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REPORT ON RADAR TESTS AT WHITE
SANDS PROVING GROUNDS, N.M.

January, 1952

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REPORT ON TESTS OF THE RADAR DETECTABILITY OF LOW-ALTITUDE, PERSONNEL CARRYING BALLOONS CONDUCTED DURING JANUARY 1952 AT THE WHITE SANDS PROVING GROUNDS, LAS CRUCES, NEW MEXICO PROJECT 171

25X1

Prepared by

Report No. 1084

25 February 1952

Approved by

Engineer in Charge of
Balloon Operations

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A-20732-C	Time/Altitude Curve	Flight No. 676
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REPORT ON

THE RADAR DETECTABILITY OF LOW-ALTITUDE, PERSONNEL-CARRYING BALLOONS

CONDUCTED DURING JANUARY 1952 AT THE WHITE SANDS PROVING GROUNDS,

LAS CRUCES, NEW MEXICO

I. Purpose of the Tests

A series of nine test balloon flights were carried out at the White Sands Proving Grounds for the primary purpose of determining the detectability of man-carrying balloons with different radars. Also investigated was the effect on detectability of varying the amount of metal in the balloon and equipment.

Secondary objectives of the tests were the training of personnel in balloon handling, launching, and flying; testing the Interim System gear under field conditions; proving the leak-free qualities of the new balloons; and a demonstration of the ability of the system to make flights with a specific desired trajectory and terminating at a preselected objective.

II. Equipment Tested

A. Radar Equipment

The primary radar units used in all the test flights were the tracking radar sets installed at "C" station, White Sands Proving Grounds (Refer to map, Drawing No. A-20713-D). The specifications which follow apply directly to flight No. 679, but may be considered representative values for the other flights.

1. Radar No. 1, an S-band set designated MPO12 by the Army, operated at a peak power of 175 kw. at a frequency of 2840 mc. Dish diameter was 10 feet; beam angle, 2.24 degrees; horizontal polarization and a parabolic antenna illuminator.

2. Radar No. 5, an x-band set with the Army designation MPG2, operated a peak power of 130 kw. at a frequency of 9310 mc. Dish diameter was 6 feet; beam angle, 1.3 degrees; horizontal polarization; and parabolic antenna illuminator.

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It should be pointed out that the above radar sets are designed for tracking operations only and are not suitable for search work. Normally, the target must first be found visually or by a search radar unit. Once the target has been found, however, the sets will track automatically if the return signal is strong enough. If the signal is too weak to track in automatic, the set can be made to track in remote by the radar operator who adjusts the set (varying range and bearing) to maintain the maximum "pip" on the A-scope. A manually-operated optical tracker coupled to the radar can also be used to give direction and elevation angle data while the radar set determines range and signal strength.

Ordinarily, the radar sets at "C" station are used to track rockets varying in length from three feet to 30 or 40 feet. These rockets can be tracked to maximum ranges up to 175,000 yards or about 100 miles.

3. An SCR-584 S-band search radar was available here at the Desert Weather Station and was used on three of the test flights. The SCR-584 was equipped with both an A-scope and a PPI scope and could therefore be used for search type operations. Ordinarily, this set is used to track an aluminum-foil target carried aloft by a pibal balloon to determine upper winds.

4. An SK-1M portable search radar unit was also made available for test. Although not ready for the initial flights, it was available for later tests. This set was also equipped with the A-scope as well as with the PPI. An automatic camera was provided to photograph each successive sweep of the PPI scope. Later these pictures can be projected at high speed to determine whether or not any of the "pips" on the scope were moving. Operating frequency of the SK-1M was from 192.5 mc. to 195.0 mc.

B. Balloons

The balloons used on the tests were standard Interim System balloons with the exception of a special valveless balloon used in the basic tests to

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determine the capabilities of radar against the man and balloon in the complete absence of metal.

Type GM251 Balloons were used on all radar tests. Briefly, these balloons are 25 feet in diameter and have a volume of 8000 cu. ft. The polyethylene envelopes ranged in thickness from $1\frac{1}{2}$ mil Visking material to 2 and $2\frac{1}{2}$ mil Flax material. All balloons had #890 hi-strength (500# test) glass filament load tapes.

One GM251 was modified for a radar test by removing the steel load ring and substituting a plywood ring in its place.

A special GM251 was built for the radar tests. Because a suitable non-metallic valve was not available, this balloon was simply constructed with a solid top and no valve. Control to a limited degree could be secured by pulling off a tape patch in the top of the balloon, leaving a hole one inch square. This gave more or less a "one-way ride" down although descent could be controlled by ballast.

A type GM207 balloon twenty foot diameter and 5500 cu. ft. was used on a training flight. Envelope thickness was $1\frac{1}{2}$ mil; tapes were #880 rayon fibre (200#/in.).

C. Flight Gear

All flight gear was standard Interim System except on flights no. 676 and 679.

The principal modifications to the equipment on flight no. 676 were in the suspension system, the suspension bar being replaced by a wooden equivalent. Emergency release was provided by a nylon line which could be cut with a small knife or razor blade to disengage the harness and parachute from the balloon. The harness was standard; the metal cup and barograph were eliminated, however,

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to reduce the metallic content of the system as a whole. This equipment was flown on the aforementioned balloon with the wooden load ring.

For the stripped down test in the complete absence of metal, a special harness was constructed which was tied on with nylon loops instead of metal buckles. The plywood seat was laced to the harness, and the parachute shroud lines were tied directly to the loop in the upper ends of the harness risers to eliminate connector links and snaps. Ballast was carried in 45 lb. capacity bags made of polyethylene tubing and #880 tape. The wooden suspension system and load ring were removed from the equipment on flight no. 676 and installed in the special valveless balloon.

D. Inflation Gear

Helium was used as the lifting gas on all flights. It was found that thirty standard cylinders could be transported quite readily on a 2½ ton 6x6 truck and that this amount of gas (6600 cu. ft.) was adequate for all flights.

The inflation manifold was of the double straight line type with 12 pairs of outlets. An extra outlet for attaching a gauge could also be used with a helium cylinder so that either 24 or 25 cylinders could be manifolded together at one time.

Annealed copper pig tails provided a flexible connection between the individual cylinders and the manifold.

A one-inch diameter low pressure hose (bursting strength = 1000 psi) was used between the manifold and the balloon. A new diffuser of greatly decreased length was constructed in the field and used on the later flights (no. 677 upwards).

Because of the age of the manifold and the fact that it could not be sealed against leaks at high pressure, the manifold valve was left wide open at all times and the flow of gas controlled by the valves on each individual cylinder.

III. Conclusions

A. Radar Capabilities

The radar tests at WSPG indicate that, if the amount of metal in the system is kept at a minimum (on the order of that in the present Interim System), thirty miles is the maximum range at which a high-powered tracking radar set working on X or S-band can track. Twenty miles is the maximum range for S-band search radar and ten miles is the maximum range for low-frequency (192.5 mc.) search units.

It was generally agreed by the radar people at WSPG that it would be practically impossible to detect and identify the balloon on a search radar set without prior knowledge as to its presence and position. Although tracking radar can do quite well because of its high power and narrow beam, it is quite useless for search purposes.

Variations in the metallic content of the system did not produce any significant changes in the ability of any of the radar sets to track; the stripped-down gear made almost the same quality target as the standard Interim System except that the signal strength was not subject to variations due to metal parts rotating into position to become good reflectors. The opinion expressed by the radar people was that they were tracking the man's body and the surface of the balloon and not pieces of metal.

B. Training of Personnel

Two of the pilots sent to WSPG may be considered adequately trained to make routine operational flights using the standard Interim System, having satisfactorily demonstrated proficiency in all phases of layout, inflation, rigging, weigh-off, flight, drag-roping and landing techniques, under both daylight and night-time conditions.

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The third pilot, having made only one flight, and assisted in three launchings, may be considered sufficiently well acquainted with the system to make realistic plans for its use, and if necessary could supervise the operation, although further instruction in the form of one or two more flights would be desirable.

C. Interim System Balloon and Equipment

The Interim System balloon is now satisfactory and can be relied upon to give consistent flights with an average ballast consumption of one lb./hr. or less. All control features are adequate.

The Interim System harness and equipment are also adequate, although a quick-adjusting feature may be desirable. The harness, itself, is comfortable but the need for adequately warm clothing should be stressed.

The present inflation equipment is inadequate except for the "square" diffuser. The manifold needs re-design to provide lighter weight, greater flexibility, and better leak-free qualities.

D. Operational Techniques

The present system of inflation is adequate if surface wind gusts do not exceed 15 knots prior to inflating the balloon 70% full. Above 70% full, the limiting velocity is 20 knots. However, a reefing or holding technique is needed to permit inflation during stronger winds (up to 30 knots) or ease the problems of inexperienced personnel who may use the system even in lighter winds.

Present weigh-off, launching, in-flight, drag-roping, and landing techniques are satisfactory and no changes are necessary.

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E. Forecastability

For short flights up to 50 miles, adequate forecasting can be done by visual observation of small pibal balloons sent up a few hours before take-off. The selection of the launching site can be based upon the result of the pibal soundings. The error in the final landing spot is less than 10% or within 5 miles of a pre-selected site on a 50 mile flight.

For longer flights up to 200 miles or more, better data in the form of a current upper air sounding is needed. Further flights and more data are needed to determine accurately the percentage error on long distance flights but it is believed that this error will also usually be less than 10 percent.

IV. Recommendations

A. Redesign of Balloon and Equipment

To insure a minimum target for radar to spot, the Interim System should be redesigned to eliminate metal wherever practical. Long development and testing programs are unnecessary.

Suggested changes include a plastic valve, plywood load ring, wooden suspension bar, revised drag rope pack, rip cord assembly and the substitution of smaller harness snaps and dee rings. These items will be incorporated as soon as practicable.

B. Development of High-wind Inflation Technique

In order to enable small plastic balloons to be inflated in surface winds with gusts to 25 knots, it is believed that a reefing technique for the lower portion of the balloon will prove the most adequate as it prevents the formation of large sail areas and reduces whipping of the envelope. Restraining techniques are believed to be unsuitable because all of them require the restraining force to be applied on a small portion of the balloon resulting in stress concentrations and ultimate stretching and failure of the envelope. Such systems also require a great deal of manpower and increase inflation time.

A modification of the reefing technique as developed by other balloon projects would be the use of a larger sleeve with a line running from the top of the sleeve up to a dee ring and back down to the ground to provide control of the position of the sleeve and prevent its falling to the ground.

C. Re-design of Inflation Equipment

A multiple-section manifold with a single straight line pipe and X-type couplings is recommended. Each section should provide for manifolding 12 cylinders together and the sections themselves should be capable of being coupled together by a high pressure hose to give a single manifold capable of handling 12, 24, 36 or 48 cylinders at one time arranged in various combinations of rows and stacks. (See Drawing no. A-30262-B for manifold and layouts).

D. Forecastability Study

On all future flights, regardless of proposed length and duration, the pilot should be equipped with a chart showing the forecast trajectory and a table showing all upper winds along the route, as well as a pre-determined flight plan indicating the proper levels at which to fly at different times to maintain the desired trajectory.

RADAR SUMMARY

Flt. No.	Set No.	Type	Band	Freq. (Mc.)	Peak Output (Kw)
671	1	MPQ-12	S	2875	245
	5	MPG-2	X	9310	65
672	3	MPQ-12	S	2877	235
	5	MPG-2	X	9310	60
673	1	MPQ-12	S	2875	250
676	1	MPQ-12	S	2875	250
	4	MPG-2	X	9300	60
	5	MPG-2	X	9310	65
679	1	MPQ-12	S	2875	250
	5	MPG-2	X	9310	65

General:

Beam angle of MPQ-12 (S-band) = 2.15°

Beam angle of MPG-2 (X-band) = 1.4°

Dish Diameter of MPQ-12 (S-band) = 10 ft.

Dish Diameter of MPG-2 (X-band) = 6 ft.

All sets have horizontal (plane) polarization

X-band feeds

Type: Resonant cavity double slot AN 206 offset 0.4°; 9000 to 9600 mc.

S-band feeds

Type: Resonant cavity double slot WA 584 - 10H crossover of 80%

Ranges:

A - Maximum range gates will run out to:
S-band - 384,000 yds.
X-band - 192,000 yds.

B - Working range - good targets, reflective tracking
S-band - 100,000 yds.
X-band - 80,000 yds.

C - With beacon - limited only by range gates and line of sight.

Flight Summaries

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APPENDIX A FLIGHT SUMMARIES

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FLIGHT SUMMARY

Flight No.: 671 Balloon Serial No.: 131

Date: 10 Jan 1952 Launching Time: 1426 MST Balloon Type: 251P-CDH Wt.: 37 1/2#

Pilot: AE

Purpose: Interim System Test. Radar vulnerability test.

Gross Load: 341 1/2 lbs. Load on balloon: 304 lbs.

Maximum altitude: 8000 ft. Initial theoretical altitude: 14,500 ft.

Performance: Ballast consumption less than 1.0 lb/hr.

Landing: where? 1/2 mi. north hiway 70 when? 1513 MST

Success: yes; duration of flight - 47 min.

Equipment and weights:

Balloon	37 1/2
Harness & chute	45
Pilot	155
Ballast	103
Gr. Wt.	340 1/2 lbs.

Radar units tested:

I. "C" station

1. MPQ 12
2. MPG 2

II. Desert weather station

1. SCR 584

25 cylinders of helium used for inflation.

Rigging method: standard interim system except that shovel was not included. A folding radar target was carried and dropped when the desired floating level of 4000 ft. above the radar (8000 ft. above MSL) was reached.

Critique: Launching crew of the pilot and three assistants experienced some difficulties during inflation due to an extremely variable 10-15 knot wind and the lack of an inflation hose, the polyethylene inflation tube being substituted in lieu of the hose (see photo no. 3204). Despite a small hole in the side of the balloon (about 1 ft. below the equator) no ballast was dropped to maintain altitude and balloon may be assumed to have been gastight. Floating maintained with slack balloon at 8000 ft. MSL and at 4500 ft MSL although pressure ceiling was 14,500 ft. Landing routine in 15 MPH surface wind. All interim system equipment functioned satisfactorily. For track and radar data see dwg. no. A-20711-D.

