A procedure for launching a radar target balloon to achieve level flight

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A PROCEDURE FOR LAUNCHING A RADAR TARGET BALLOON TO ACHIEVE LEVEL FLIGHT

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ABSTRACT

Launching procedures for single balloons and double-balloon assemblies are described. A method of predetermining the level-flight altitude is included.

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A PROCEDURE FOR LAUNCHING A RADAR TARGET BALLOON TO ACHIEVE LEVEL FLIGHT

- J. Akeroyd -

INTRODUCTION

Reflecting balloons are useful in testing radar performance because they present a target of known size, and are more economical and more easily obtainable than aircraft. Launching is fairly simple; however, care must be taken to prevent damaging the balloon and safety precautions to protect personnel must be observed.

SAFETY PRECAUTIONS

If helium gas is used there is very little danger. Care must be taken not to damage the tank valve and also not to open the valve quickly when there is no pressure regulator. The tank must always be supported if it is standing upright. It can be tied to some handy support or kept in a tank cart.

If hydrogen gas is used there is great danger of explosion. Cigarettes, matches, etc., must be kept away from the launch site. Care must be taken to prevent static discharge. A large metal plate should be placed on the ground, all the equipment should be placed on it, and personnel should stand on it. The filling hose must be connected to the balloon before any valves on the tank are opened.

HEIGHT DETERMINATION

The balloon stays at constant altitude once it reaches its equilibrium or floating altitude. This is the height at which the balloon weight equals the weight of the atmosphere displaced [1].

Curves (Figs. 1 and 2) are provided to determine the floating altitude. Curves 1(a) and 1(b) are used for 4-foot-diameter balloons (33.5 cu. ft.). Curves 2(a) and 2(b) may be used for balloons of any size or an assembly of balloons. The balloon pressure, ΔP, in curves 1(a) and 2(a) is the pressure to which the pressure relief valve is set. The pressure usually quoted by the manufacturer is in inches of water. To convert to pounds per square inch multiply by 0.036. The usual pressures are: for 4-foot balloons, 0.65 lb/sq. in.; for 25-foot balloons, 0.1 lb/sq. in.

For a 4-foot-diameter balloon (Use Figs. 1(a) and (b))

1. Weigh the balloon and attachments (valve, etc.). Some balloons are weighed by the manufacturers and marked.

2. Place Fig. 1(a) over Fig. 1(b).

3. Slide Fig. 1(a) until the base line, as indicated by arrows, is coincident with the balloon weight on Fig. 1(b); ensure that Fig. 1(a) is square on Fig. 1(b).

4. Read the altitude at the intersection of the curve in Fig. 1(b) and the curve in Fig. 1(a) corresponding to balloon pressure, ΔP.

For balloon assemblies or sizes other than 4-foot-diameter
(Use Figs. 2(a) and (b))

In order to use the curves the density of the balloons must be calculated as follows:

1. Weigh the balloons and all accessories (valves, string, etc.).

2. Divide the total weight by the volume of the balloon or balloons: $\frac{W_t}{V + v}$, where W_t is total weight, V volume of lifting balloon, v volume of reflecting balloon. To determine altitude, use Figs. 2(a) and (b) in the same manner as Figs. 1(a) and (b) are used, except that the base line of Fig. 2(b) is made coincident with density on Fig. 2(a).

FILLING GAS

Helium or hydrogen may be used as the filling gas. Helium is preferred as it is very safe to handle; however, hydrogen gives a slightly higher altitude and is much cheaper. Helium costs about $3\frac{1}{2}$ times as much as hydrogen.

LAUNCH SITE

The launch site should be in the lee of a building to keep wind to a minimum. Four-foot balloons should not be launched with ground winds over 25 m.p.h., or large balloons with ground winds over 15 m.p.h. There should be no high obstruction for about 100 feet down wind from the launch site. The ground should be grass-covered or paved, and free of sharp objects. For large balloons, a piece of 2-mil construction polyethylene about 6 feet by 50 feet should be laid down.

