

DRAFT AT LARGE END OF RAFT	BUOYANCY	* SUPPORT
Inner Tube Inflated	73.28 lbs.	146.56 lbs.
Inner Tube Inflated, Outer Tube Foamed	147.33 lbs.	294.66 lbs.
Inner Tube Punctured, Outer Tube Foamed	74.05 lbs.	148.10 lbs.

CENTERS OF FLOTATION:

Athwartships - On centerline in all conditions

Longitudinally - From large end of raft per design drawing no. 92031-1.

Inner Tube Inflated -	25.64 in.	(From large end of raft per design drawing no. 92031-1)
Inner Tube Inflated, Outer Tube Foamed -	28.77 in.	" " " "
Inner Tube Inflated, Outer Tube Foamed -	27.73 in.	" " " "

Tensile strength of positioning tabs - 26 lbs.

* Buoyancy theoretical in salt water, weight of raft and foaming equipment not included in support figures.

FIGURE 18 A

small tube on the top of the small end of the raft. Figures 18, 19, and 20 show side, bow, and stern views of the raft with a 200 pound occupant.

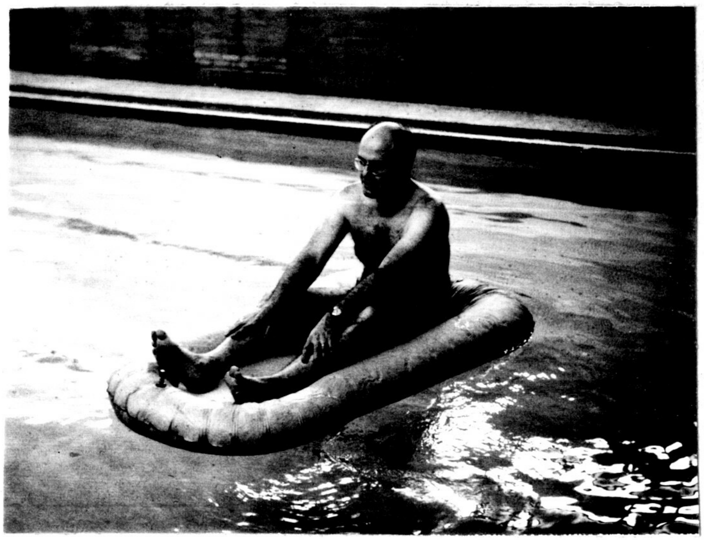


Figure 18
Side View of Foamed Raft

Figure 19
Bow View of Raft Showing Foaming Tube

The raft is very strong in the foamed condition and even standing on it did not cause any measurable deflection as pictured in Figure 21. With the occupant seated in the raft no longitudinal deflection could be seen as compared with the unoccupied condition, Figure 22. Although the stability buckets were not incorporated on this model, the raft shows remarkable stability and had no tendency to turn over even when leaning over the side, Figure 23.

It is proposed to conduct research to see if it is possible to completely inflate both sections of the raft, the outer one being inflated by escaping air or CO_2 from the inner tube through a pressure relief valve set at 4 psi. If the foam machine can then foam the outer space between the two tubes against this inflation pressure, letting the inflation gas exhaust through another relief valve in the outer tube, the whole raft and foam machine could be reduced about one third in size and weight as the entire raft could be used for initial buoyancy before foaming.

After finalization of the raft design, drawings will be resubmitted to NASA for approval prior to construction of the required rafts.

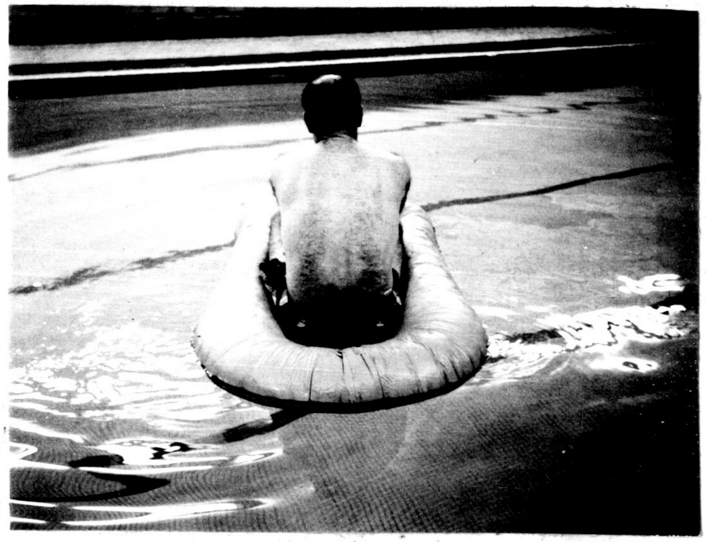


Figure 20
Stern View of Raft Showing Air Inflation Tube
Which is Relocated to Side of Raft in Design Drawing