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FLIGHT SUMMARY

Flight no.: 672 Balloon Serial no.: 134

Date: 11 Jan. 1952 Launching Time: 1426 MST Type: 251P-CDH Weight: 37 1/2 lbs.

Pilot: DSW

Purpose: Measure max. range of radar; check out new pilot

Gross load: 388 1/2 lbs. Load on balloon: 351 lbs.

Maximum altitude: 8500 ft. Initial theoretical altitude: 10,800 ft.

Performance: Ballast consumption less than 1.0 lbs/hr.

Landing: where? 3 mi. south of Holloman AFB when: 1634 MST

Success: Yes; duration of flight = 2 hrs. 08 min

Equipment and weights:

Balloon	37 1/2 lbs.
Pilot	185
Harness & chute	45
Very pistol & flares	6
Ballast	115
Gr. Wt.	388 1/2 lbs.

Radar units tested:

I. "C" station

1. MPQ 12
2. MPG 2

II. Desert weather station

1. SCR 584

28 Cylinders of helium used for inflation

Rigging method: Standard interim system. Very pistol and flares carried for emergency use. Radar target was NOT carried.

Critique: Excellent inflation due to use of proper hose and the existance of calm surface conditions. Launching crew of pilot and two assistants. Pilot maintained desired floating altitude of 800 above MSL without difficulty. Balloon very tight requiring less than 1.0 lb/hr. ballast. Pilot drag roped five miles before landing because of approaching high tension wires. Landing was routine in 10 MPH surface wind. For track and radar data, all see dwg. A-20713-D.

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FLIGHT SUMMARY

Flight No: 673 Balloon Serial No: 26

Date: 15 Jan. 1952 Launching time: 0830 MST Type: 251P-BDH Weight: 23 lbs.

Pilot: SFH

Purpose: Measure max. effective range of radar; check out new pilot.

Gross load: 394 lbs. Load on balloon: 371 lbs.

Maximum altitude: 10,000 ft. Initial theoretical altitude: 9,900 ft.

Performance: Ballast consumption less than 10lb/hr.

Landing: where 2 mi NE Escondido, N.M., 1040 MST

Success: Yes; duration of flight = 2 hrs. 10 min.

Equipment and Weights:

Balloon	23 lbs
Pilot	190
Harness & gear	45
Ballast	136
Gr. Wt.	394 lbs.

Radar Units Tested:

I. "C" Station

1 -MPQ 12

28 cylinders of helium used for inflation.

Rigging method: Standard interim system;balloon material was 1 1/2 mil Visking, but tapes were #890 hi-strength kind. Single slit rip panel.

Critique: Routine inflation. Pilot was able to float at or near the pressure ceiling of the balloon without difficulty. Pilot also drag-roped several miles before landing. Calm surface conditions at landing site. No ballast was dropped by the pilot during the hour that he remained aloft at the pressure ceiling of the balloon.

FLIGHT SUMMARY

Flight No.: 674

Balloon Serial No.: 135

Date: 20 Jan. 1952 Launching time: --

Type: 251 P-CDH Weight: 33 lbs.

Pilot: HFS

Purpose: Overnight flight

Gross load: -

Load on balloon: -

Maximum altitude: -

Initial theoretical altitude: -

Performance: -

Landing: -

Success: No.

Equipment and weights:

-

13 cylinders of helium expended.

Rigging method: Standard interim system. Balloon was standard without reefing.

Critique: Failure was caused by a surface wind which had risen to 18-20 knots by the time it became necessary to cut down the balloon by pulling the rip panel. Balloon was badly damaged, prior to cut-down, by sage brush and other sharp objects on the ground. Severe twisting occurred during inflation making it necessary to shut off the gas flow until the balloon could be unwound. Believe that a combination of the following would have made a successful inflation and launching possible despite the wind and lack of shelter:

1. Reefing sleeve or similar technique to reduce sail.
2. Better clearing of the inflation area.
3. A diffuser to permit more rapid inflation.

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FLIGHT SUMMARY

Flight No.: 675

Balloon Serial No.: 136

Date: 22-23 Jan. 1952

Launching time: 920 MST

Type: 251P-CDH

Weight: 33 lbs.

Pilot: HFS

Purpose: Overnight flight to terminate at Pyote AFB

Gross load: 423 lbs.

Load on balloon: 390 lbs

Maximum altitude: 12,500 ft.

Initial theoretical altitude: 7,600 ft.

Performance: Ballast consumption less than 1.0 lb./hr.

Landing: 15 mi. NE Pyote AFB, 705 MST, 23 Jan. '52.

Success: Yes; duration of fligt = 11 hrs. 45 min.

Equipment and weights:

Balloon	33
Pilot	190
Harness & gear	45
Extra equipment	13
Ballast	142
Gr. Wt.	423 lbs.

Radar tested:

I. "C" station

1. SK-1M

Extra equipment:

1. 2 cell flashlite
2. Delta lite with flashing red beacon
3. Water flask
4. Sandwiches and chocolate
5. Radar target
6. Barograph

30 cylinders of helium used for inflation.

Rigging method: Standard interim system.

Forecast landing 10 miles NE Pyote AFB.

Critique: Inflation routine, although conducted after dark. Static electricity sparks seen and shocks felt by crew. After inflation was complete, line holding top of parachute to side of balloon slipped and chute fell to ground. Chute successfully pulled back in place by safety line. Launching routine with a rapid rate of rise (500 ft/min.). Ballast consumption was very low with no ballast being dropped after midnight. Pilot experienced extreme discomfort in the extreme cold at 12,500 ft. Suggest the use of better clothing and pocket type hand warmers. Visual results with the SK-1M radar unit were negative although the balloon passed within 3 miles of the station. Error of forecast = 2 1/2%; error of target = 7 1/2%.

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FLIGHT SUMMARY

Flight No: 676 Balloon Serial No: 106

Date: 24 Jan. 1952 Launching time: 1400 MST Type: 251P-BD Weight: 22.5 lbs.

Pilot: HFS

Purpose: Test radar against semi-stripped interim system.

Gross load: 369 1/2 lbs. Load on balloon: 347 lbs.

Maximum altitude: 9000 ft. Initial theoretical altitude: 11,900 ft.

Performance: Ballast consumption rate less than 1.0 lbs/hr.

Landing: White Sands Monument, 1800

Success: Yes, duration of flight= 4 hrs.

Equipment and weights;

Balloon	22 1/2 lbs.
Harness & gear	45
Pilot	185
Ballast	117
Gr. Wt.	369 1/2 lbs.

Radar tested:

I. "C" Station

1. MPQ 12
2. MPG 2
3. SK-1M

25 cylinders of helium used for inflation

Rigging method: Interim system modified to substitute a wooden load ring and suspension bar to replace their steel counterparts. Valve left in.

Critique: 180° wind shift occurred during inflation making it necessary to more tie down jeep. Otherwise, routine. Pilot had difficulty climbing in turbulence on lea side of the Organ Mts. but finally reached his desired level and secured the predicted winds. Pilot drag roped for over two hr. and covered a distance of approximately 20 miles before landing. Radar people stated that they thought they were tracking only the man and the balloon and not any pieces of metal. For radar track and summary of results see accompanying drawing.

FLIGHT SUMMARY

Flight No: 677

Balloon Serial No: 177

Date: 28 Jan. 1952 Launching time: 1420 MST

Type: 207P BD Weight: 21 lbs.

Pilot: SFH, MDR, AE

Purpose: Training flight; hedgehop

Gross load: 286 lbs.

Load on balloon: 265 lbs.

Maximum altitude: 6900 ft.

Initial theoretical altitude: 7900 ft.

Performance: Ballast consumption less than 1.0 lb./hr.

Landing: Highway 70, 1711

Success: Yes, total duration = 2 hrs. 51 min.

Equipment and weights:

	#1	#2	#3
Balloon	21	21	21
Harness & gear	45	45	45
Pilot	180	155	150
Ballast	40	64	65
Gross Wt.	286lb.	285lb.	281 lb.

Radar tested:

I. "C" Station
   1. SK-1M

22 cylinders of helium used for inflation

Rigging method: Standard Interim system with Type 207 balloon (5500 ft^3)

Critique: Exceptionally rapid inflation (less than 10 min.) due to use of new diffuser. Flights were routine except that rip panel was not used on landing.

After the last landing the balloon was tied to the rear bumper of a jeep and towed 5 miles down the highway at a speed of 10 mph. with a headwind of 5 mph. Towing finally abandoned due to failure of one load tape and the approach of wires which could not be gotten under.

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FLIGHT SUMMARY

Flight No: 678

Balloon Serial No.: 133

Date: 29-30 Jan. 1952 Launching Time: 1720 MST

Type: 251P-CDH Weight: 36 lbs.

Pilot: SFH

Purpose: Over-night trajectory; target: Pyote AFB

Gross load: 404 lbs.

Load on balloon: 368 lbs.

Maximum altitude: 12,500 ft.

Initial theoretical altitude: 9,200 ft.

Performance: Fair; ballast consumption rate = 6 lbs./hr.

Landing: 25 miles NW Pecos, Texas, 0505 MST, 30 Jan. 1952

Success: Fair, duration 11 hrs. 45 min.

Equipment and weights:

Balloon	36.0 lbs.
Harness & gear	45.0
Extra equipment	13.0
Pilot	190.0
Ballast	120.0
Gr. Wt.	404.0 lbs.

Radar tested:

I. "C" Station
 1. SK-1M

28 cylinders of helium used for inflation

Rigging method: Standard Interim System

Critique: Inflation and launching routine. Flight expended all ballast in about 10½ hrs. and continued for another hour by drag roping. Drag rope was finally lost but landing was safely accomplished in 20 mph wind without it. Actual ballast consumption rate was about 6 lbs./hr. due to the wasting of 60 lbs. of ballast in climbing to 12,500 feet. Pilot had no difficulties keeping warm. Pocket hand-warmers were used and found satisfactory. One-half inch long slit found in valve diaphragm after flight believed to have caused high rate of ballast consumption.

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FLIGHT SUMMARY

Flight No.: 679

Balloon Serial No: 139

Date: 31 Jan. 1952 Launching Time: 1320 MST

Type: 251P-CDHS Weight: 32 lbs.

Pilot: AE

Purpose: Test radar against completely stripped gear.

Gross load: 343 lbs.

Load on balloon: 311 lbs.

Maximum altitude: 8400 ft.

Initial theoretical altitude: 14,100 ft.

Performance: Ballast consumption less than 1.0 lb./hr.

Landing: Oro Grande, N.M., 1502 MST

Success: Yes

Equipment & Weights:

Balloon	32.0 lbs.
Pilot	150.0
Harness & gear	16.0
Ballast	145.0
	343.0 lbs.

Radar tested:

II. "C" Station
1. MPQ12
2. MPG 2
3. SK-1M

25 cylinders of helium used for inflation

Rigging method: Special balloon and gear containing no metal. Emergency release and valve omitted. Pillow balloons and a 1 inch square controlled-leak patch used to initiate descent. Ballast carried in polyethylene bags. One single-edge razor blade carried for emergency.

Critique: Excellent flight to test the characteristics of radar against a man and balloon in the absence of metal. Balloon was extremely tight; no ballast used for floating. Experienced some difficulty in descending through inversion. Pillow balloons proved inadequate and it became necessary to pull the controlled-leak patch. Landing routine. See Drawing no. A-20708-D for details of flight track and radar data.

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Time/Altitude Curves

APPENDIX B TIME/ALTITUDE CURVES

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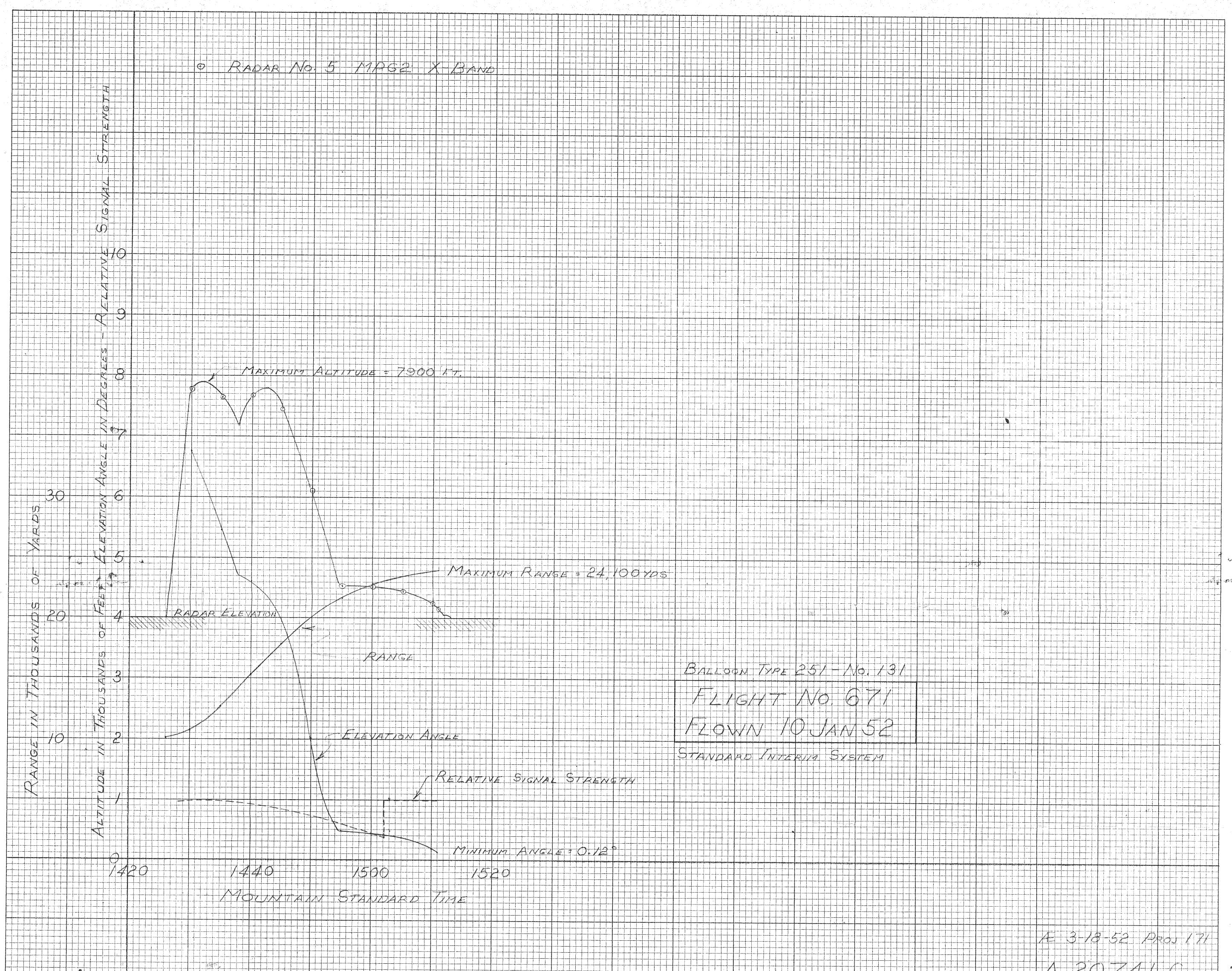