EQUIPMENT

To inflate 4-foot-diameter balloons

1. Silicone oil: Dow Corning 510 Fluid, viscosity 50 c.s.
2. 1 set of gas pressure regulator and gauges, similar to oxygen gauges used on welding equipment
3. Filling gas: 1 tank of helium will fill 6 balloons; 1 tank of hydrogen (size K) will fill 5 balloons
4. 1 hose: 5/16 inch I.D. by 6 feet long, plastic or rubber
5. 1 adapter: hose to pressure regulator
6. 1 adapter: hose to balloon. This is used only with certain makes of balloons; on others the hose slips over the inflation valve.

To inflate large carrying balloons

1. The same equipment as above for 4-foot balloons
2. Extra gas: 1.5 tanks (size K) for 25-foot sphere
   2 tanks (size K) for a 42-foot tetrahedron
3. Hose $\frac{1}{2}$ inch I.D. by 50 feet long, plastic or rubber
4. 1 adapter: hose to tank or pressure regulator
5. 1 adapter: hose to balloon
6. String (butcher string or a lacing string) 50 feet long

INFLATION OF 4-FOOT BALLOONS

Four-foot balloons can be filled and launched by one person; however, an assistant will make the task much easier. The procedures are the same whether one or two persons carry out the launching. The assistant helps to hold the balloon so that it does not hit the ground or sharp objects. When the balloon gains free lift, he can hold it down by the loop provided; then release it when fully inflated.

PROCEDURE

1. Connect the pressure regulator valve and gauges to the gas tank.
2. Connect one end of the hose to the regulator valve.

3. Open the gas tank valve.

4. Carefully unwrap the balloon, making sure it does not touch the ground or any sharp objects.

5. Pour 5 or 6 drops of silicone oil on the balloon pressure relief valve. Raise the valve off the seat to allow the oil to flow onto the seat; slide the valve on the seat to spread the oil.

6. Remove the cap from the balloon inflation tube; connect the hose to the tube.

7. Open the pressure regulator valve at the tank until the gauge reads approximately 20 lb. Plate I shows the balloon ready for inflation and the valve being turned on.

8. Fill the balloon until the pressure relief valve operates. Plate II shows the balloon partly inflated; Plate III shows the balloon fully inflated.

9. Shut off the pressure regulator valve, remove the hose from the balloon filler tube, and replace the filler tube cap.

10. Check the balloon pressure relief valve for oil bubbles, indicating a valve leak. If there is a slight leak, apply more silicone oil and slide the valve on the seat.

11. To launch the balloon, walk away from buildings and other obstructions and let go of the loop handle. Plate IV shows a balloon ready for launch.

INFLATING BALLOON ASSEMBLIES

Four persons are required to launch an assembly of a 4-foot reflecting balloon and a large lifting balloon. Two persons are required to hold the large balloon during inflation, one to operate the tank valves, and one to connect the hoses and watch the balloon during inflation.

A 25-foot spherical balloon requires 270-350 cubic feet of helium; 310 cubic feet is optimum. Since the balloons are equipped with safety valves, it is not necessary to measure the gas volume accurately. The correct volume can be obtained by using 1 tank, and enough from a second tank to drop the pressure by 1200 lb. The first tank can be used without pressure regulators, but care must be taken to open the valve very slowly. The second tank must be equipped with a pressure regulator valve and pressure gauges. The large balloons should be filled as quickly as possible to minimize the possibility of damage due to wind buffeting.

Before inflating the large balloon, inflate the 4-foot reflecting balloon. Tie one end of the 50-foot string to the loop handle. Tie the balloon down, or have

someone hold it out of the wind and at least 25 feet from the large balloon. Detailed procedure for unpacking and launching large balloons is supplied by the manufacturer. The procedure varies because of different packaging.

