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BALLOON
EB-134E LEAFLET
NEOPRENE STUDY

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APPENDIX TO

CONFIDENTIAL

INVESTIGATION INTO THE GROUND AND FLIGHT CHARACTERISTICS OF J-100 AND J9-10-300 NEOPRENE BALLOONS

FINAL REPORT

COVERING PERIOD OF JUNE 1, 1957 - JANUARY 1, 1958

SECTION V OPERATIONAL INFORMATION

SECTION VI OPERATION RAINDROP

DEWEY AND ALMY CHEMICAL COMPANY
Division of W. R. Grace & Co.
CAMBRIDGE, MASSACHUSETTS

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V. OPERATIONAL INFORMATION

25X1

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FORMULAS FOR BALLOON CALCULATIONS

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GROSS LIFT = FREE LIFT, PLUS BALLOON WEIGHT, PLUS PAYLOAD:

ALSO, TOTAL VOLUME TIMES GAS LIFTING FORCE.

GROSS WEIGHT = PAYLOAD + BALLOON WEIGHT

FREE LIFT = GROSS LIFT MINUS GROSS WEIGHT

AREA OF SPHERE = πD^2 OR $4 \pi R^2$

CIRCUMFERENCE = πD

AREA OF CIRCLE = πR^2

VOLUME OF SPHERE = $\frac{\pi}{6} D^3$ OR $\frac{4}{3} \pi R^3$

DIAMETER OF SPHERE = $\sqrt[3]{\text{VOLUME} \times 1.9}$

LIFTING FORCE OF:

HYDROGEN = 1.13 GRAMS/LITER)
= 0.07 LB./CU.FT.) STANDARD TEMPERATURE & PRESSURE
= 31.8 GRAMS/CU. FT)

LIFTING FORCE OF:

HELIUM = 1.00 GRAM/LITER)
= .062 LB./CU.FT) STANDARD TEMPERATURE & PRESSURE
= 28.2 GRAMS/CU.FT)

1 METER = 3.28 FEET

1 FOOT = .305 METERS

1 CUBIC FOOT = 28.32 LITERS

1 LB. = 454.5 GRAMS

1 OUNCE = 28.4 GRAMS

ASCENT RATE

J-100 BALLOON

THEORETICAL RATE OF RISE = $340 \frac{(\text{FREE LIFT})^{1/2}}{(\text{GROSS LIFT})^{1/3}}$ = FT./MIN.

J9-10-300 BALLOON

THEORETICAL RATE OF RISE = $\cancel{546} \frac{(\text{FREE LIFT})^{1/2}}{(\text{GROSS LIFT})^{1/3}}$ = FT./MIN.

X 420 FOR 5 LB. PAYLOAD
X 500 FOR 10 LB. PAYLOAD

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DENSITIES OF GASES

GAS	DENSITY		SPECIFIC GRAVITY
	GRAMS/LITER	LB./FT.^{3}	
AIR	1.293	0.0810	1.000
AIR @ 20°C	1.205	0.0755	0.932
CO_2	1.977	0.1230	1.529
H_2	0.090	0.0056	0.069
He	0.179	0.0110	0.138
N_2	1.251	0.0780	0.967
O_2	1.429	0.0890	1.105
STEAM @ 100°C	0.598	0.0370	0.462

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FEET		METERS			MILLIBARS
5000	=	1525	=	APPROXIMATELY	848
10000	=	3048	=	"	712
15000	=	4570	=	"	590
20000	=	6096	=	"	486
25000	=	7620	=	"	394
30000	=	9144	=	"	315
35000	=	10667	=	"	252
40000	=	12192	=	"	200
45000	=	13716	=	"	152
50000	=	15240	=	"	125
55000	=	16764	=	"	95
60000	=	18288	=	"	75

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Fig. 8. RELATIONSHIP BETWEEN DIAMETER, AREA AND VOLUME