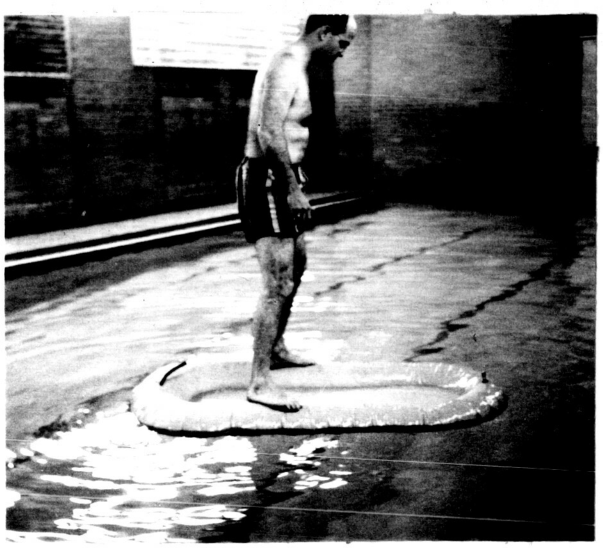


Figure 21
Strength of Raft

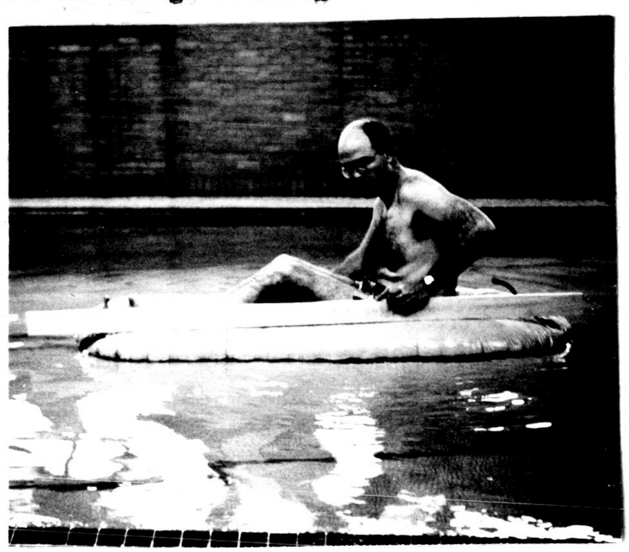


Figure 22
Deflection of Loaded Raft