REFERENCE

1. A. Hendry and J. Akeroyd, "Free Floating Metallized Plastic Balloons for Use as Radar Targets", NRC Report ERB-703, April 1965

FIG. 1 (A)

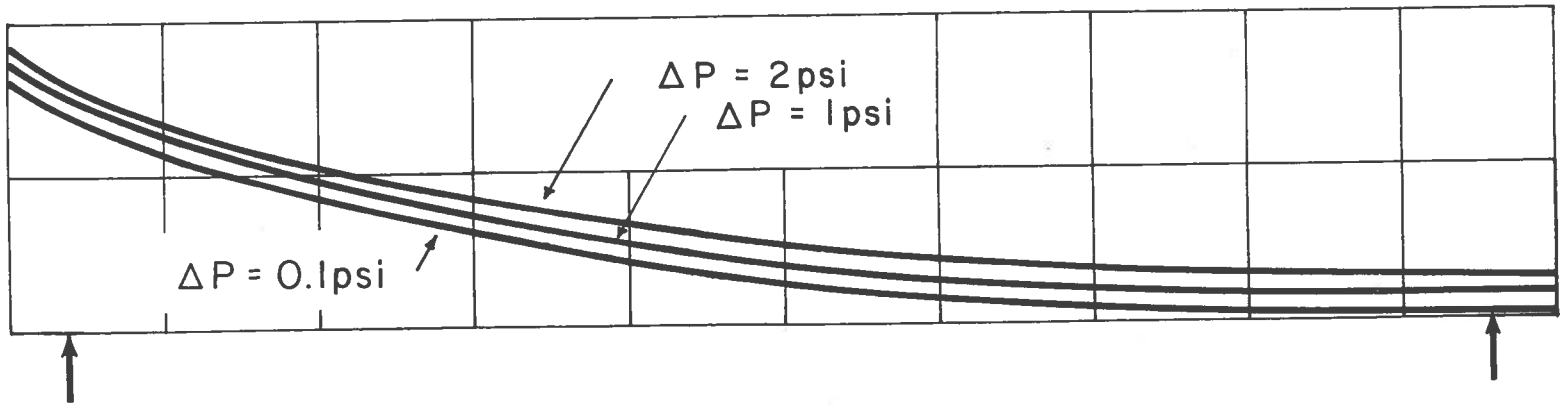


FIG 2 (A)