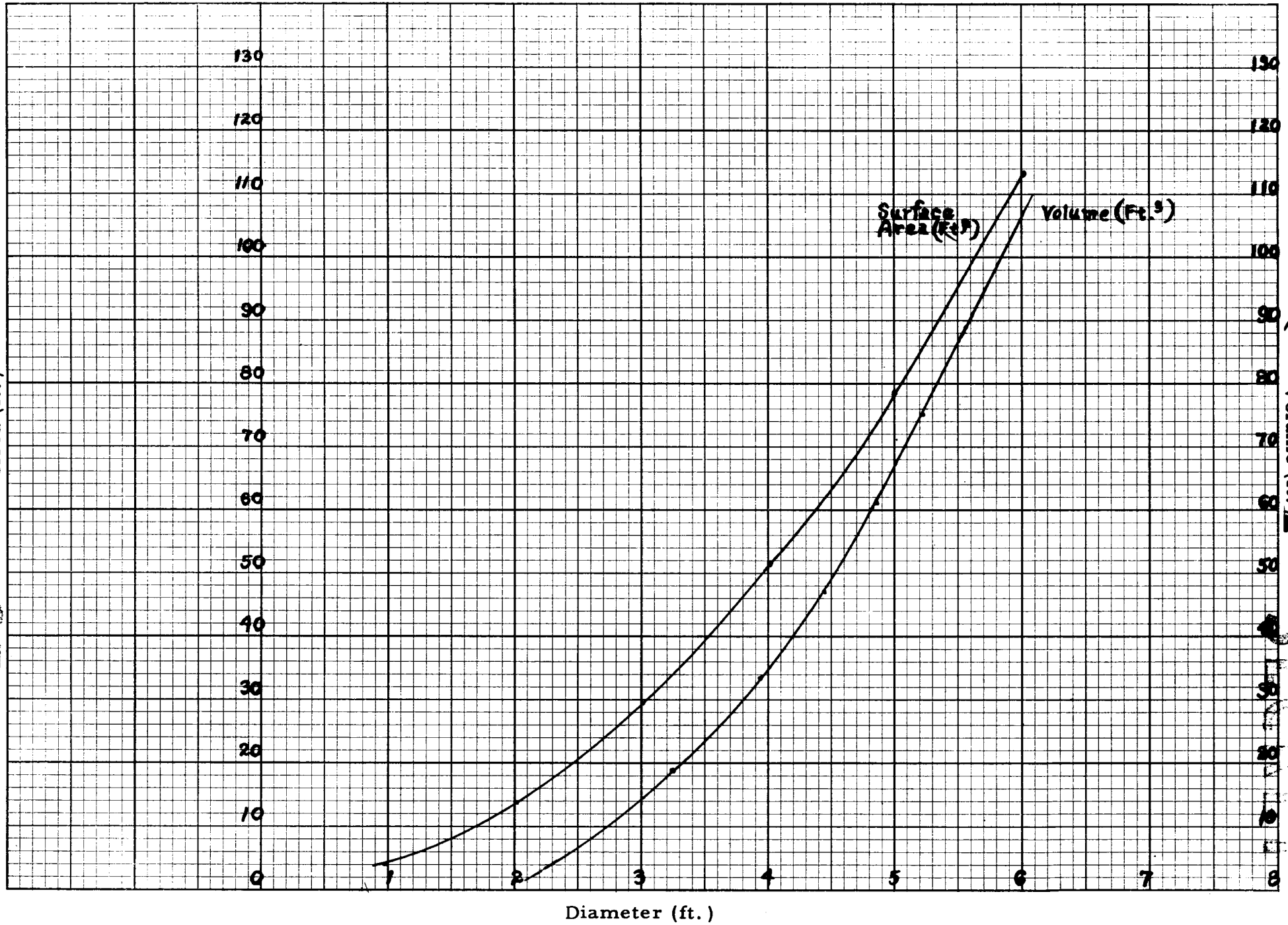

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Fig. 9. VOLUME OF BALLOON VERSUS GROSS LIFT AT SEA LEVEL.