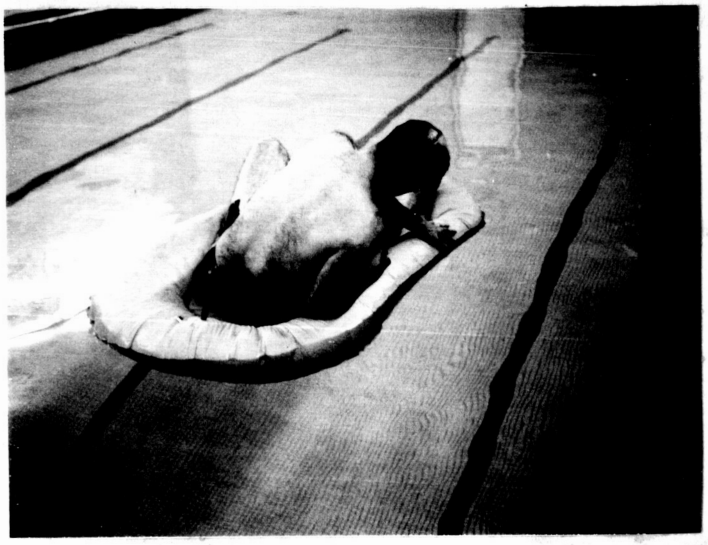
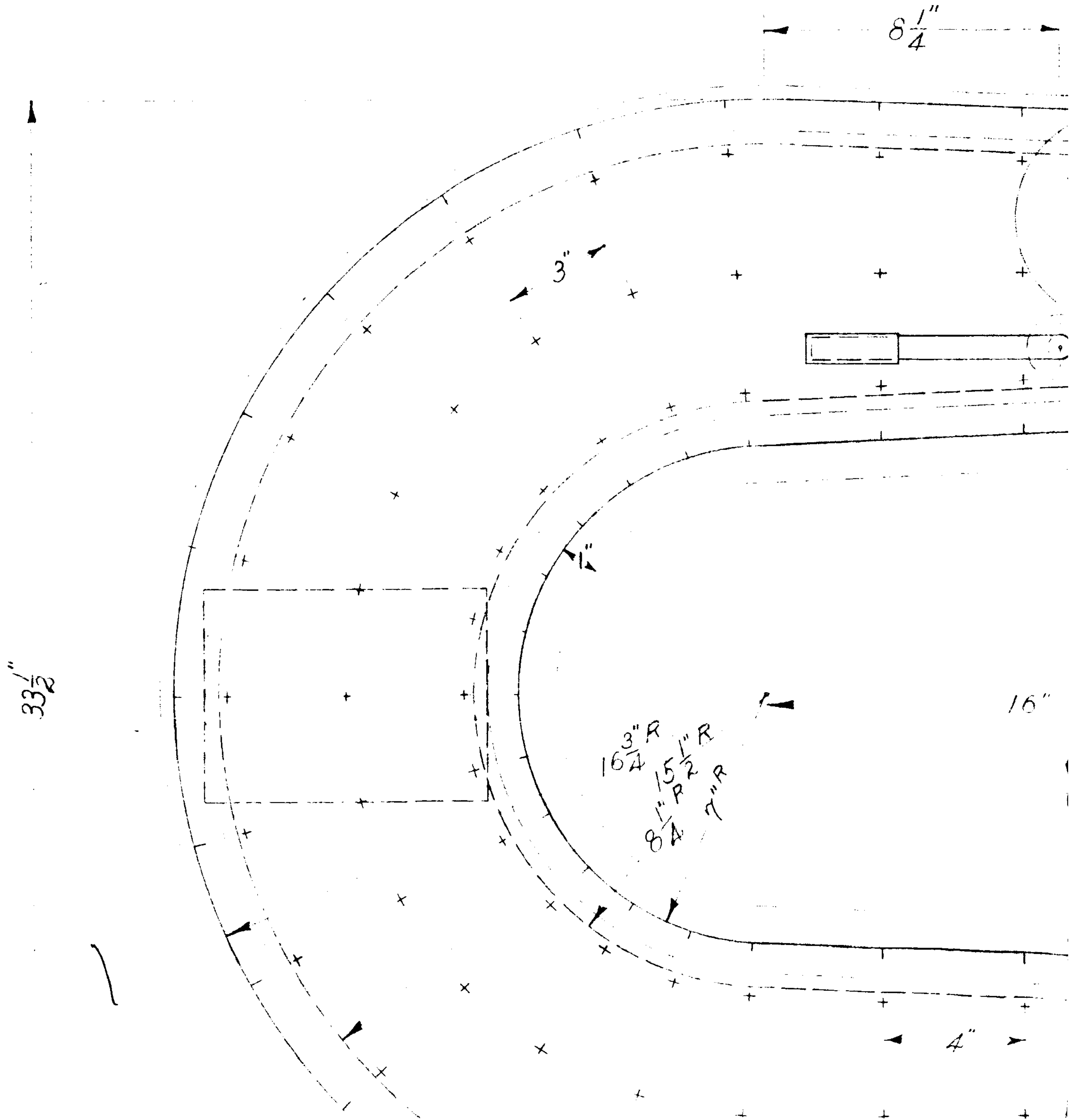
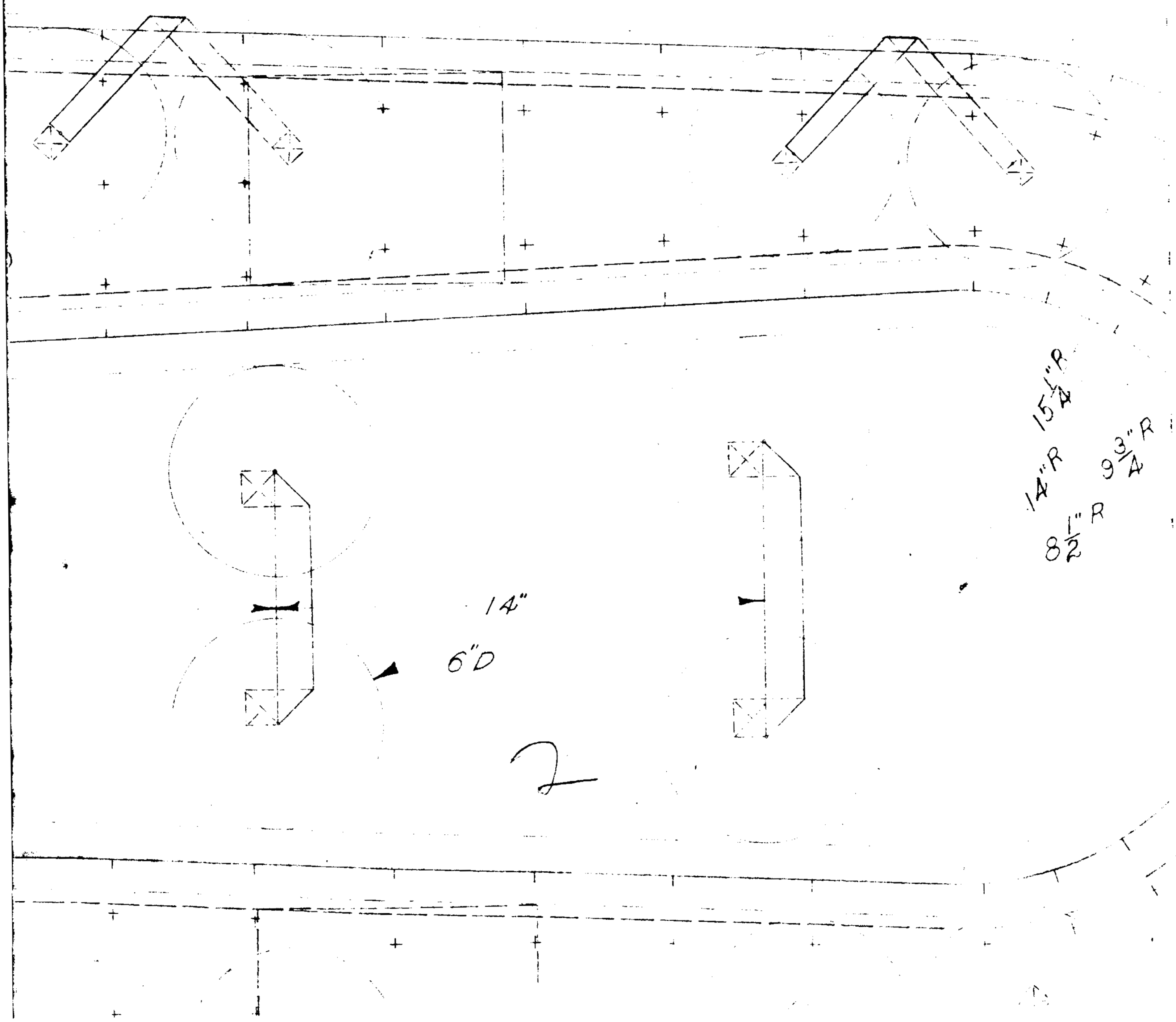
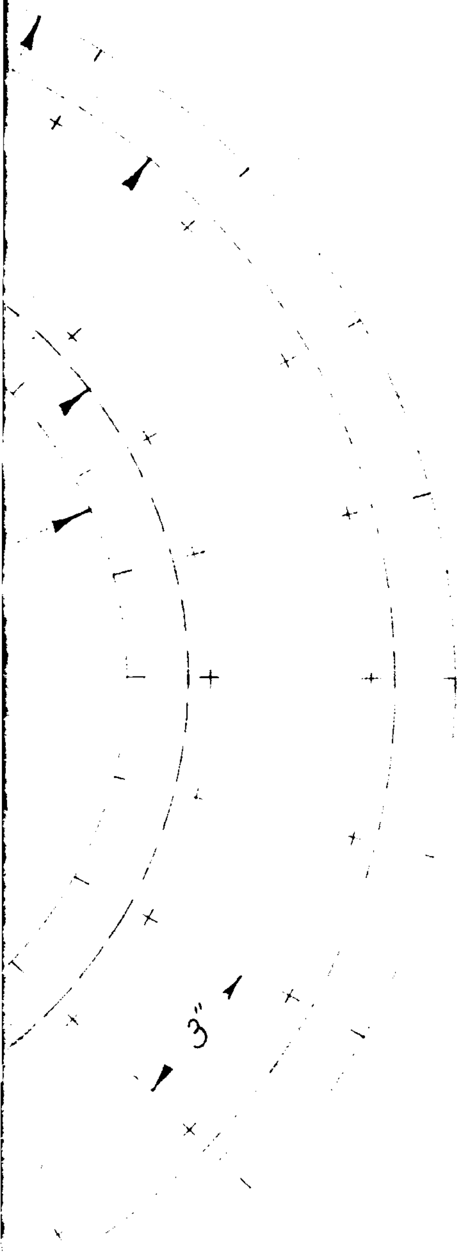