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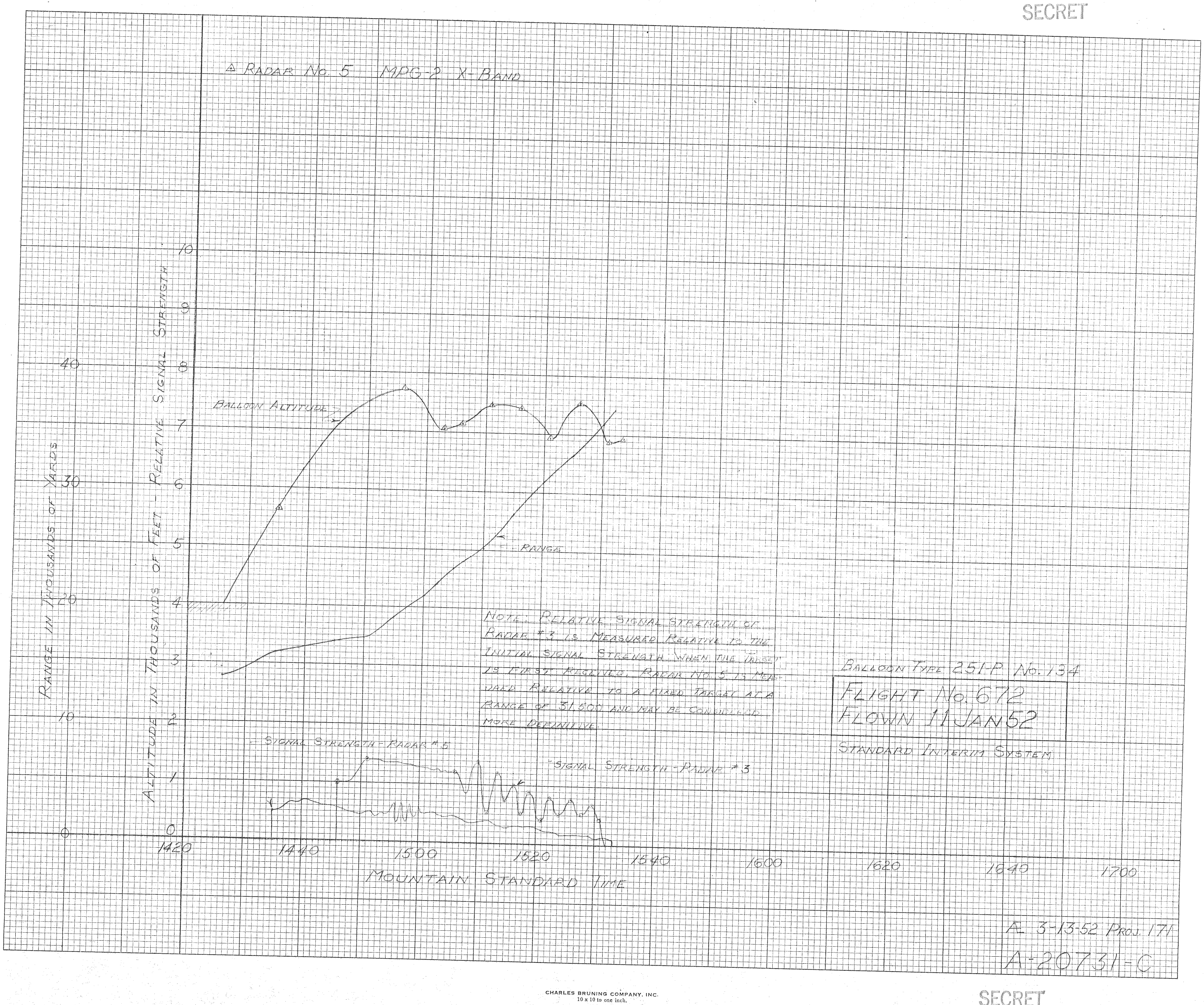
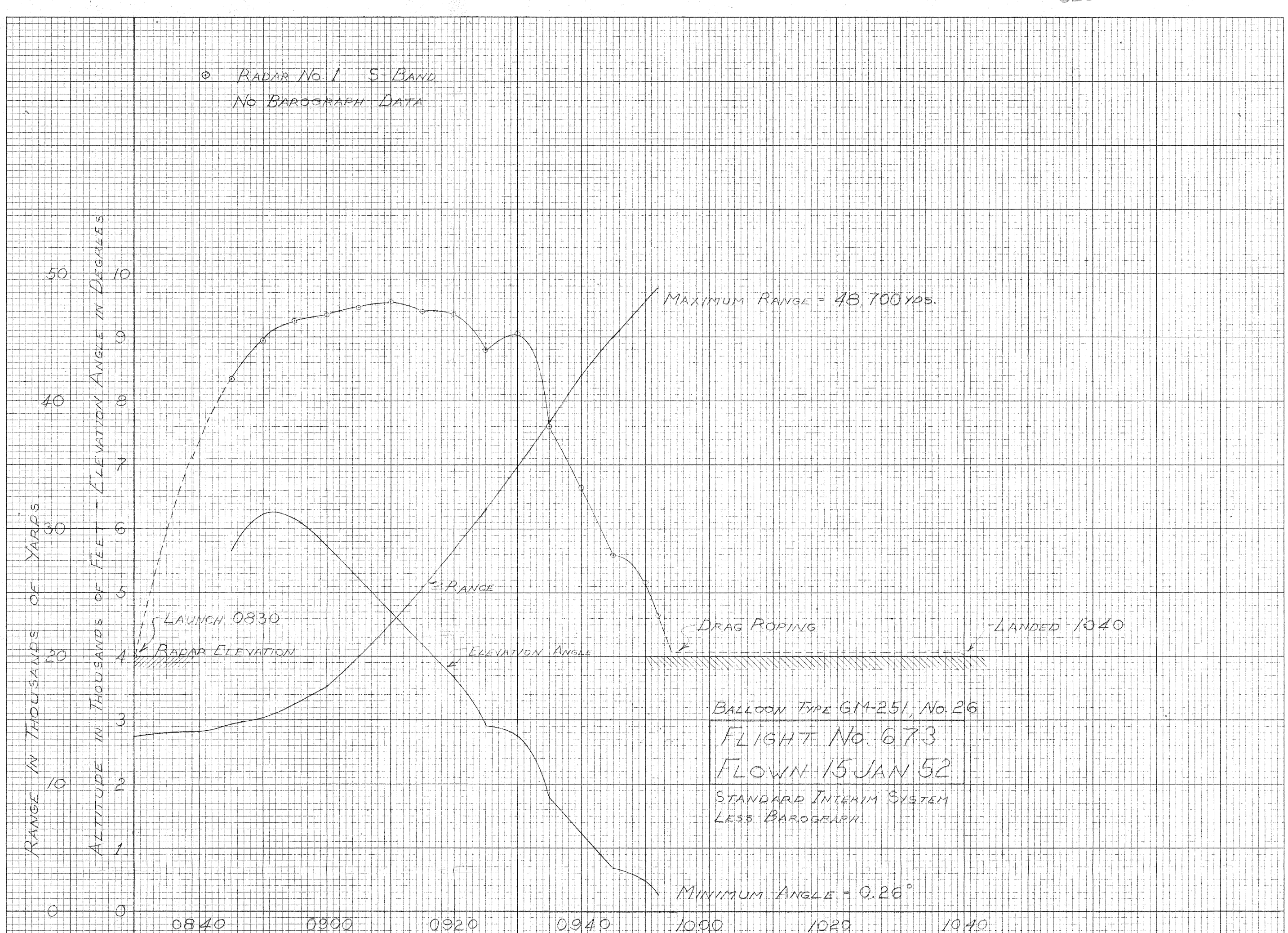
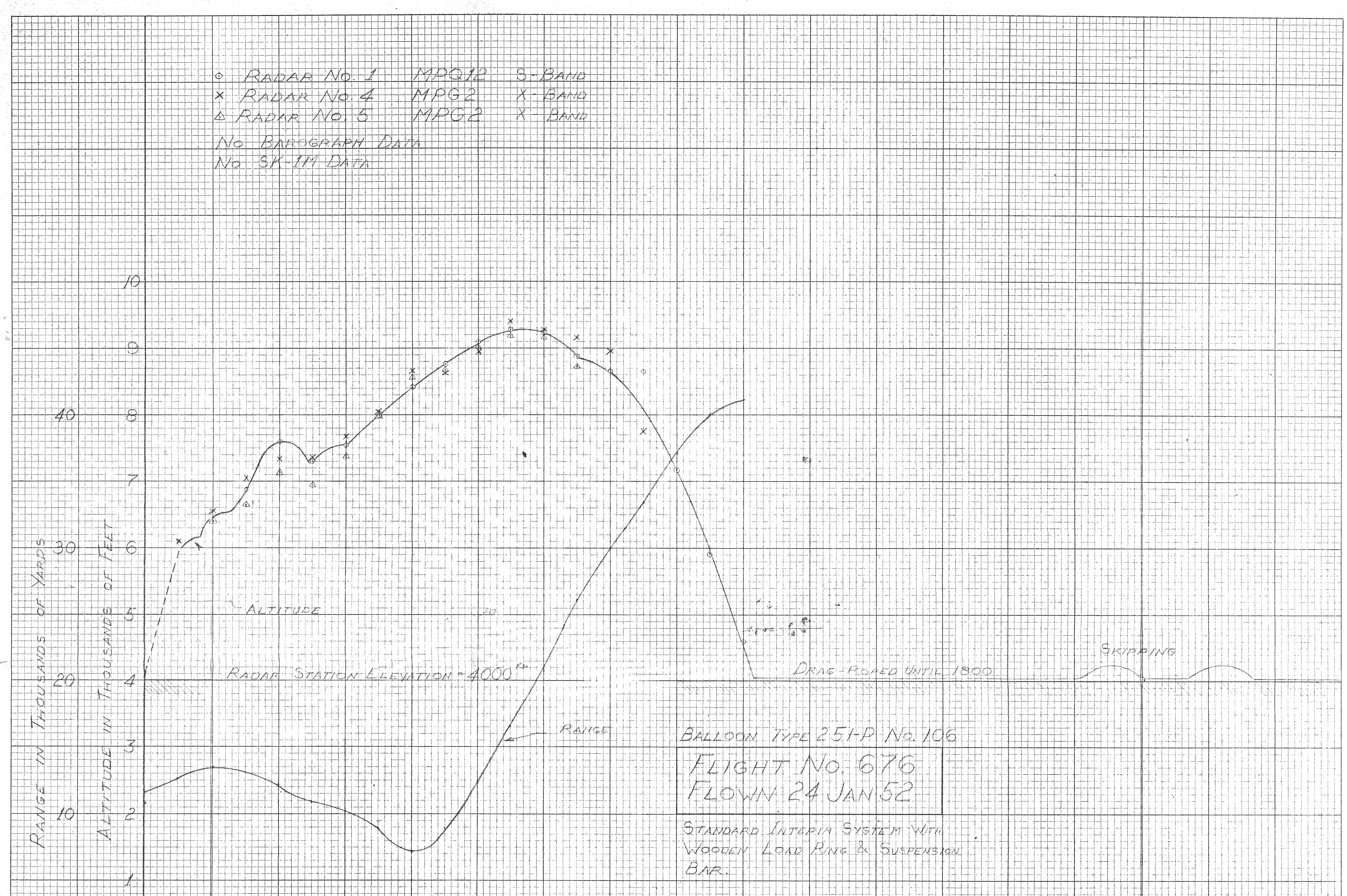