Gross Lift - grams

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Fig. 11. PAYLOAD VERSUS ALTITUDE

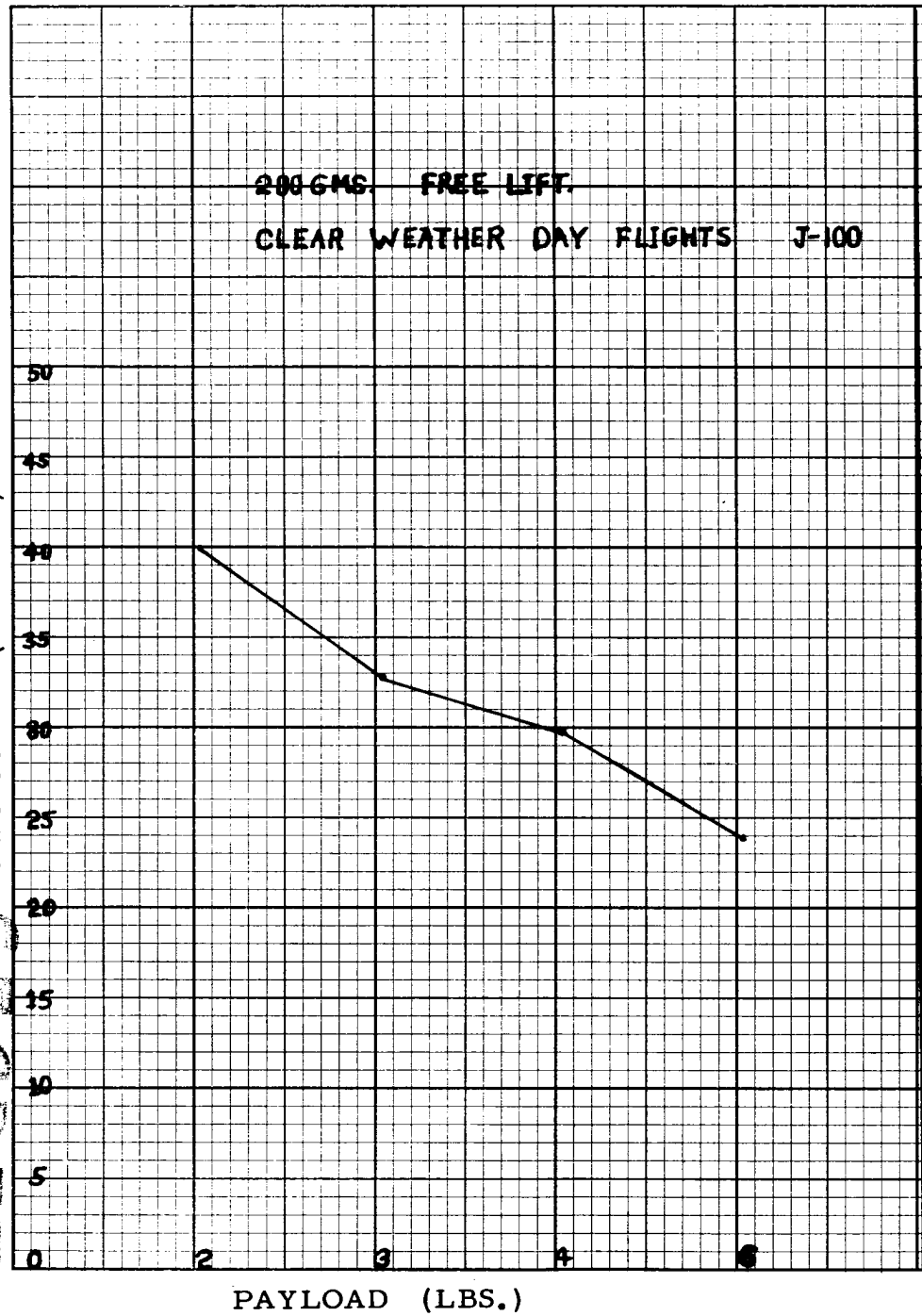
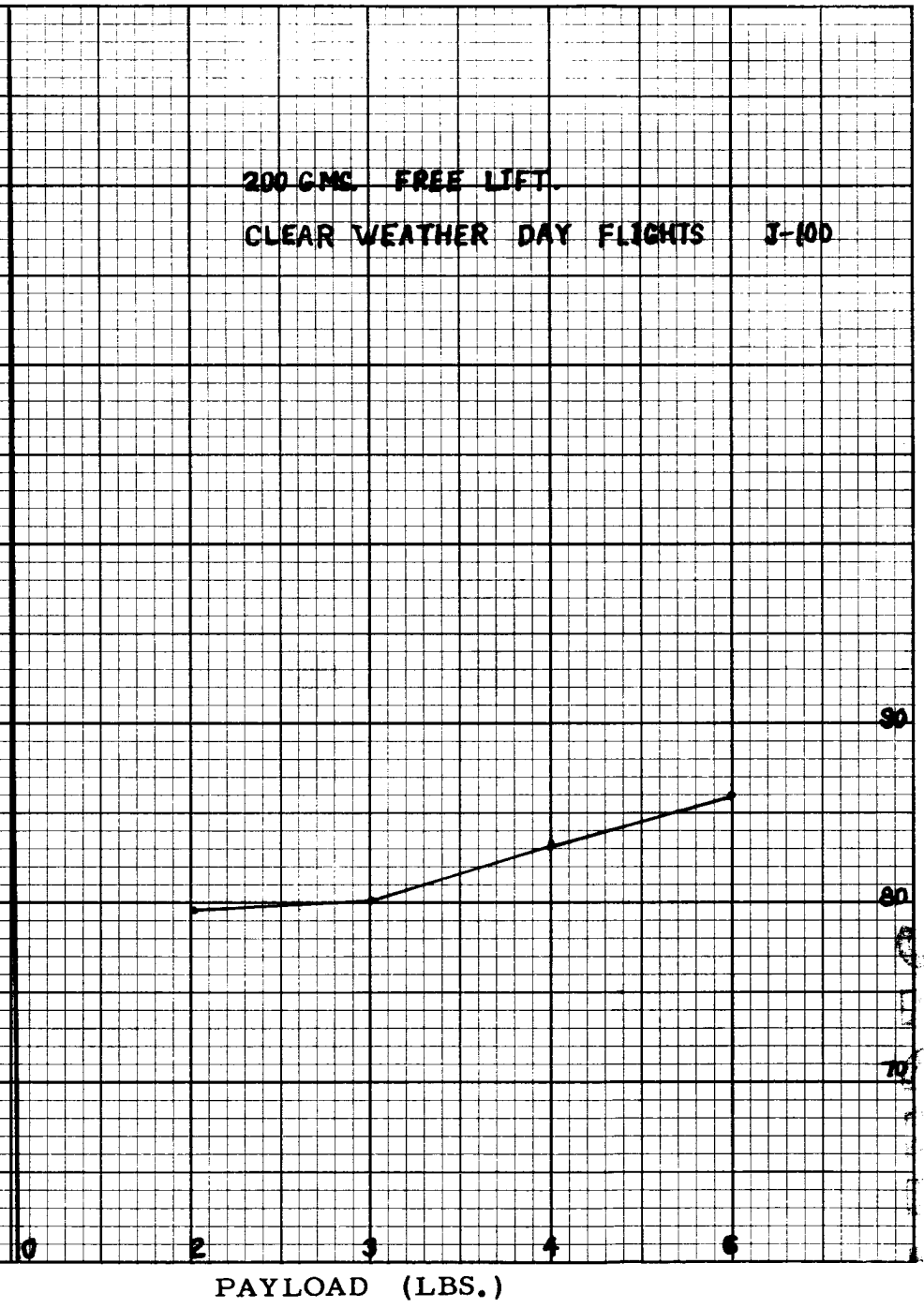