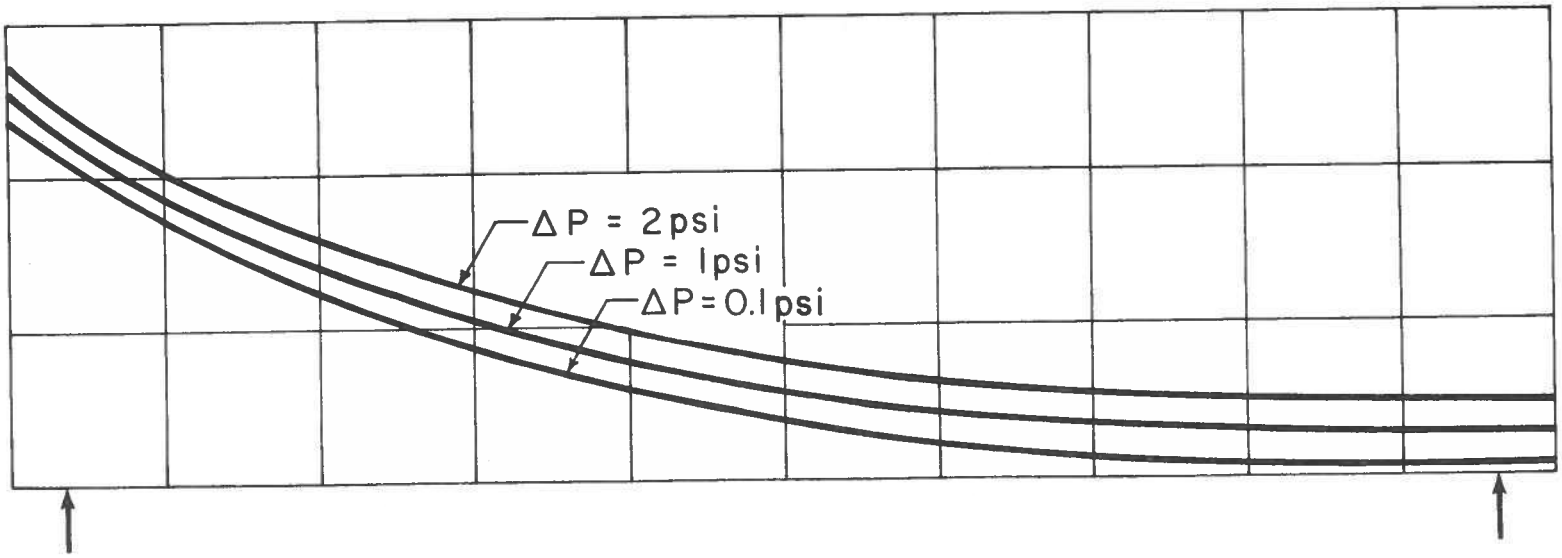
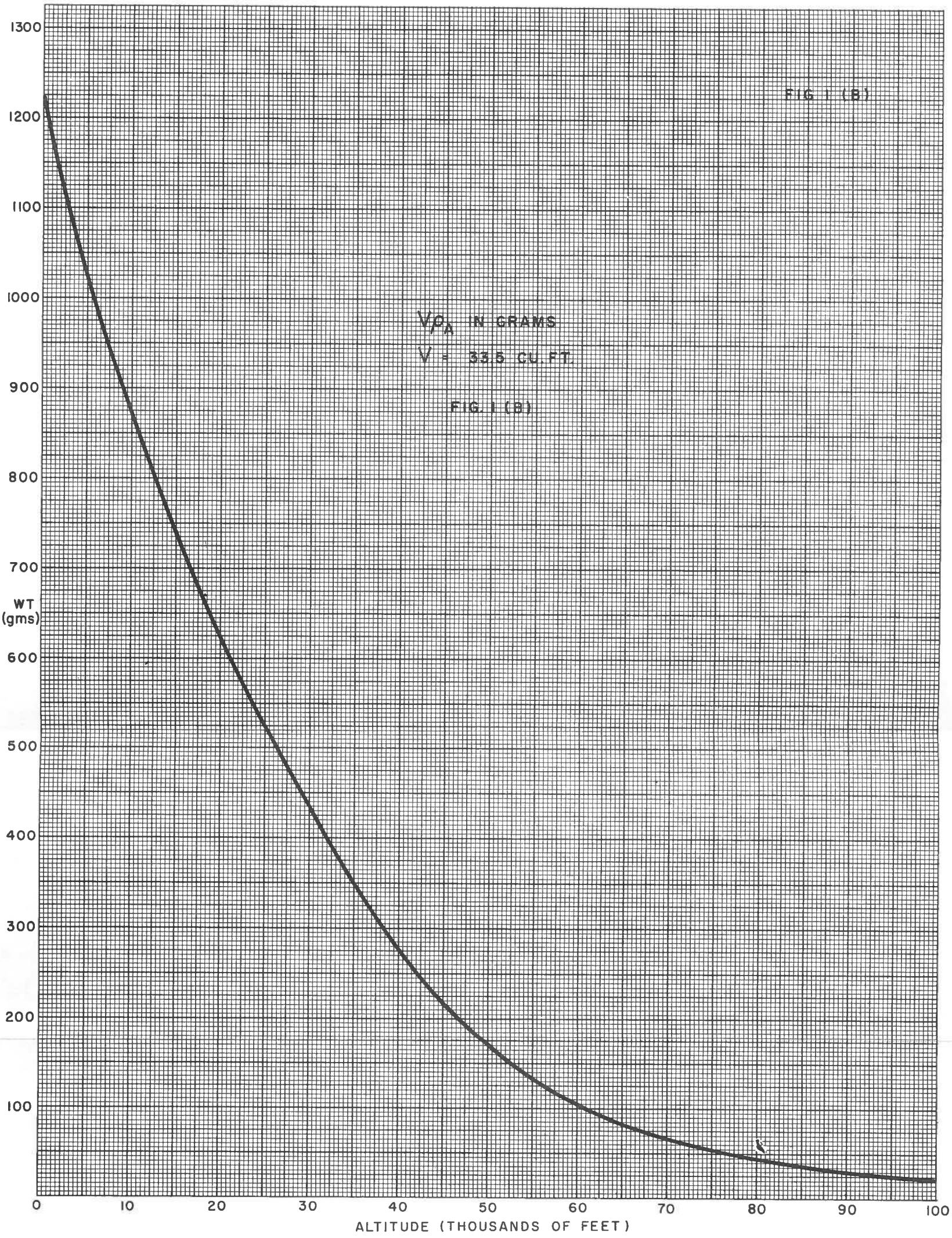


FIG. 1 (B)



VC_A IN GRAMS.