CHARLES BRUNING COMPANY, INC.
10 x 10 to one inch.
NO. 645

SECRET

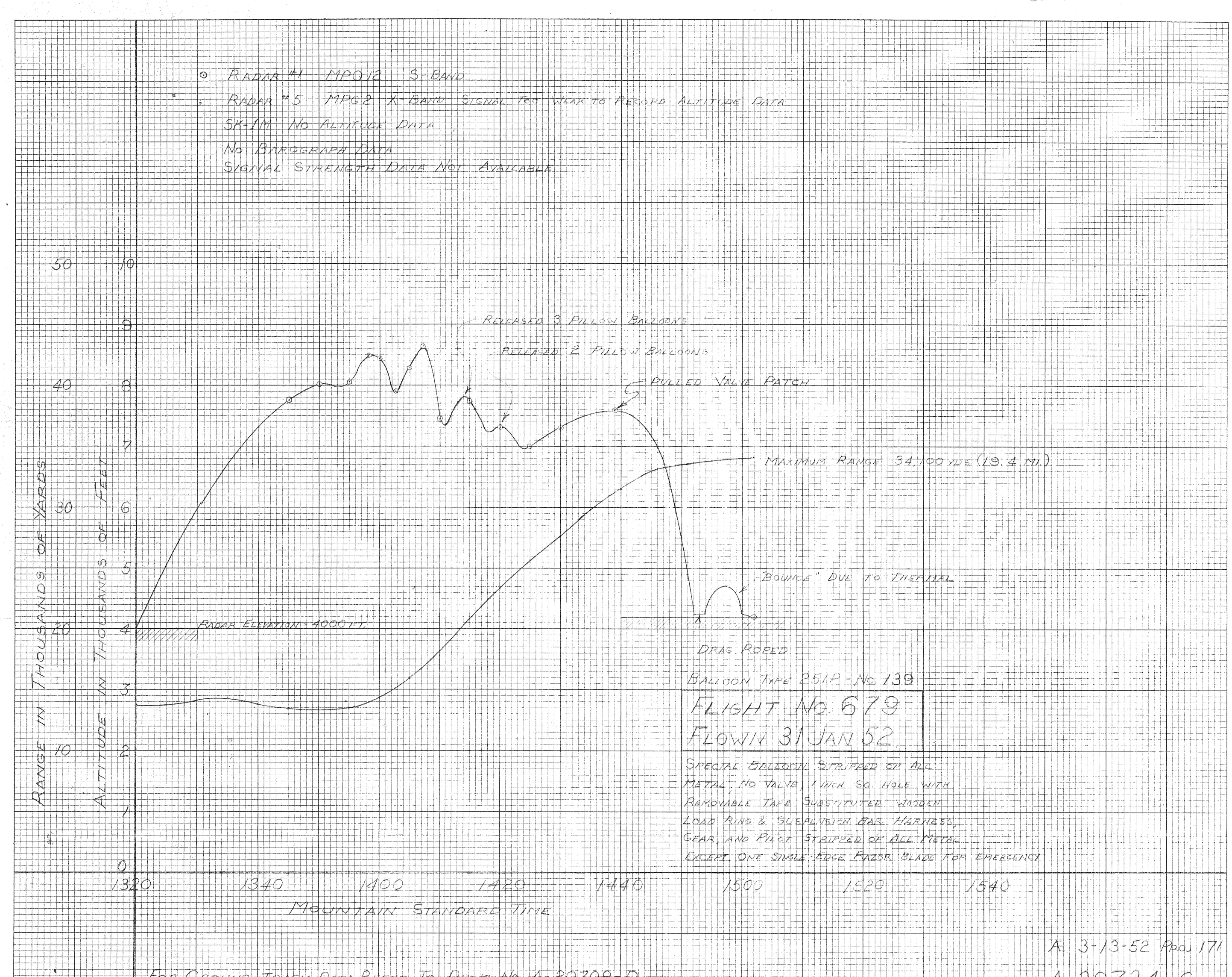


RADAR NO. 1 S-BAND
NO BAROGRAPH DATA
RANGE IN THOUSANDS OF YARDS
ALTITUDE IN THOUSANDS OF FEET - ELEVATION ANGLE IN DEGREES
MAXIMUM RANGE = 48,700 YDS.
RANGE
ELEVATION ANGLE
LAUNCH 0830
RADAR ELEVATION
DRAG ROPING
LANDED 1040
BALLOON TYPE GM-251, NO. 26
FLIGHT NO. 673
FLOWN 15 JAN 52
STANDARD INTERIM SYSTEM
LESS BAROGRAPH
MINIMUM ANGLE = 0.26°
0840
0900
0920
0940
1000
1020
1040
MOUNTAIN STANDARD TIME
3-18-52 PROJ 171
A-20739-C



○ RADAR NO. 1 MPQ12 S-BAND
× RADAR NO. 4 MPG2 X-BAND
△ RADAR NO. 5 MPG2 X-BAND
NO BAROGRAPH DATA
NO SK-1M DATA
RANGE IN THOUSANDS OF YARDS
ALTITUDE IN THOUSANDS OF FEET
ALTITUDE
RADAR STATION ELEVATION = 4000 FT.
RANGE
DRAG-ROPED UNTIL 1800
SKIPPING
BALLOON TYPE 251-P NO. 106
FLIGHT NO. 676
FLOWN 24 JAN 52
STANDARD INTERIM SYSTEM WITH WOODEN LOAD RING & SUSPENSION BAR.
1400
1430
1500
1530
1600
1630
MOUNTAIN STANDARD TIME
Æ 3-12-52 PROJ. 171
A-20732-C

SECRET



CHARLES BRUNING COMPANY, INC.
10 x 10 to one inch.
NO. 645

SECRET

Radar Traces

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APPENDIX C RADAR TRACES

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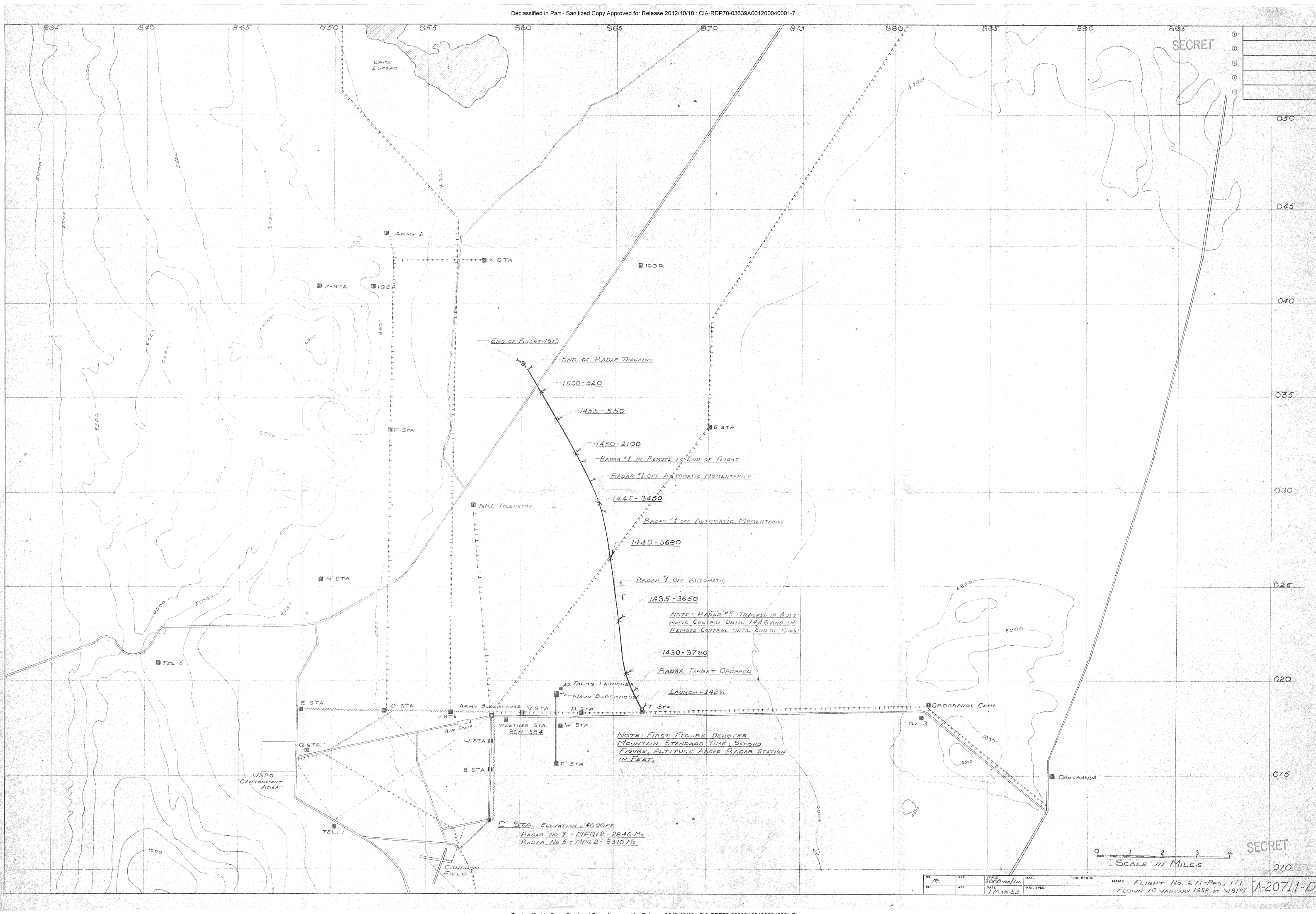
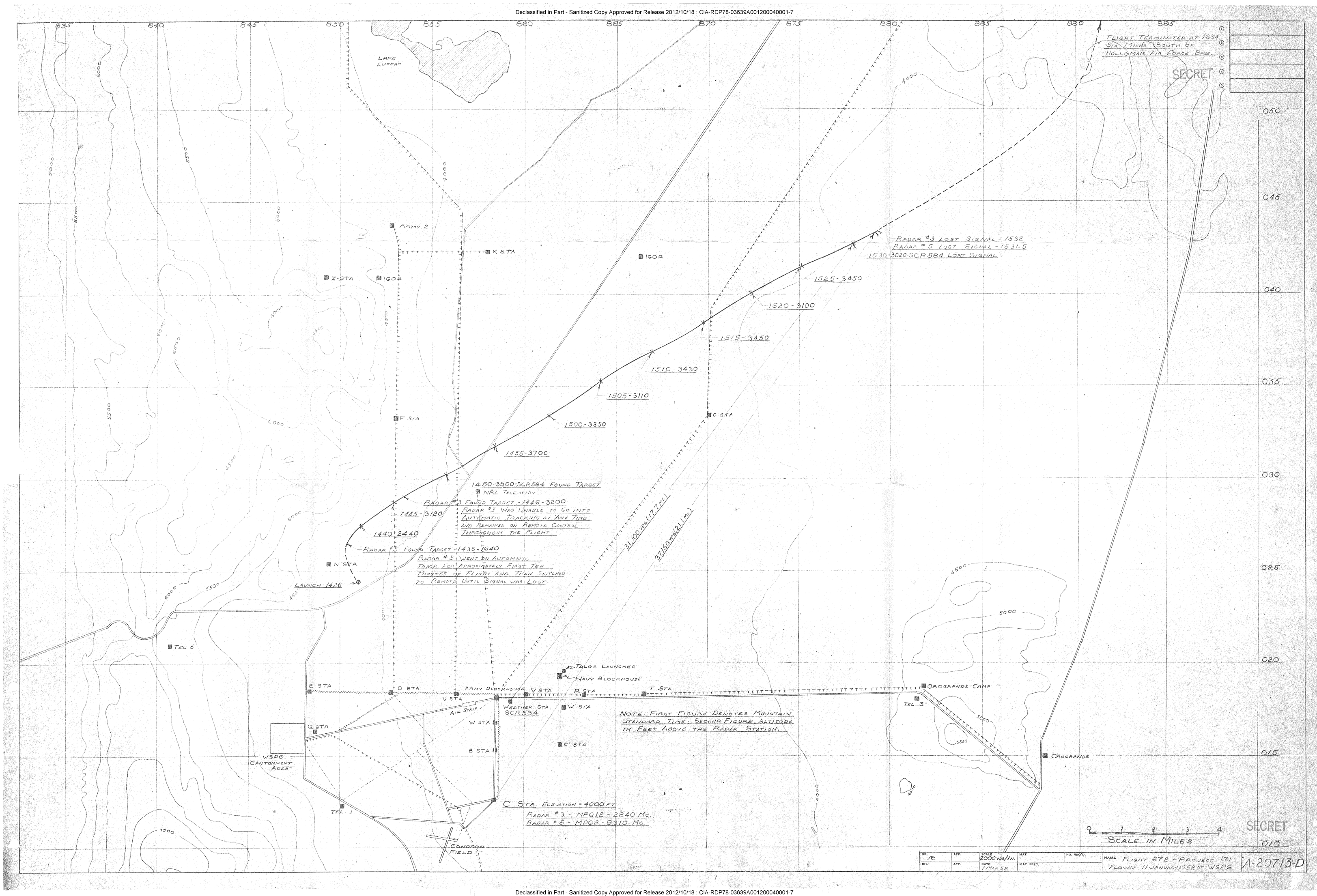
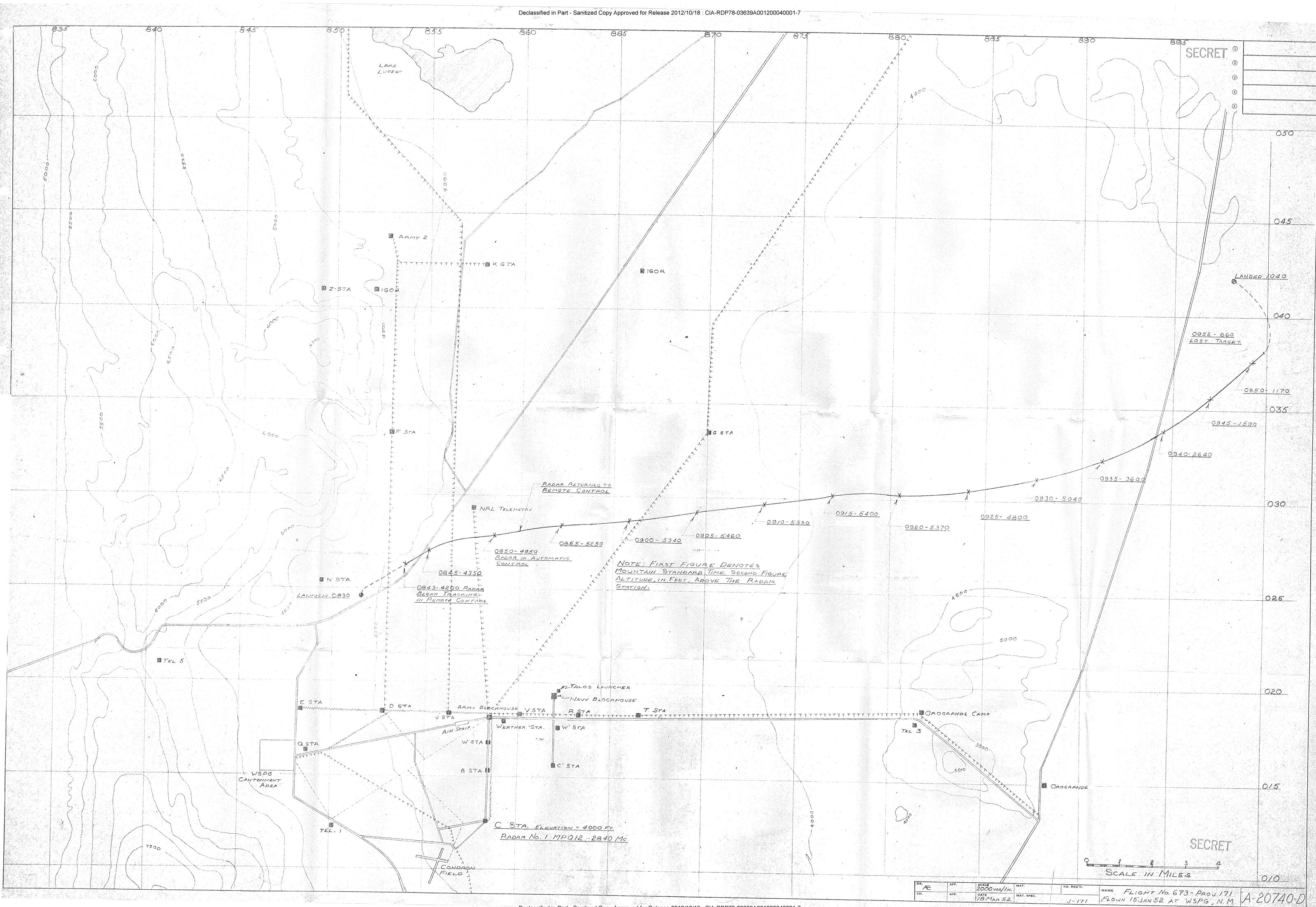
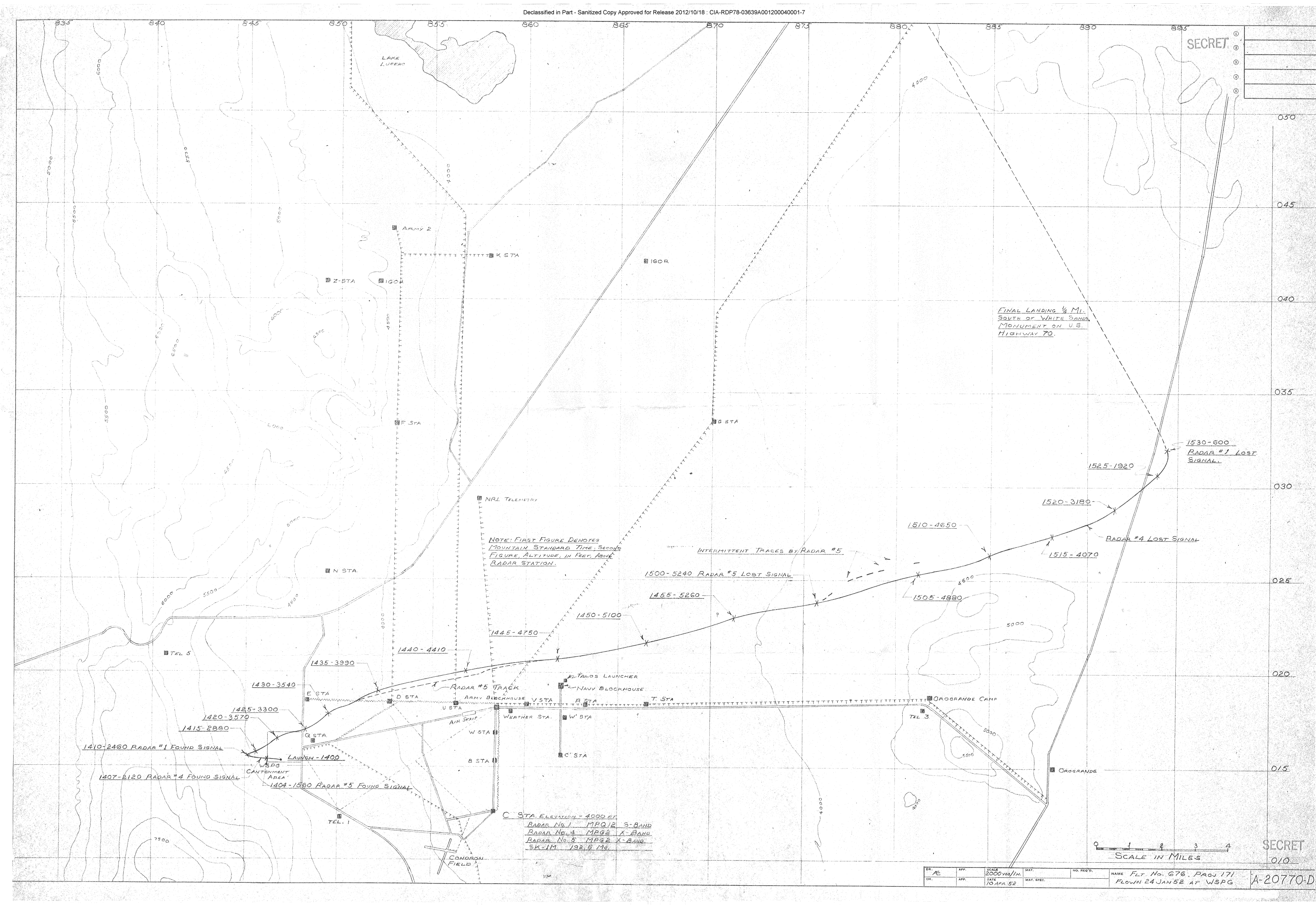