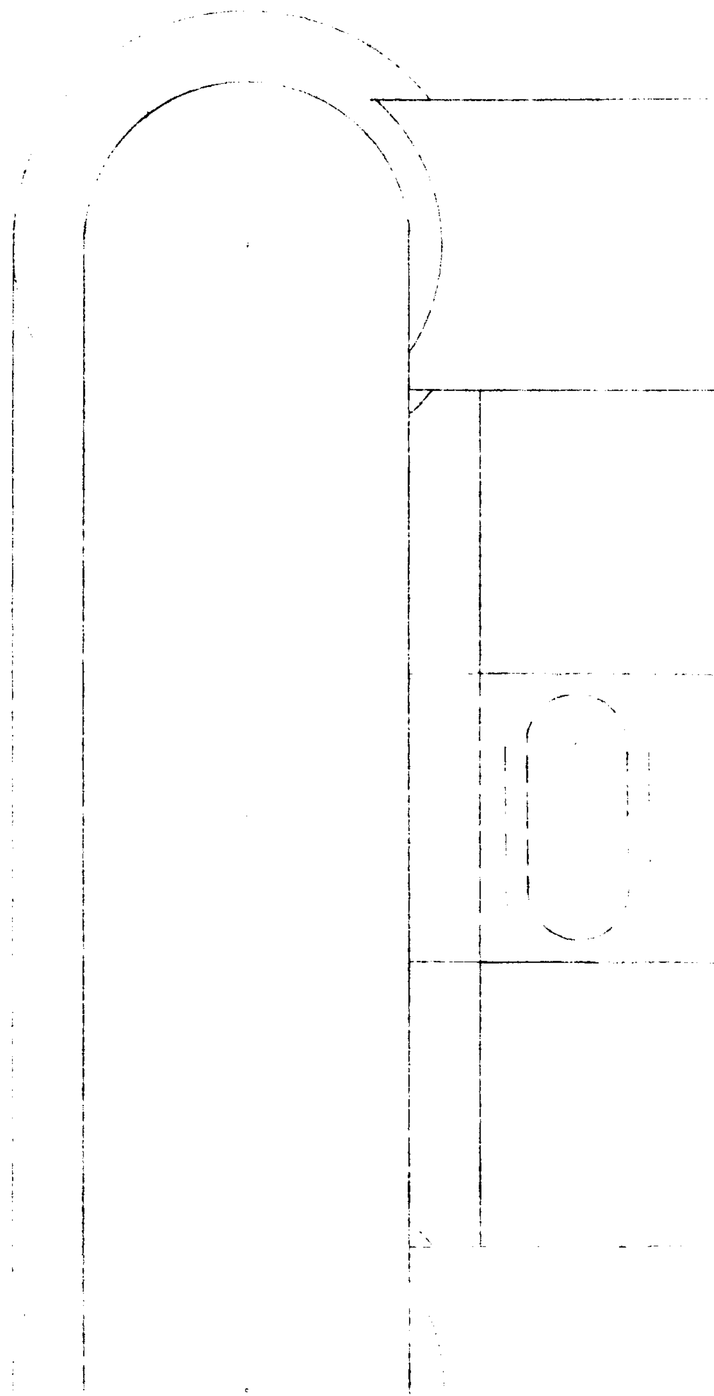
Figure 23
Stability of Raft Without Water Buckets


8 1/4"
3"
33 1/2"
1"
16"
16 3/4" R
15 1/2" R
8 1/4" R
7" R
4"