V = 33.5 CU. FT.

FIG. 1 (B)

FIG 2 (B)

ATMOSPHERIC DENSITY

FIG. 2 (B)

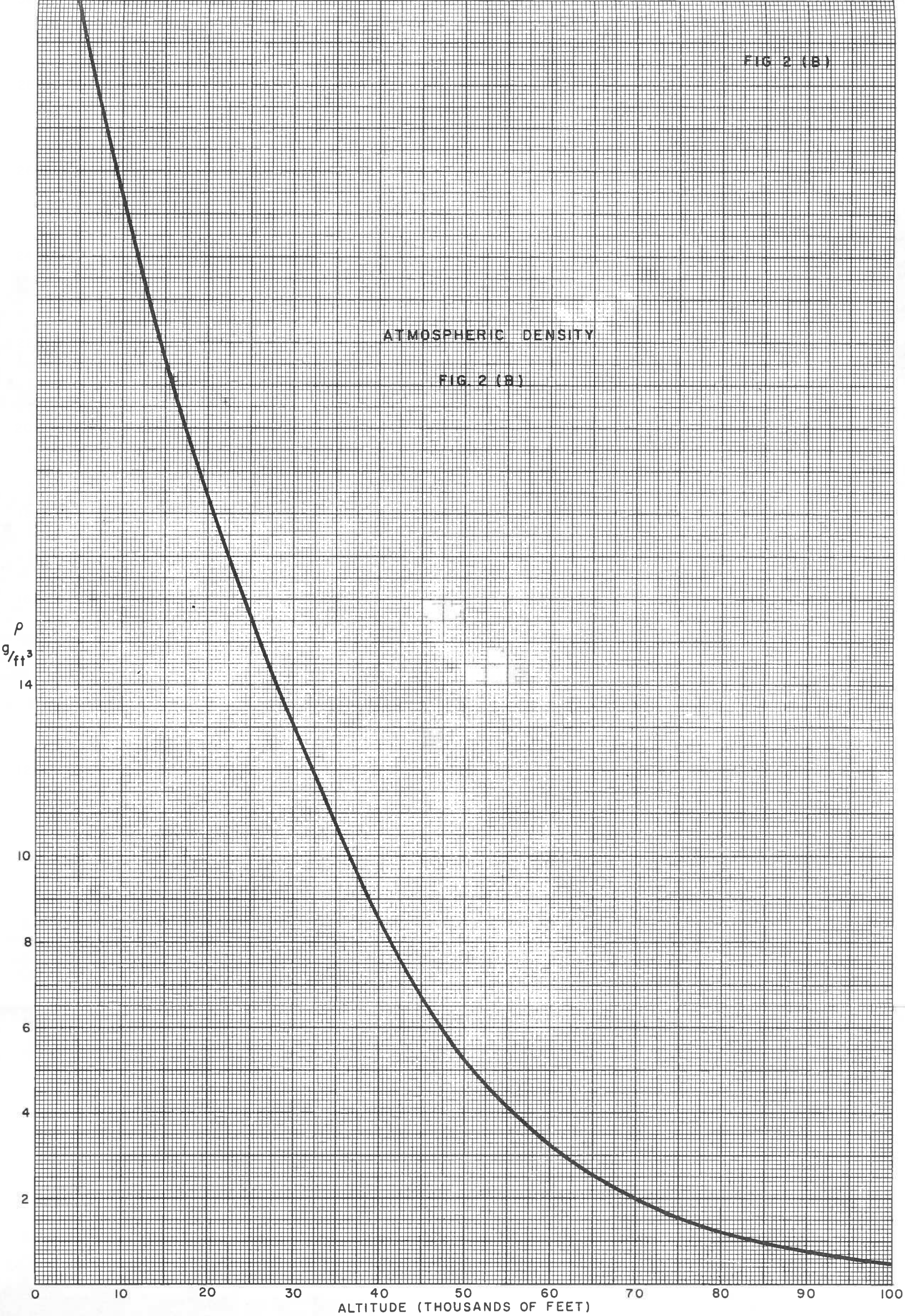


Plate I — Balloon ready for inflation