SECRET
Lake Lucero
Army 2
K STA
IGOR
Z-STA
IGOR
F STA
G STA
NRL Telemetry
N STA
Tel. 5
End of Flight-1513
End of Radar Tracking
1500-520
1455-550
1450-2100
Radar #1 in Remote to End of Flight
Radar #1 off Automatic Momentarily
1445-3450
Radar #1 off Automatic Momentarily
1440-3680
Radar #1 Off Automatic
1435-3650
Note: Radar #5 Tracked in Automatic Control Until 1446 and in Remote Control Until End of Flight
1430-3760
Radar Target Dropped
Talos Launcher
Navy Blockhouse
Launch-1426
E STA
D STA
Army Blockhouse
U STA
V STA
R STA
T STA
Orogrande Camp
Tel 3
Weather Sta.
SCR-584
W' STA
Air Strip
W STA
Q STA
B STA
C' STA
WSPG Cantonment Area
Note: First Figure Denotes Mountain Standard Time; Second Figure, Altitude Above Radar Station in Feet.
Orogrande
C Sta. Elevation = 4000 ft.
Radar No 1 - MPQ12 - 2840 Mc
Radar No 5 - MPG2 - 9310 Mc
Tel. 1
Condron Field
Scale in Miles
SECRET
DR. Æ
SCALE 2000 yds/In.
DATE 1 Mar 52
NAME Flight No. 671-Proj 171 Flown 10 January 1952 at WSPG
A-20711-D

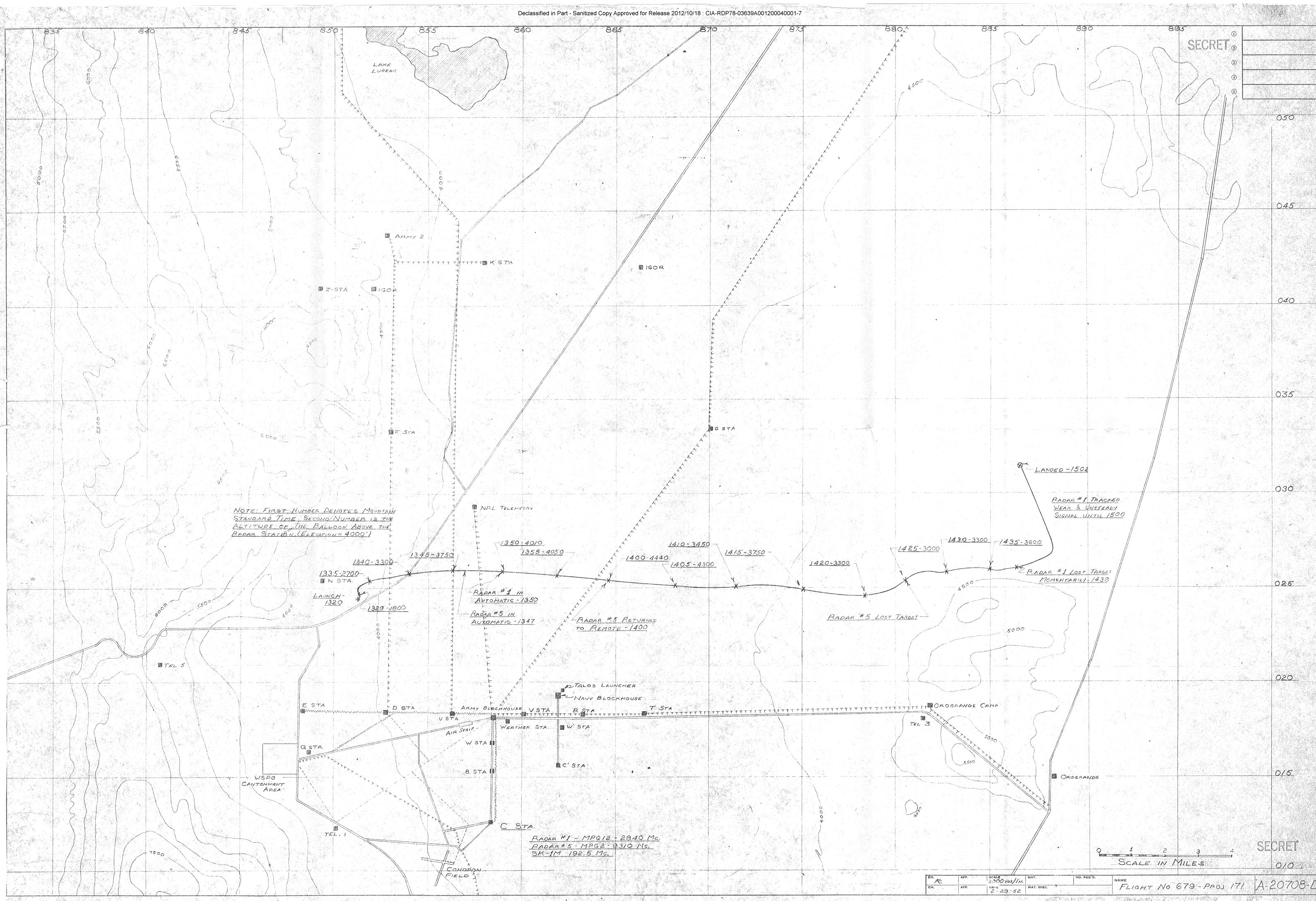


Flight Terminated at 1634 Six Miles South of Holloman Air Force Base.
SECRET
Lake Lucero
Army 2
K Sta
160R
Z-Sta
160R
F Sta
G Sta
N Sta.
Launch-1426
Radar #5 Found Target -1435-1640
Radar #5 Went on Automatic Track for Approximately First Ten Minutes of Flight and then Switched to Remote Until Signal Was Lost.
1440-2440
1445-3120
Radar #3 Found Target -1446-3200
Radar #3 Was Unable to Go into Automatic Tracking at Any Time and Remained on Remote Control Throughout the Flight.
1450-3500-SCR584 Found Target.
NRL Telemetry
1455-3700
1500-3350
1505-3110
1510-3430
1515-3450
1520-3100
1525-3450
1530-3020-SCR584 Lost Signal
Radar #5 Lost Signal -1531.5
Radar #3 Lost Signal -1532
31,100 yds (17.7 mi)
37,150 yds (21.1 mi)
Tel 5
E Sta
D Sta
Army Blockhouse
U Sta
V Sta
R Sta
T Sta
Talos Launcher
Navy Blockhouse
Air Strip
Weather Sta.
SCR584
W' Sta
W Sta
B Sta
C' Sta
Q Sta.
WSPG Cantonment Area
Tel. 1
Condron Field
C Sta. Elevation = 4000 ft
Radar #3 - MPQ12 - 2840 Mc.
Radar #5 - MPG2 - 9310 Mc.
Note: First Figure Denotes Mountain Standard Time; Second Figure Altitude in Feet Above the Radar Station.
Orogrande Camp
Tel 3.
Orogrande
Scale in Miles
SECRET
DR. Æ
SCALE 2000 yds/In.
DATE 1 Mar 52
NAME Flight 672 - Project 171 Flown 11 January 1952 at WSPG
A-20713-D