Fig. 10. PAYLOAD VERSUS DIAMETER AT BURST



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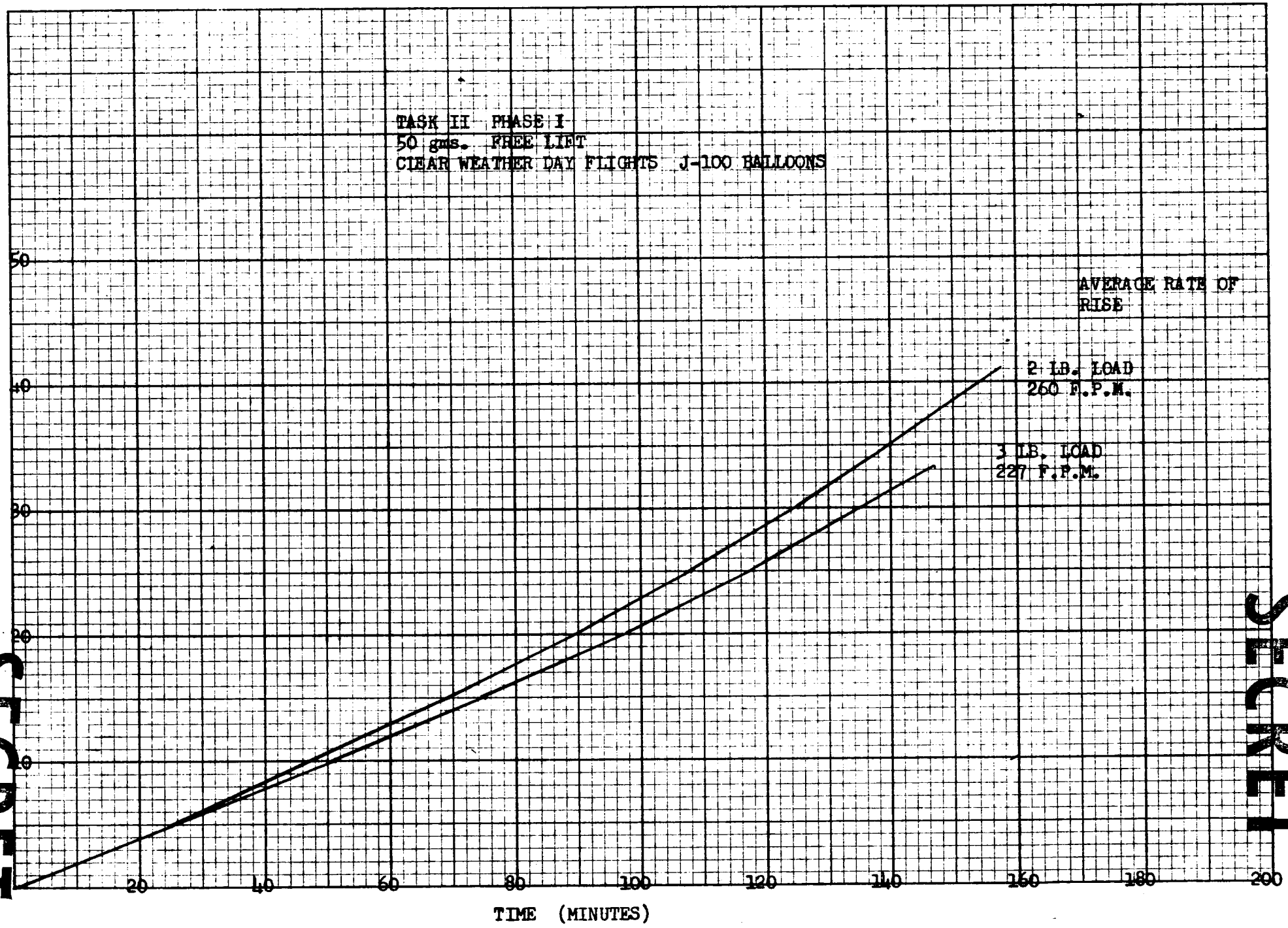