15 1/4" R
14" R
9 3/4" R
8 1/2" R
14"
6" D
2



3



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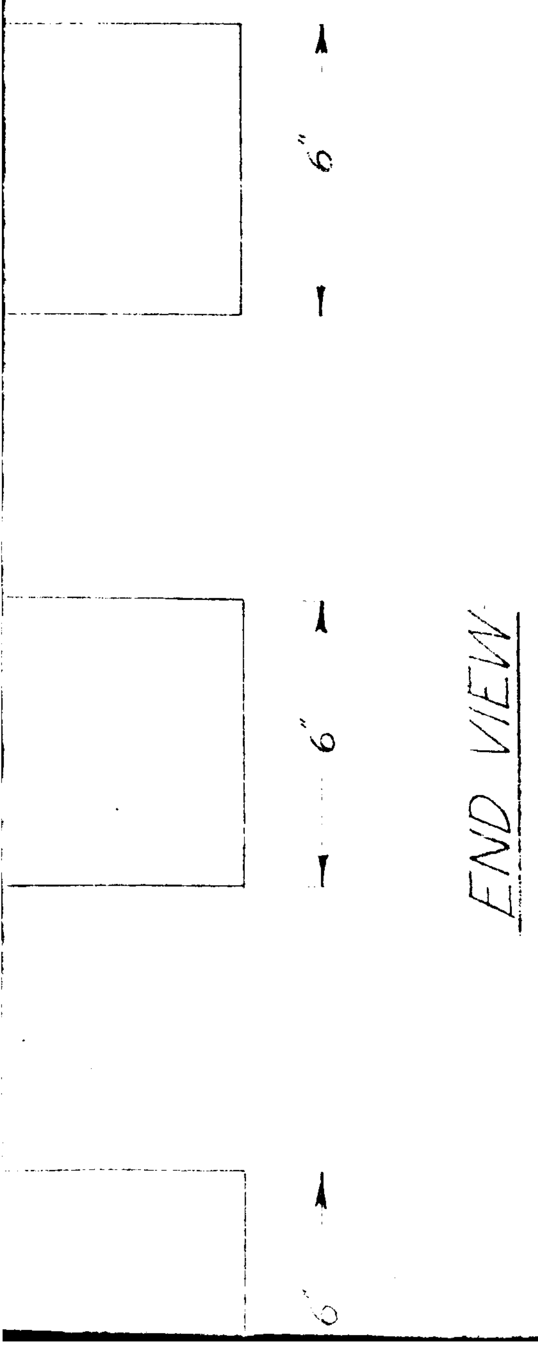
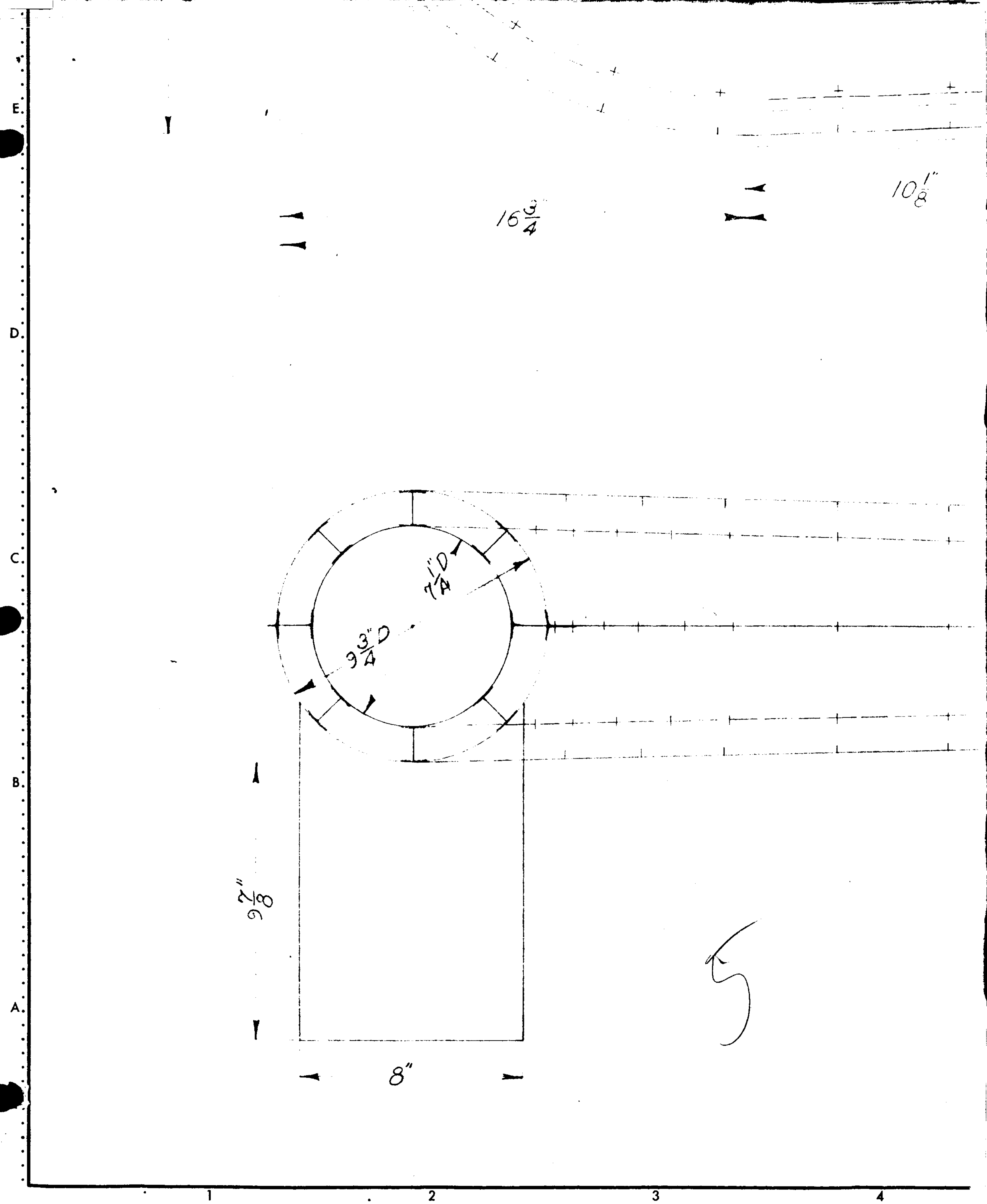
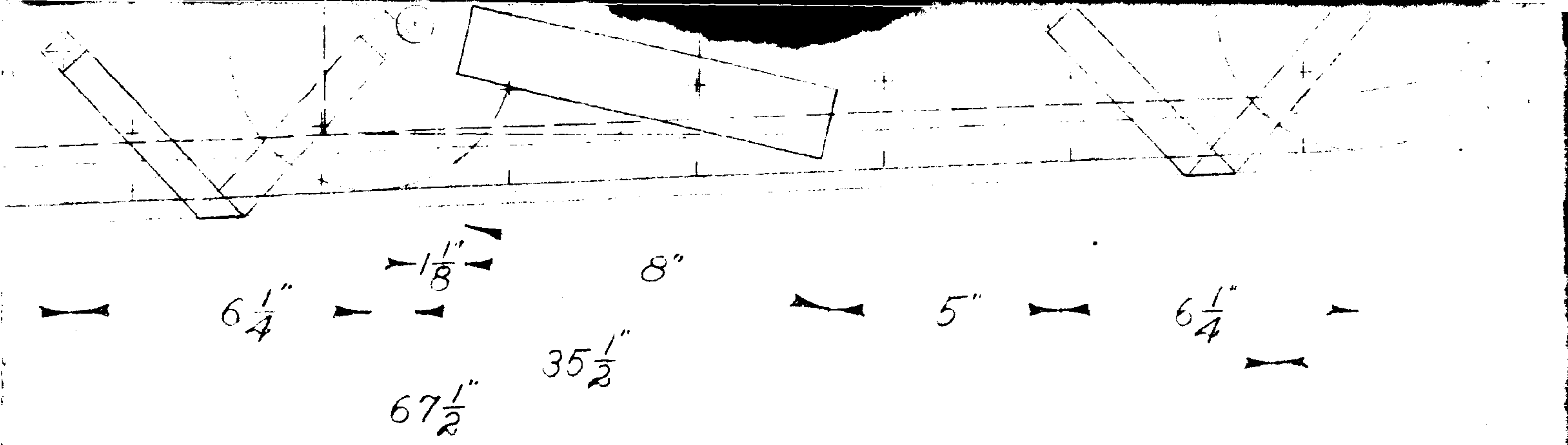