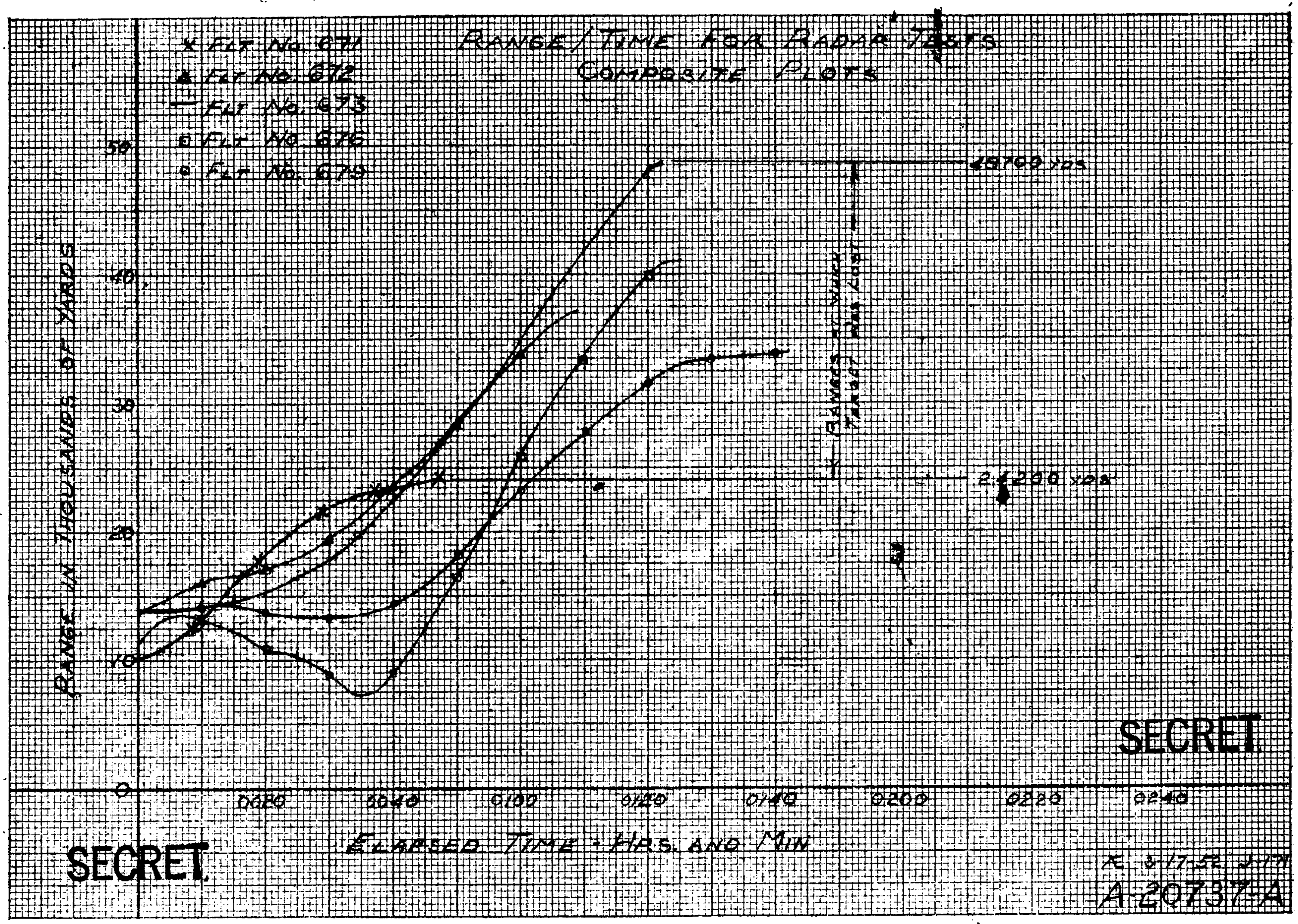

SECRET
Lake Lucero
Army 2
K STA
Z-STA
IGOR
F STA
G STA
NRL Telemetry
Radar Returned to Remote Control
N STA
Launched 0830
0843-4200 Radar Began Tracking in Remote Control
0845-4350
0850-4850 Radar in Automatic Control
0855-5250
0900-5340
0905-5460
0910-5550
0915-5400
0920-5370
0925-4800
0930-5040
0935-3600
0940-2640
0945-1590
0950-1170
0952-860 Lost Target
Landed 1040
Note: First Figure Denotes Mountain Standard Time. Second Figure Altitude, in Feet, Above The Radar Station.
Tel 5
E STA
D STA
Army Blockhouse
V STA
R STA
T STA
Talos Launcher
Navy Blockhouse
Weather Sta.
W' STA
W STA
B STA
C' STA
Q STA
Air Strip
WSPG Cantonment Area
Tel. 1
Condron Field
C Sta. Elevation = 4000 Ft.
Radar No. 1 MPQ12 -2840 Mc
Orogrande Camp
Tel 3
Orogrande
Scale in Miles
SECRET
2000 yds/in.
18 Mar 52
J-171
Flight No. 673 - Proj 171
Flown 15 Jan 52 at WSPG, N.M.
A-20740-D



SECRET
Lake Lucero
Army 2
K STA
Z-STA
IGOR
IGOR
F STA
G STA
NRL Telemetry
N STA
Tel 5
Final Landing ½ Mi. South of White Sands Monument on U.S. Highway 70.
Note: First Figure Denotes Mountain Standard Time; Second Figure Altitude, in Feet, Above Radar Station.
Intermittent Traces by Radar #5
1530-600 Radar #1 Lost Signal.
1525-1920
1520-3180
1510-4650
Radar #4 Lost Signal
1515-4070
1500-5240 Radar #5 Lost Signal
1505-4880
1455-5260
1450-5100
1445-4750
1440-4410
1435-3990
1430-3540
1425-3300
1420-3570
1415-2880
1410-2460 Radar #1 Found Signal
1407-2120 Radar #4 Found Signal
1404-1560 Radar #5 Found Signal
Launch-1400
WSPG Cantonment Area
Radar #5 Track
E STA
D STA
Q STA
U STA
Army Blockhouse
V STA
R STA
T STA
Talos Launcher
Navy Blockhouse
Weather Sta.
W' STA
W STA
B STA
C' STA
Air Strip
Orogrande Camp
Tel 3
Orogrande
Tel. 1
Condron Field
C Sta. Elevation = 4000 Ft.
Radar No. 1 MPQ12 S-Band
Radar No. 4 MPG2 X-Band
Radar No. 5 MPG2 X-Band
SK-1M 192.5 Mc.
Scale in Miles
SECRET
Dr. Æ
Scale 2000 yds/in.
Date 10 Apr 52
Name Flt. No. 676, Proj 171 Flown 24 Jan 52 at WSPG
A-20770-D


SECRET
Lake Lucero
Army 2
K Sta
160A
Z Sta
120A
F Sta
G Sta
NRL Telemetry
Note: First Number Denotes Mountain Standard Time, Second Number is the Altitude of the Balloon Above the Radar Station. (Elevation = 4000')
1335-2700
N Sta.
1340-3300
1345-3750
1350-4010
1355-4050
1400-4440
1405-4300
1410-3450
1415-3750
1420-3300
1425-3000
1430-3300
1435-3600
Launch-1320
1329-1800
Radar #1 in Automatic-1350
Radar #5 in Automatic-1347
Radar #5 Returned to Remote-1400
Radar #5 Lost Target
Radar #1 Lost Target Momentarily-1439
Radar #1 Tracked Weak & Unsteady Signal until 1500
Landed-1502
Talos Launcher
Navy Blockhouse
E Sta
D Sta
Army Blockhouse
V Sta
B Sta
T Sta
Orogrande Camp
Weather Sta.
W Sta
C' Sta
Q Sta
WSPG Cantonment Area
Tel. 1
Tel. 3
Tel. 5
C Sta.
Condron Field
Orogrande
Radar #1 - MPQ12 - 2840 Mc.
Radar #5 - MPS2 - 9310 Mc.
SK-1M 192.5 Mc.
Scale in Miles
SECRET
Dr. Æ
Scale 2000 yds/in.
Date 2-29-52
Name Flight No 679 - Proj 171
A-20708-D

20 x 20 to the inch.



Equipment Modifications

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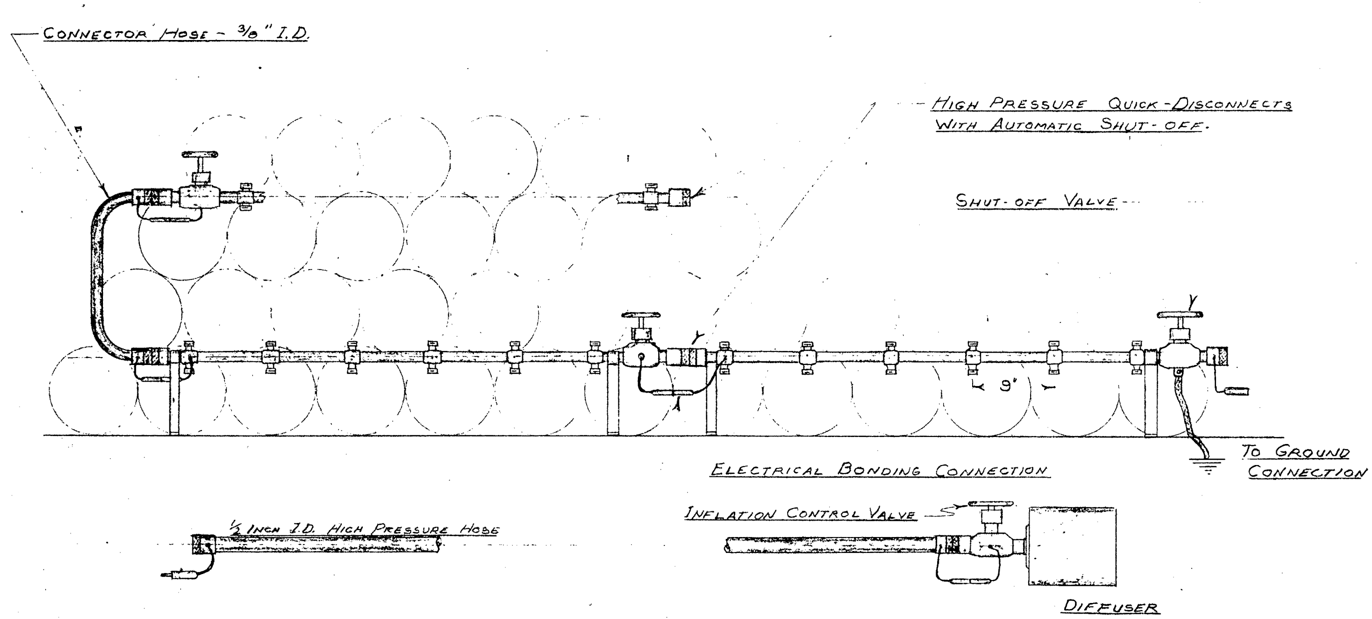
APPENDIX D EQUIPMENT MODIFICATIONS

SECRET

①
②
③
④
⑤



SECRET

IF NOT SPECIFIED TOLERANCES ARE:
±.001" - IF 3 DECIMAL FIGURES ARE GIVEN
±.01" IF 2 DECIMAL FIGURES ARE GIVEN
±.1" IF 1 DECIMAL FIGURE IS GIVEN

DR.	APP.	SCALE	MAT.	NO. REQ'D.	NAME	
Æ		NONE			HIGH-PRESSURE INFLATION MANIFOLD	A-30262-B
CH.	APP.	DATE 15 MAR 52	MAT. SPEC.	J-171		

25X1

Photographs

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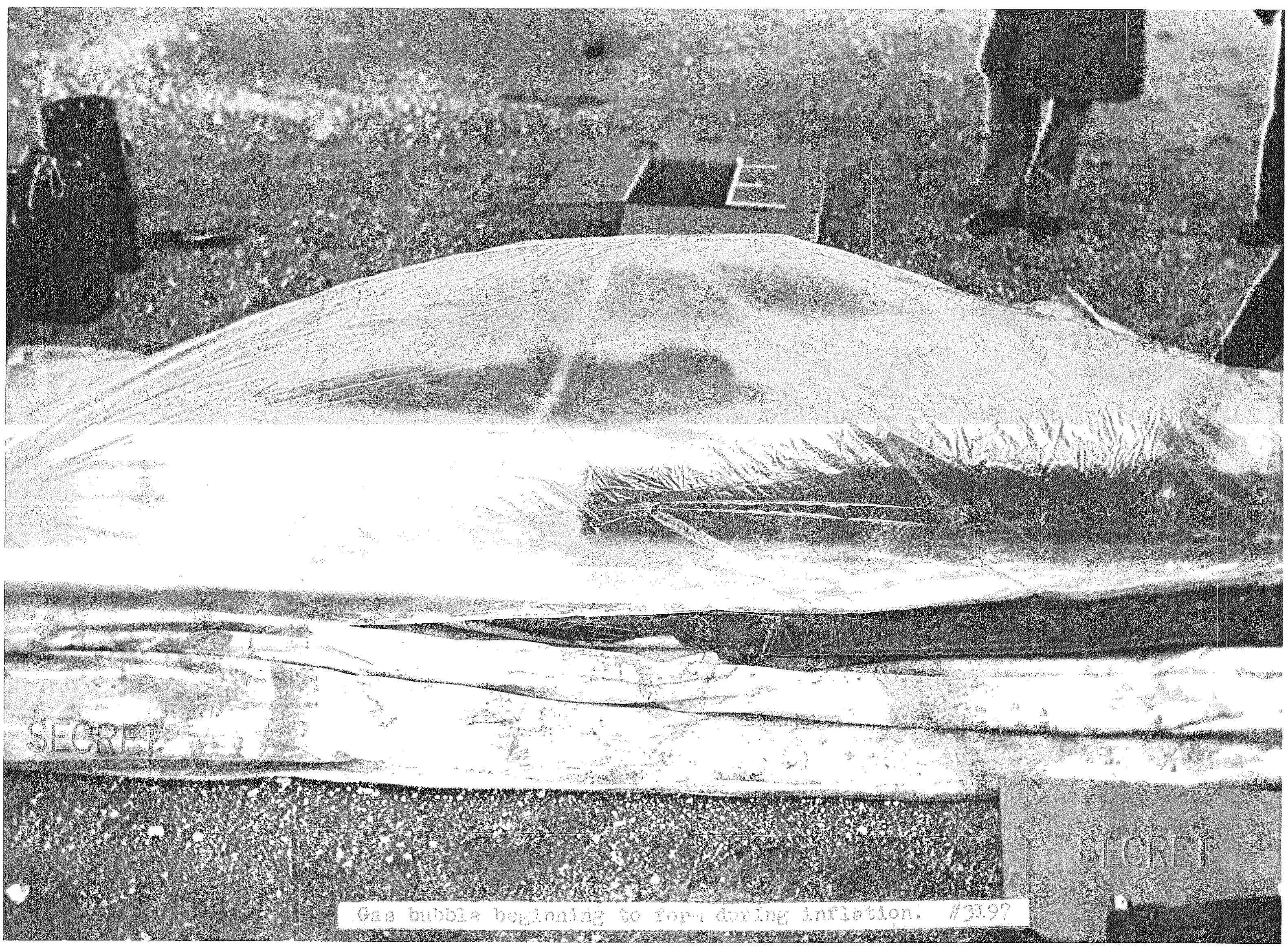
Layout of Flight No. 671. Note radar target in lower right hand corner of photo. Filled ballast bags appear at left. Balloon is tied down to jeep by two nylon lines. #3190