Plate II — Balloon partly inflated

Plate III — Balloon fully inflated

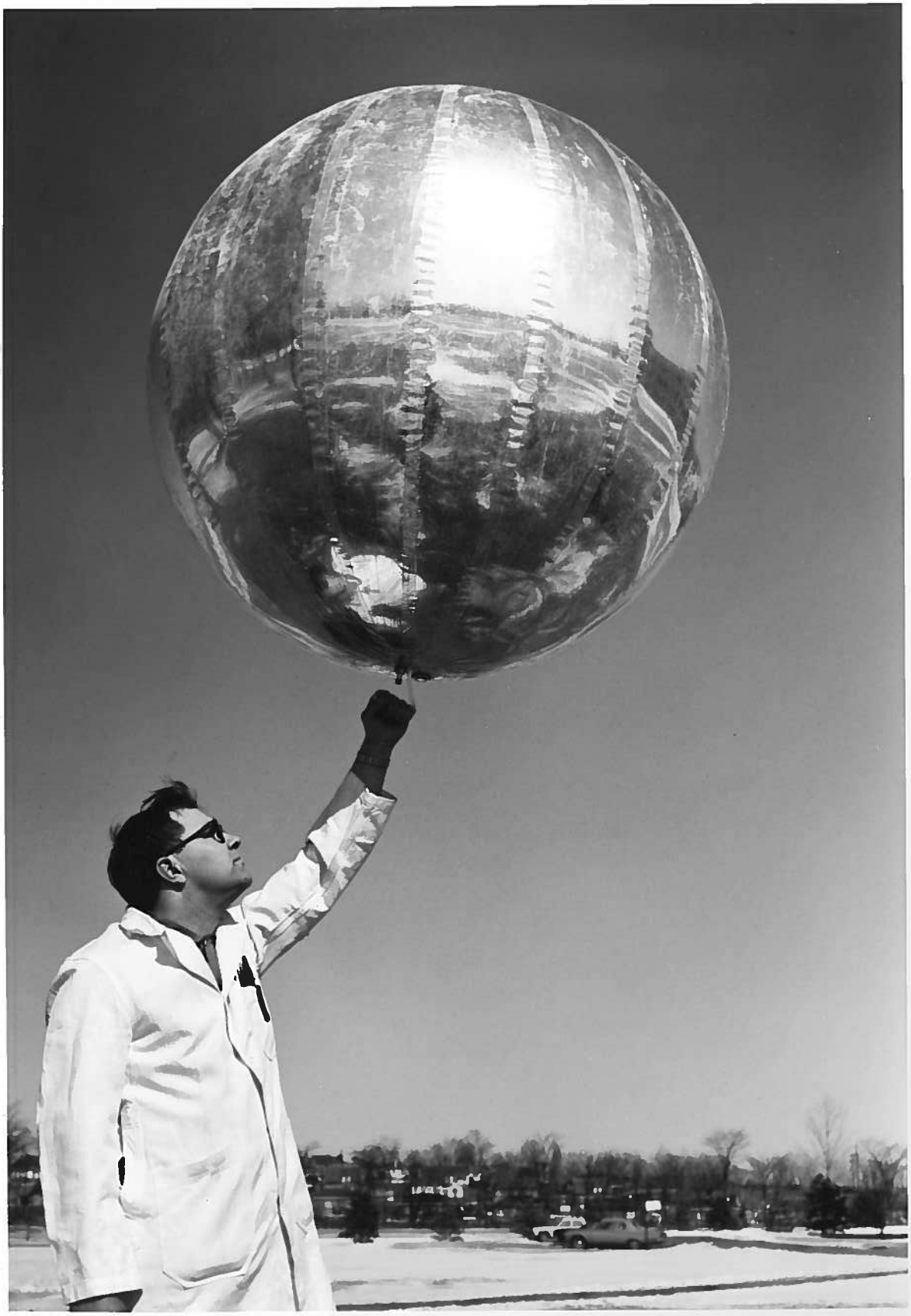


Plate IV — Balloon ready for launch