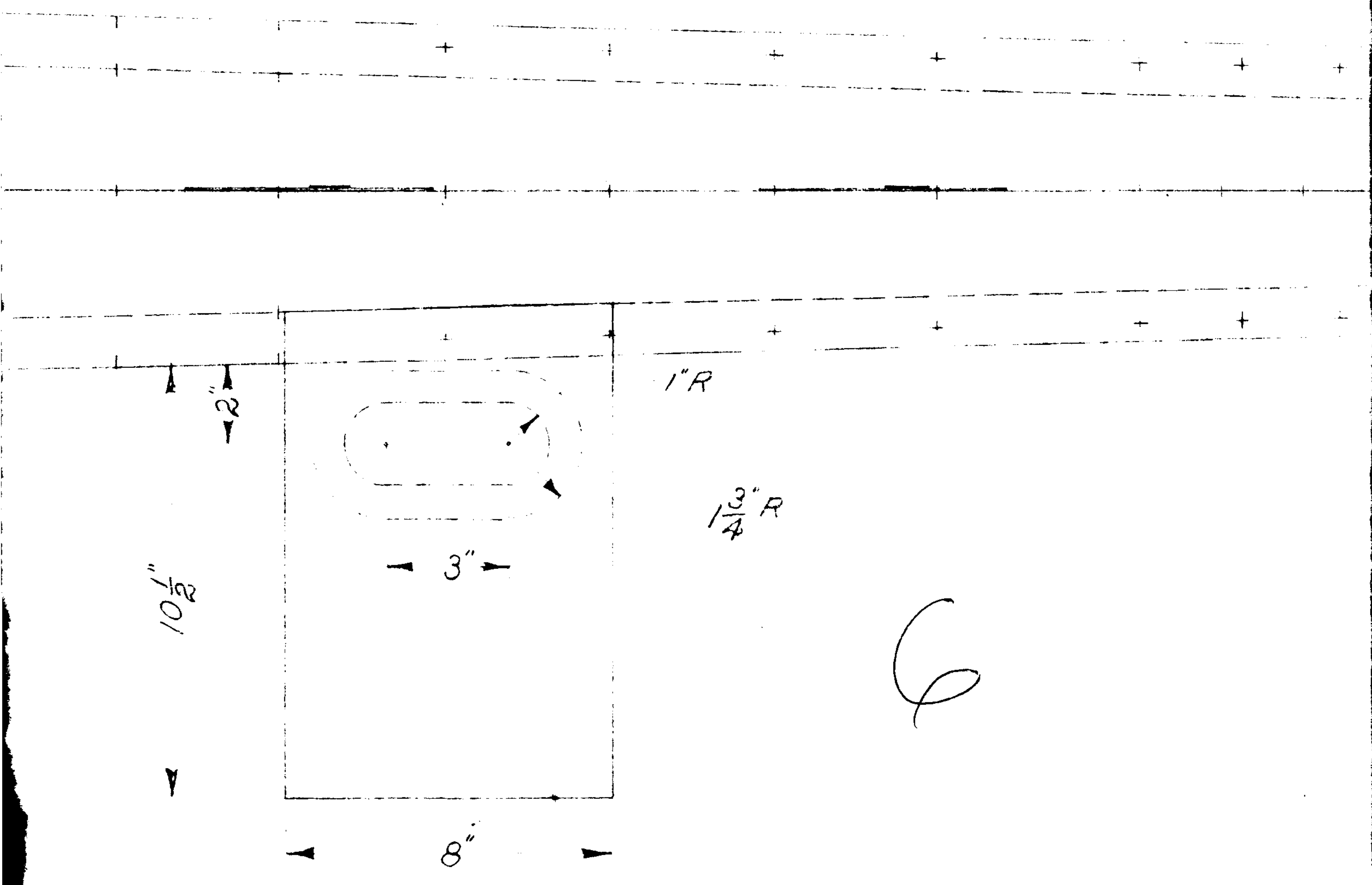
24



E.
D.
C.
B.
A.
1
2
3
4
16 3/4
10 1/8"
7 1/4" D
9 3/4" D
9 7/8"
8"
5



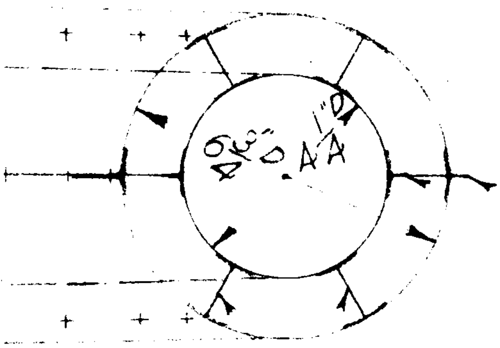
PLAN VIEW



CROSS SECTION

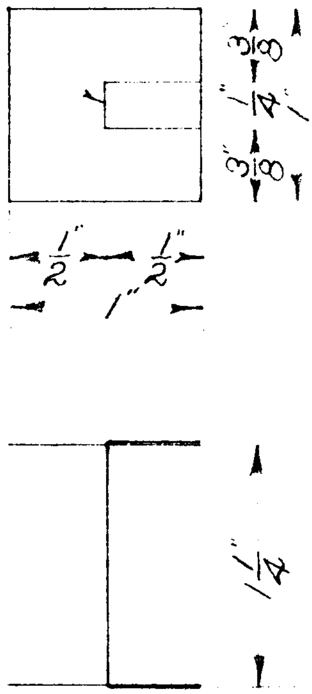
5 6 7 8

15 1/4"



1/4" SEW

3/8" SEAM



SPACING TAB ~ Full size

9 10 11 12

E – TAPE ON EACH SEAM NOT SHOWN, USE 1" TAPE

– CANOPY NOT SHOWN

– FOAM [illegible] NOT SHOWN

LET.	REVISION	E.N. NO.	BY	DATE	CK'D.	LOC.

UNLESS OTHERWISE SPECIFIED LIMITS	FOR FRACTIONAL DIMENSIONS ± FOR DECIMAL DIMENSIONS ± ANGLES ±	DO NOT SCALE

DRAWN BY: Marshall	DATE: 17 Dec 63	SURFACES FLAT AND AT RIGHT ANGLES TO OTHER SURFACES WITHIN .016 PER IN.

SCALE	APPR.	CODE	COMMON USAGE
3" = 1'-0"			

MATERIAL: NEOPRENE - NYLON	MATL. SPEC.
PART NAME: CO_2-FOAM LIFE RAFT	FINISH SPEC.

Whirlpool CORPORATION

RESEARCH AND ENGINEERING

ST. JOSEPH, MICHIGAN, U.S.A.

SIZE	ORIG. MOD. NO.
D	EXP. PART NO.

PART NO. 92031-1

13 14 15 16

LET.	REVISION	E.N. NO.	BY	DATE	CK'D.	LOC.

UNLESS OTHERWISE SPECIFIED LIMITS	FOR FRACTIONAL DIMENSIONS ± FOR DECIMAL DIMENSIONS ± ANGLES ±	DO NOT SCALE

DRAWN BY Marshall	DATE 17 Dec 63	SURFACES FLAT AND AT RIGHT ANGLES TO OTHER SURFACES WITHIN .016 PER IN.

SCALE Full	APPR.	CODE	COMMON USAGE

MATERIAL ALUMINUM	MATL. SPEC.
PART NAME PORTABLE STATIC FOAM MACH.	FINISH SPEC.