SECRET

Close-up of tie-in of top of parachute to ring in the side of the balloon. Tie-in consists of four strands of 20# linen cord. A pull of 80# is thus required to free the top of the chute from the balloon. #3193



Gas bubble beginning to form during inflation. #3397

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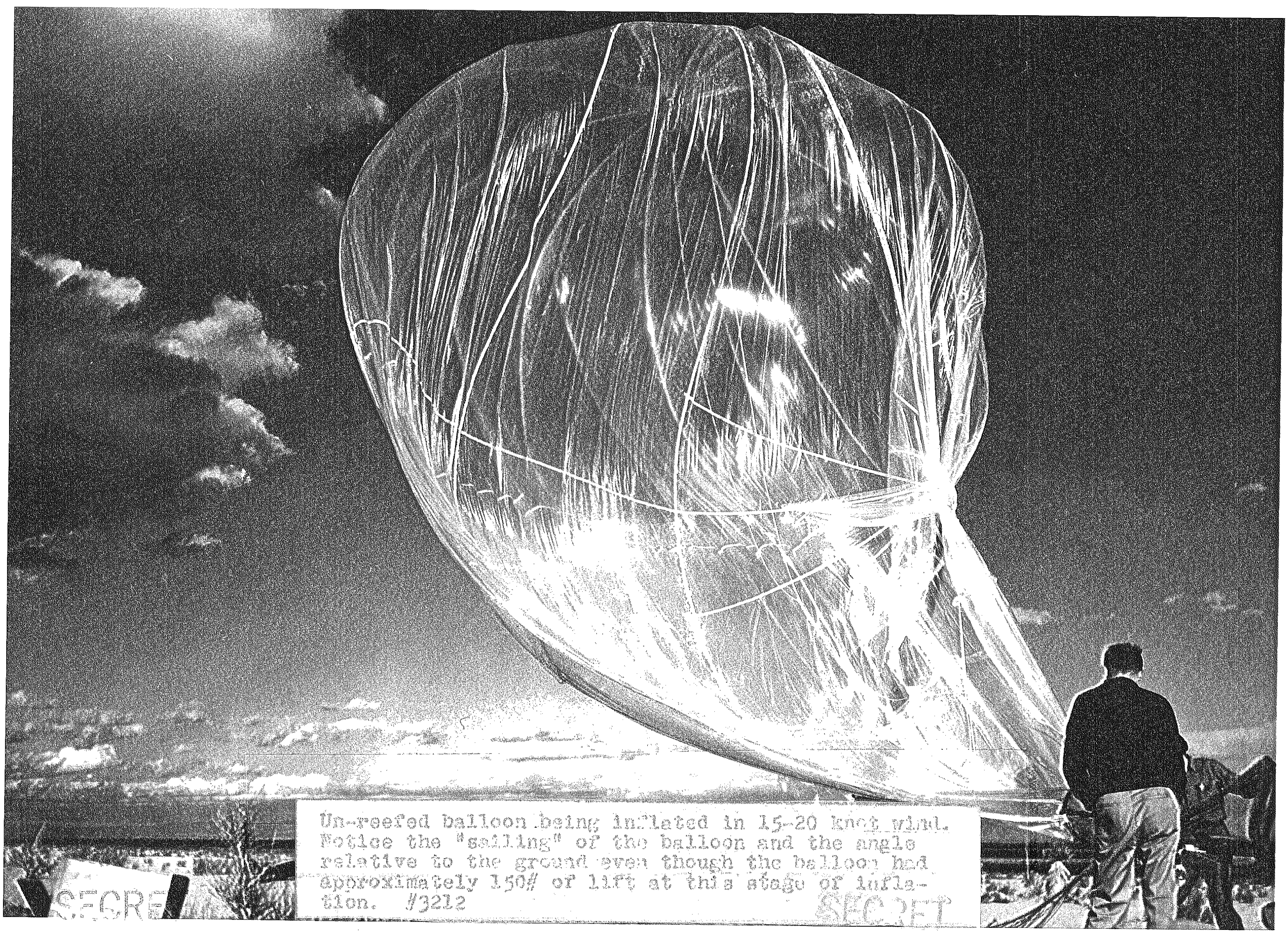
SECRET

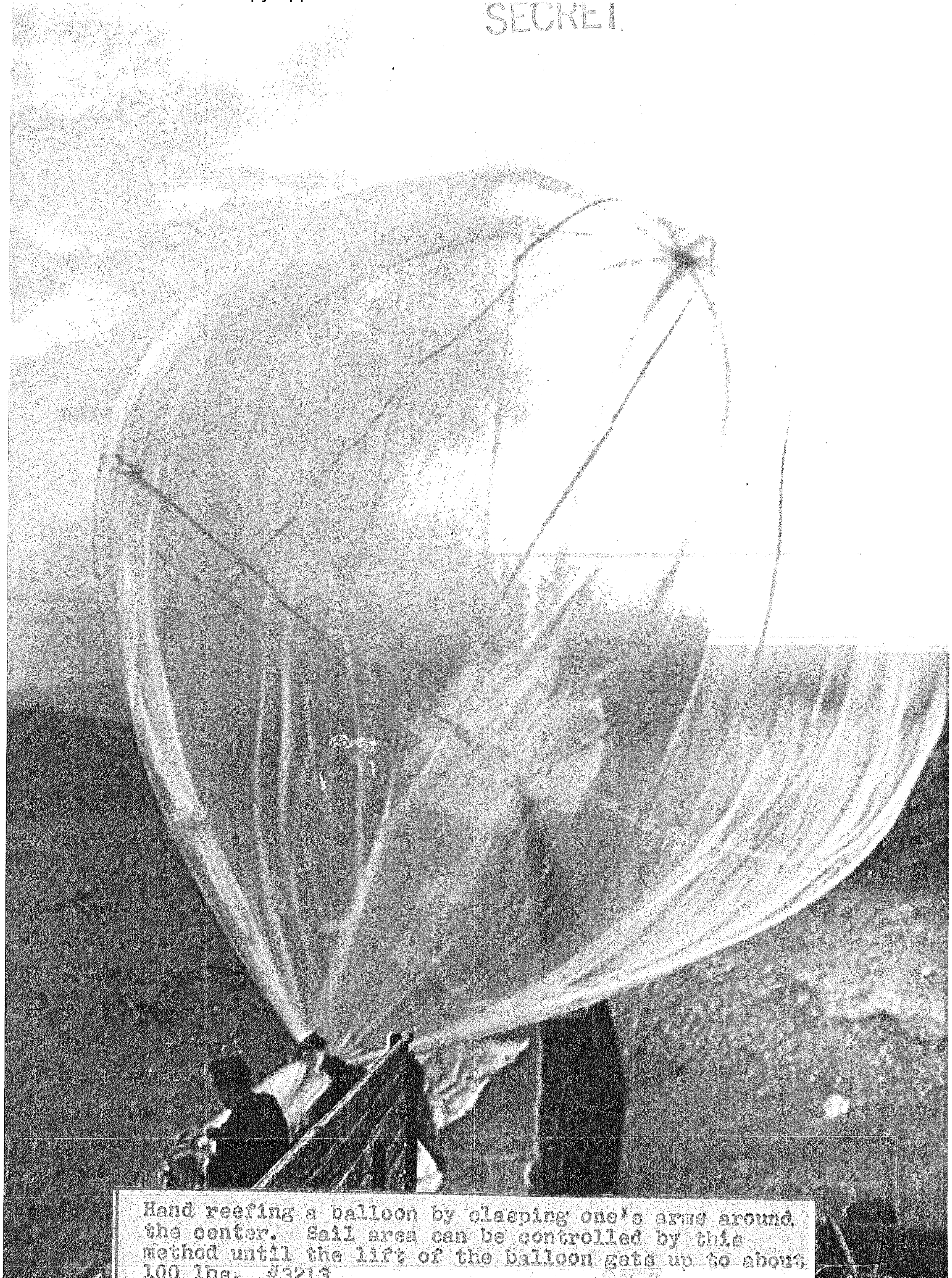
Gas bubble in the top of the balloon during early stages of the inflation. Dark spot near the center is the valve used to release gas to initiate and control descent. #3205

SECRET

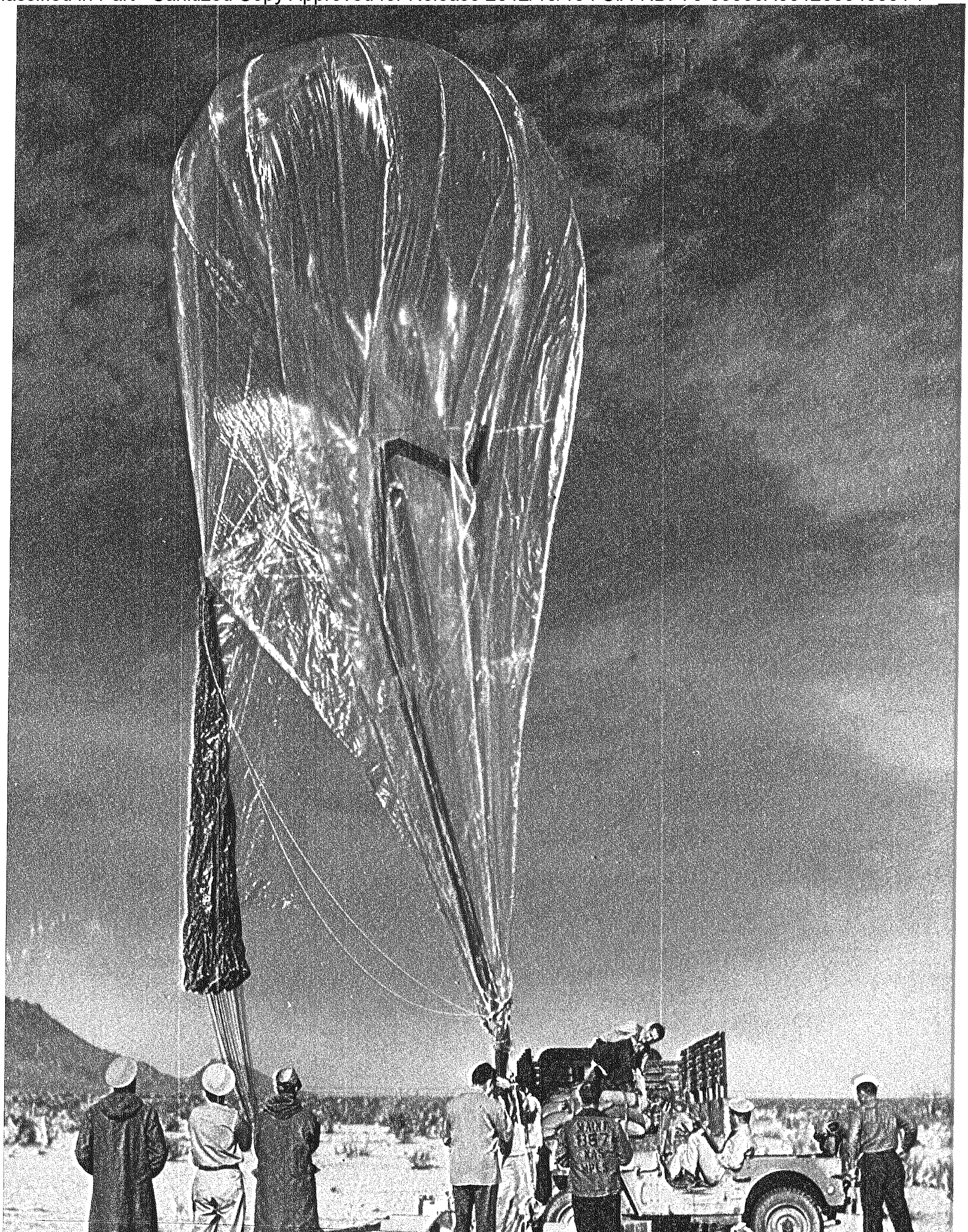


Un-reefed balloon being inflated in 15-20 knot wind. Notice the "sailing" of the balloon and the angle relative to the ground even though the balloon had approximately 150# of lift at this stage of infla-tion. #3212

SECRET

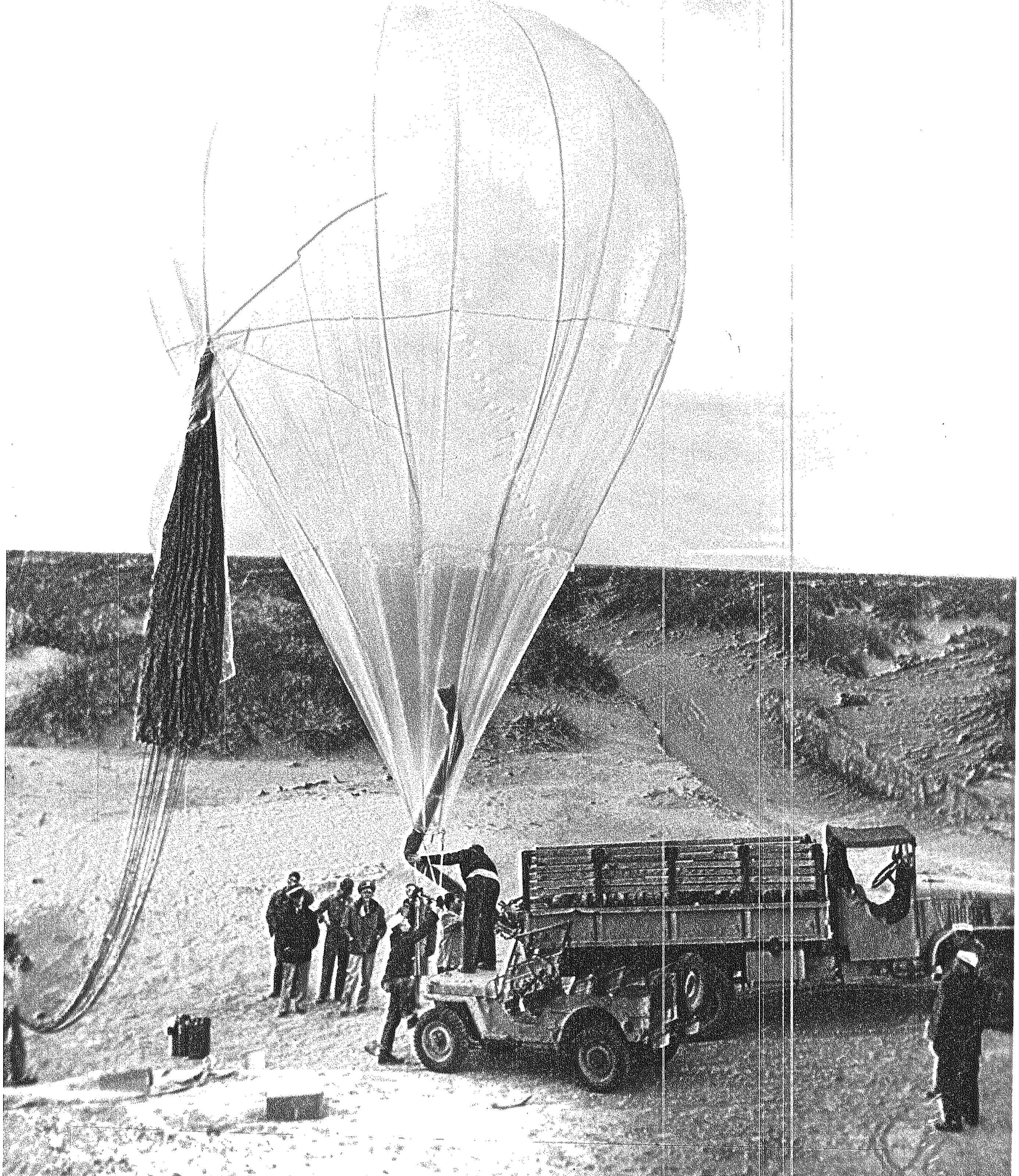


Hand reefing a balloon by clasping one's arms around the center. Sail area can be controlled by this method until the lift of the balloon gets up to about 100 lbs. #3213