Whirlpool CORPORATION

RESEARCH AND ENGINEERING

ST. JOSEPH, MICHIGAN, U.S.A.

SIZE D

ORIG. MOD. NO.

EXP. PART NO.

PART NO. 92031-2

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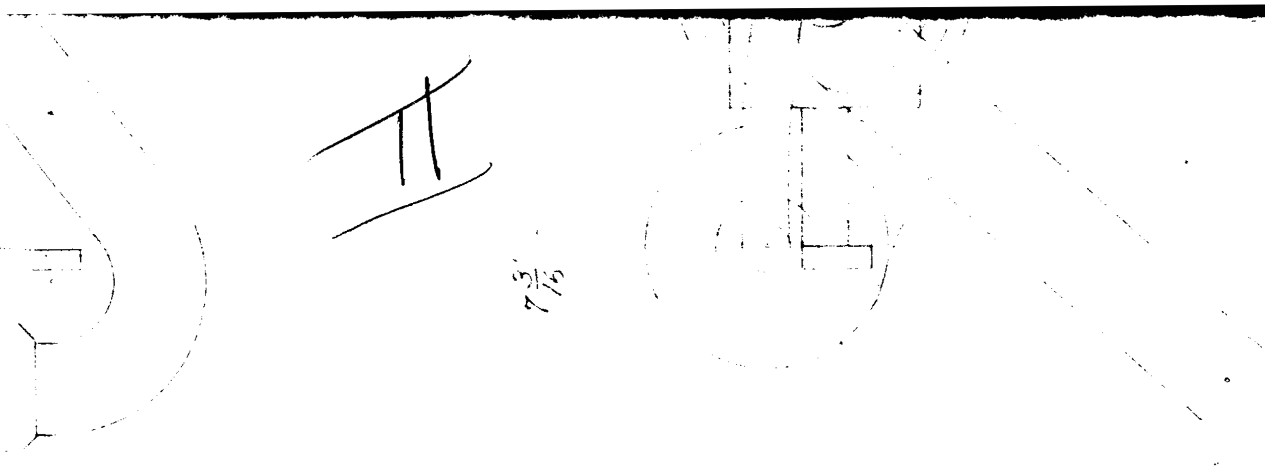
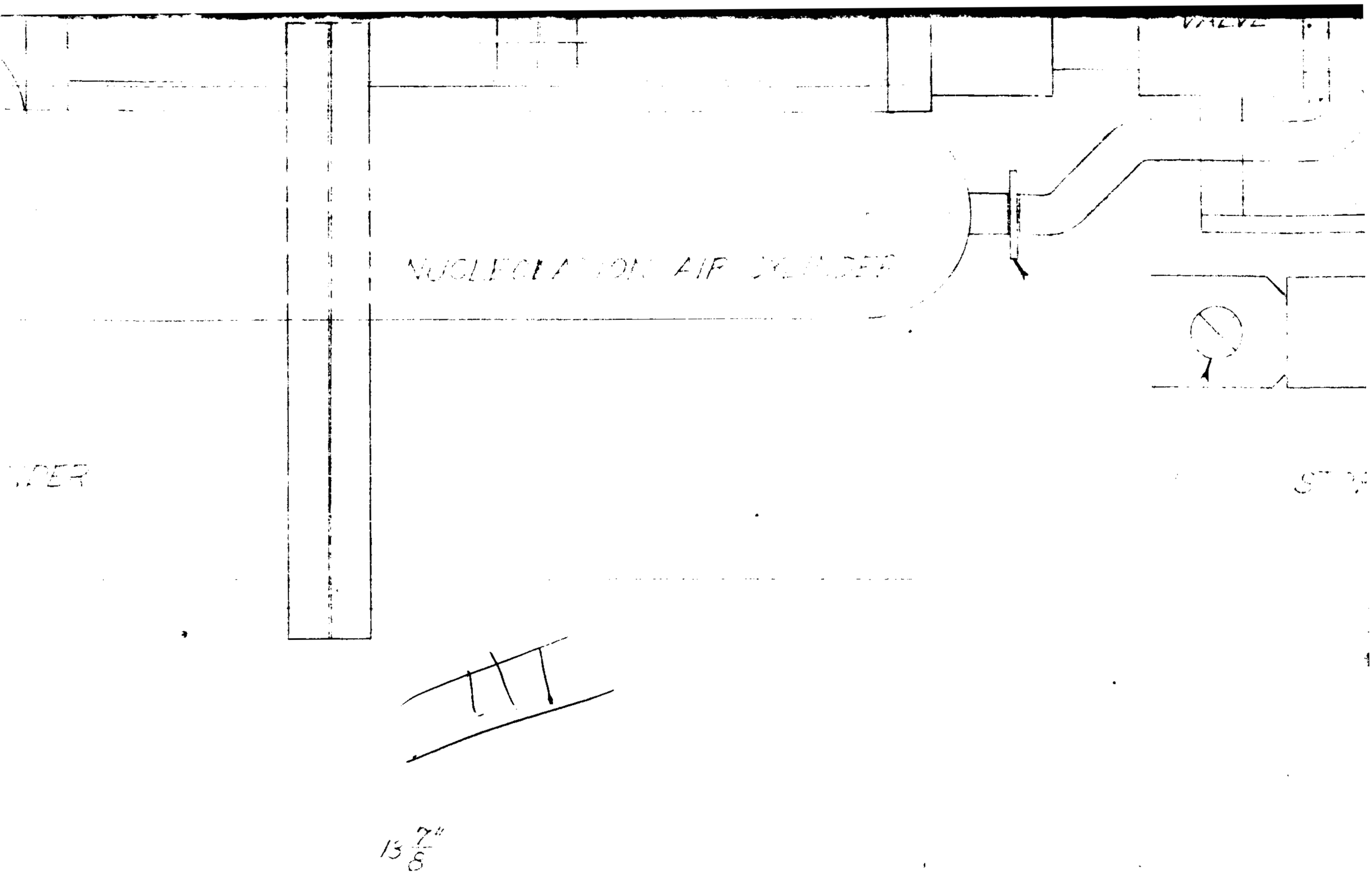
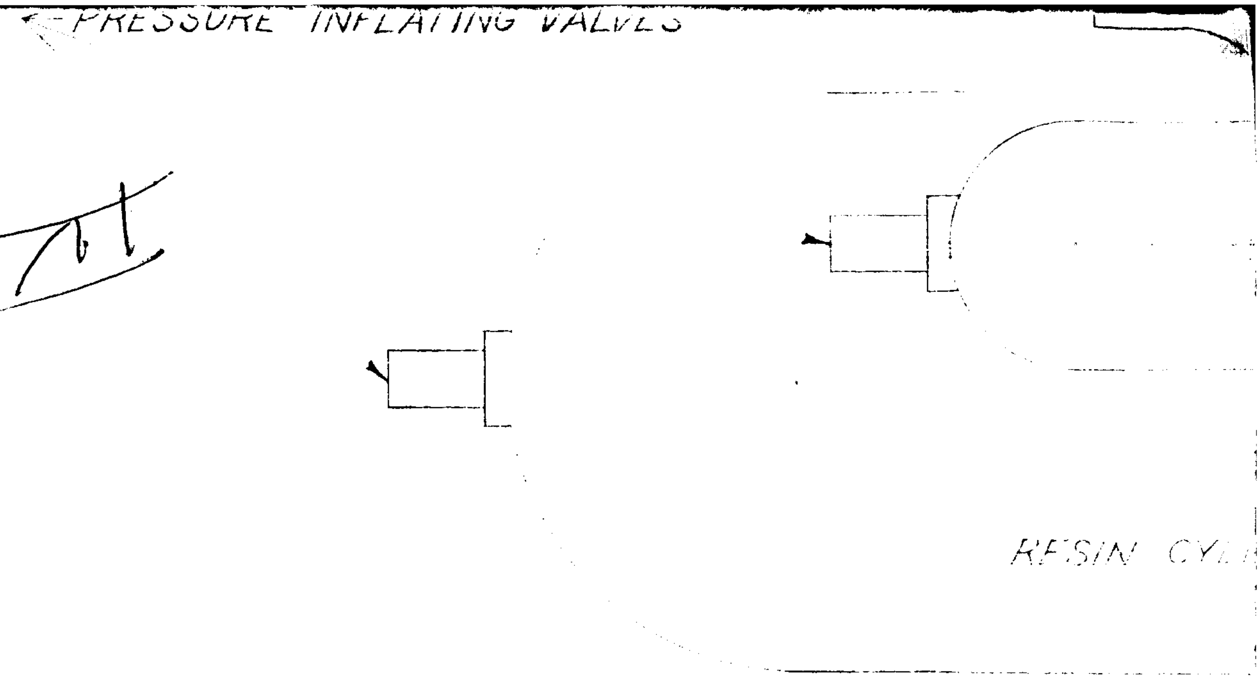


$4\frac{7}{8}$

9 10 11 12



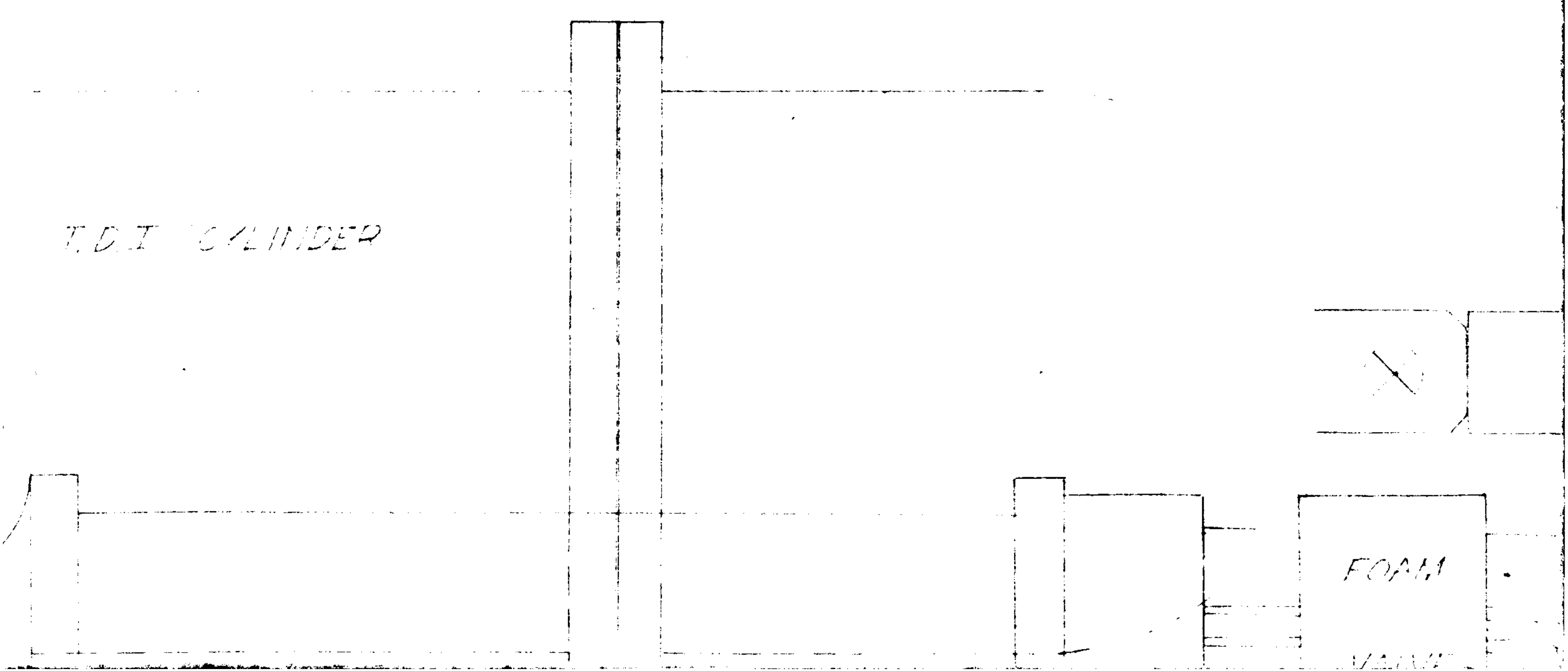
5 6 7 8



76

PART NO.

VI



VII

ACCUMULATOR BLADDER IN LOADED POSITION

FOAM NOZ. LE