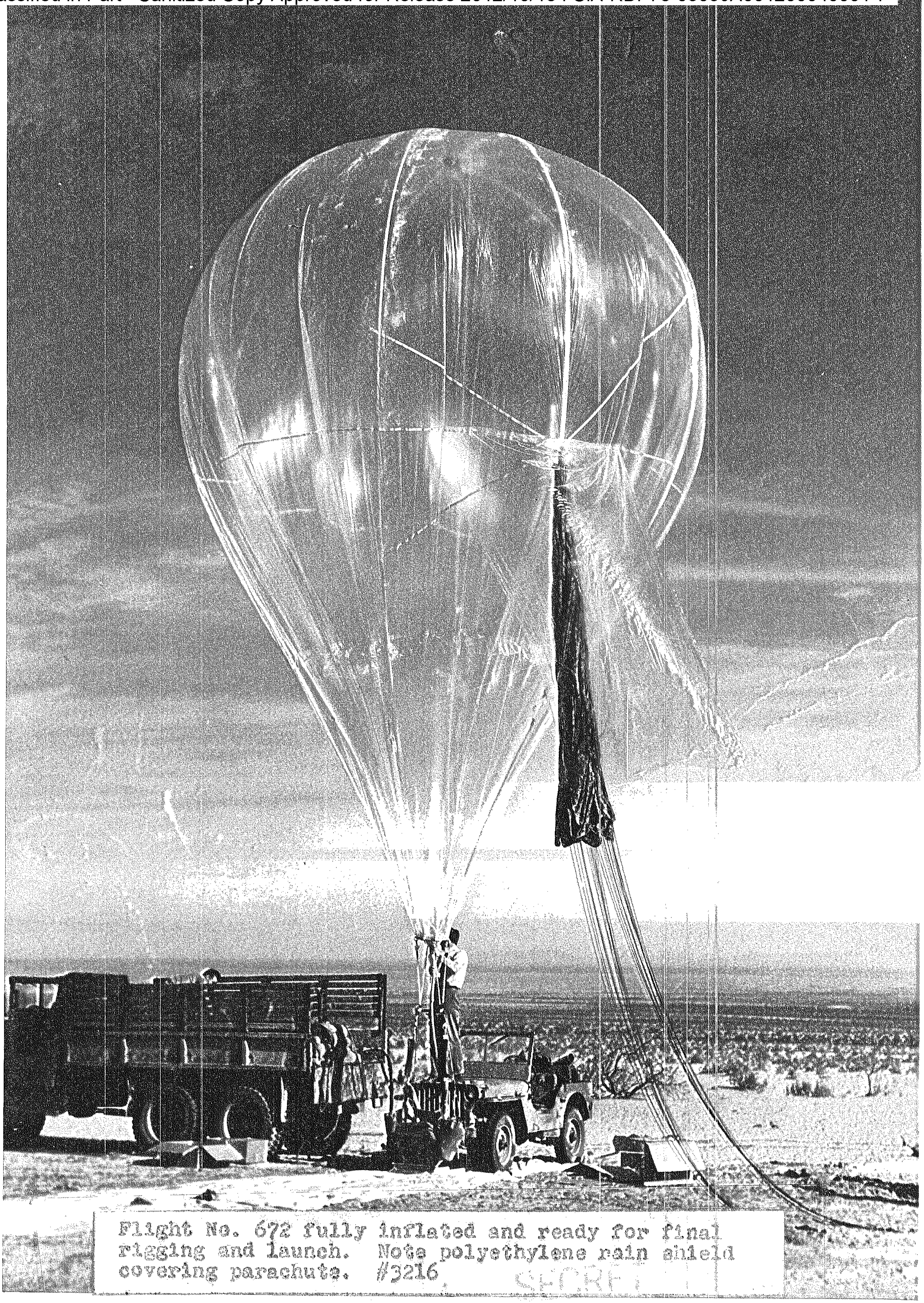


Partially inflated balloon on flight No. 672. Conditions are calm and balloon stands erect although the lift is small. #3224

SECRET



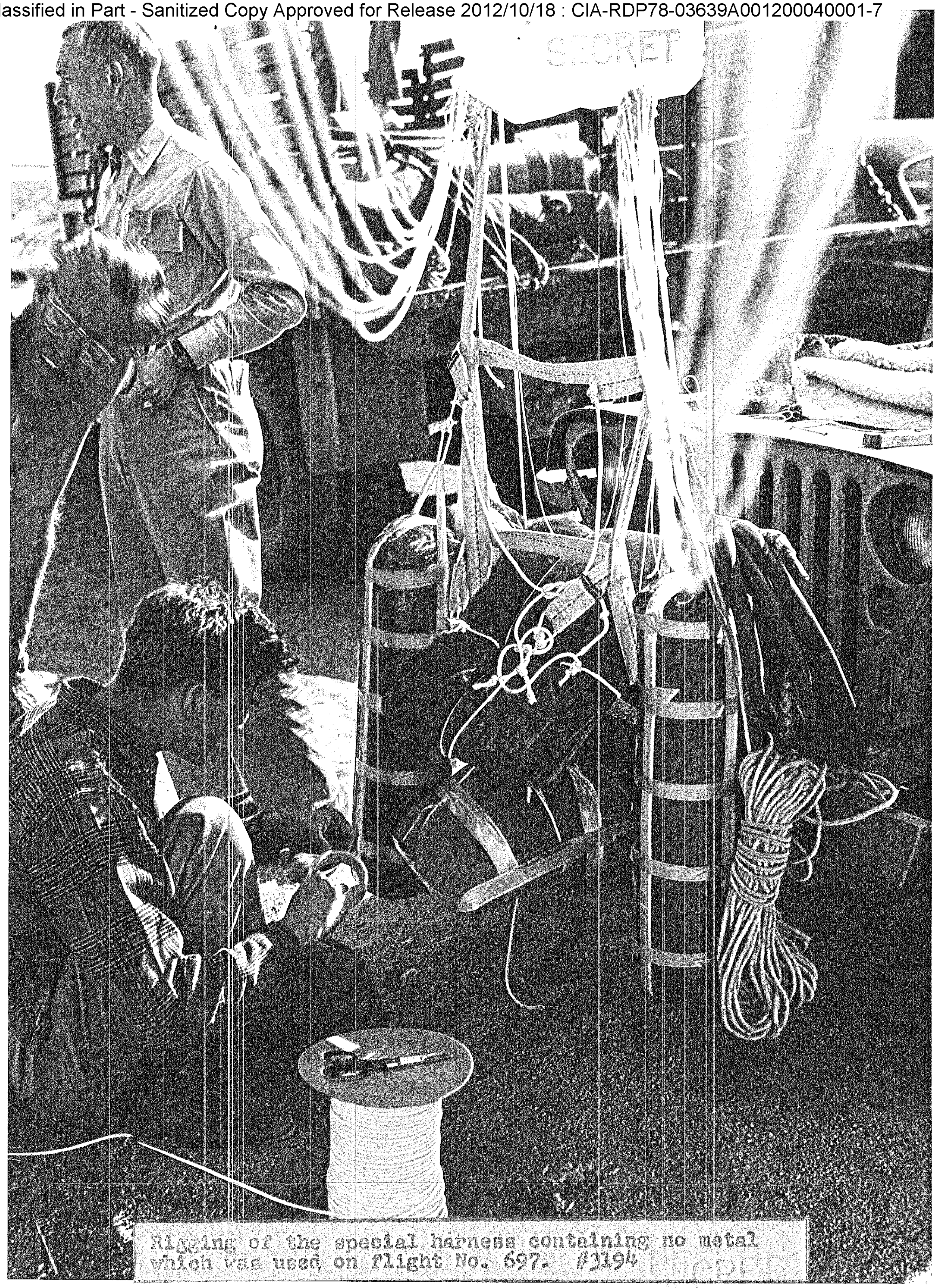
Final stage of inflation. Balloon is erect and full enough to remain free from "sail" effects. #3204



Flight No. 672 fully inflated and ready for final rigging and launch. Note polyethylene rain shield covering parachute. #3216

Night inflation and launching. Balloon is tied to the rear bumper of a passenger car. Harness is already in place and is being rigged. #3192

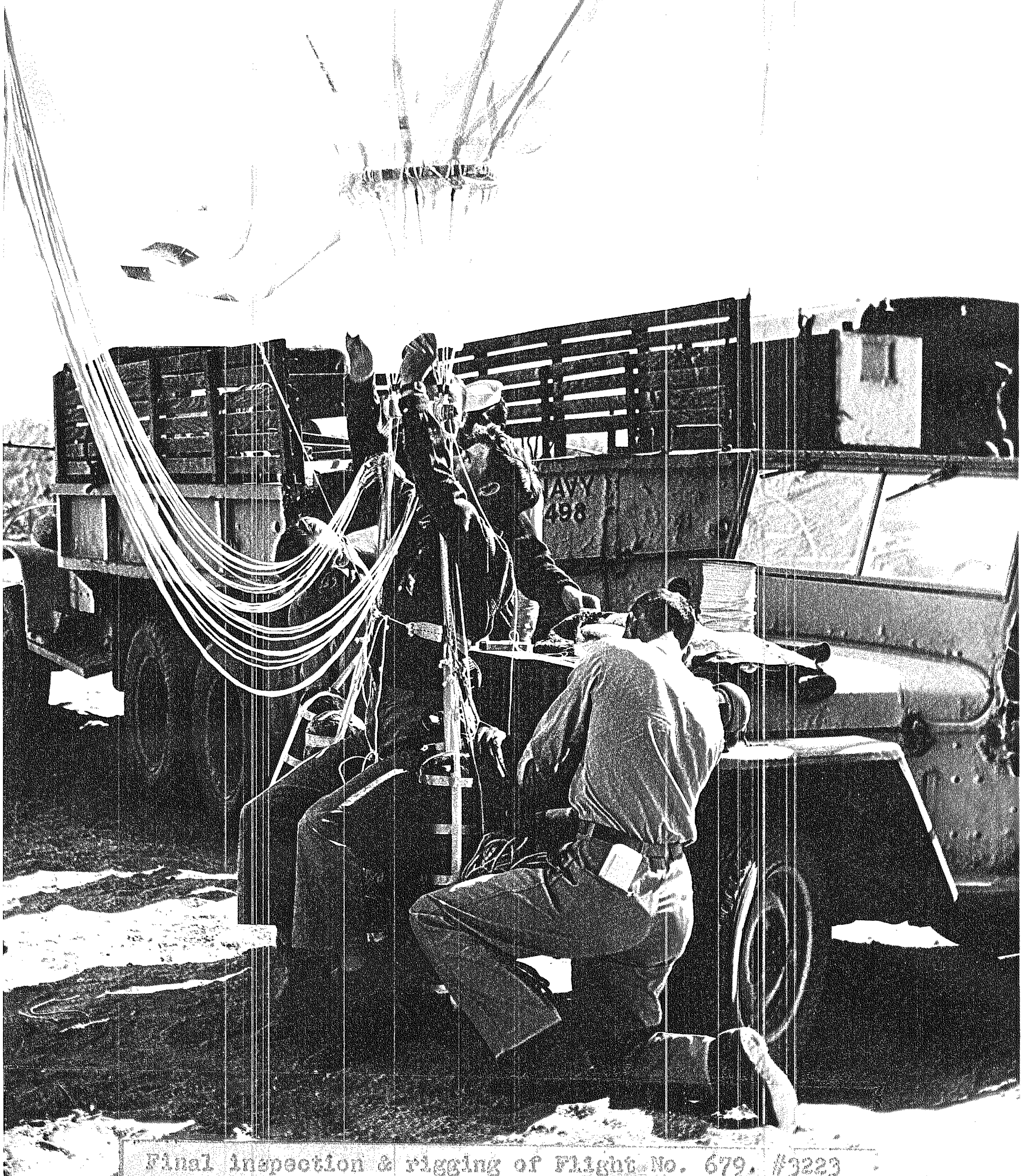
SECRET



Rigging of the special harness containing no metal which was used on flight No. 697. #3194

SECRET

Pilot tying on harness for flight No. 679. 1200# test nylon lines were used in place of buckles and die rings. "Sausages" are ballast bags. #3218



Final inspection & rigging of Flight No. 679. #3223