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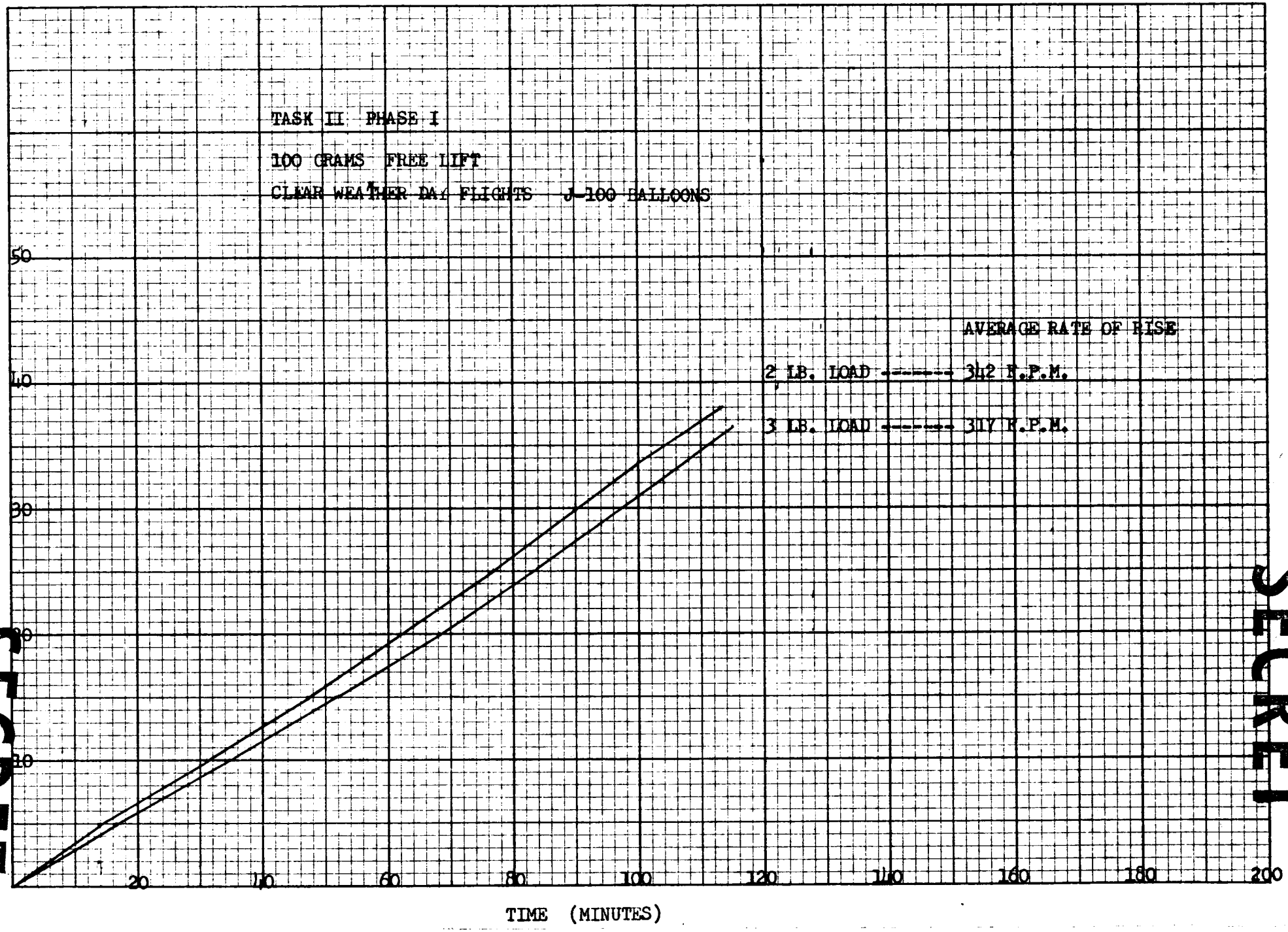

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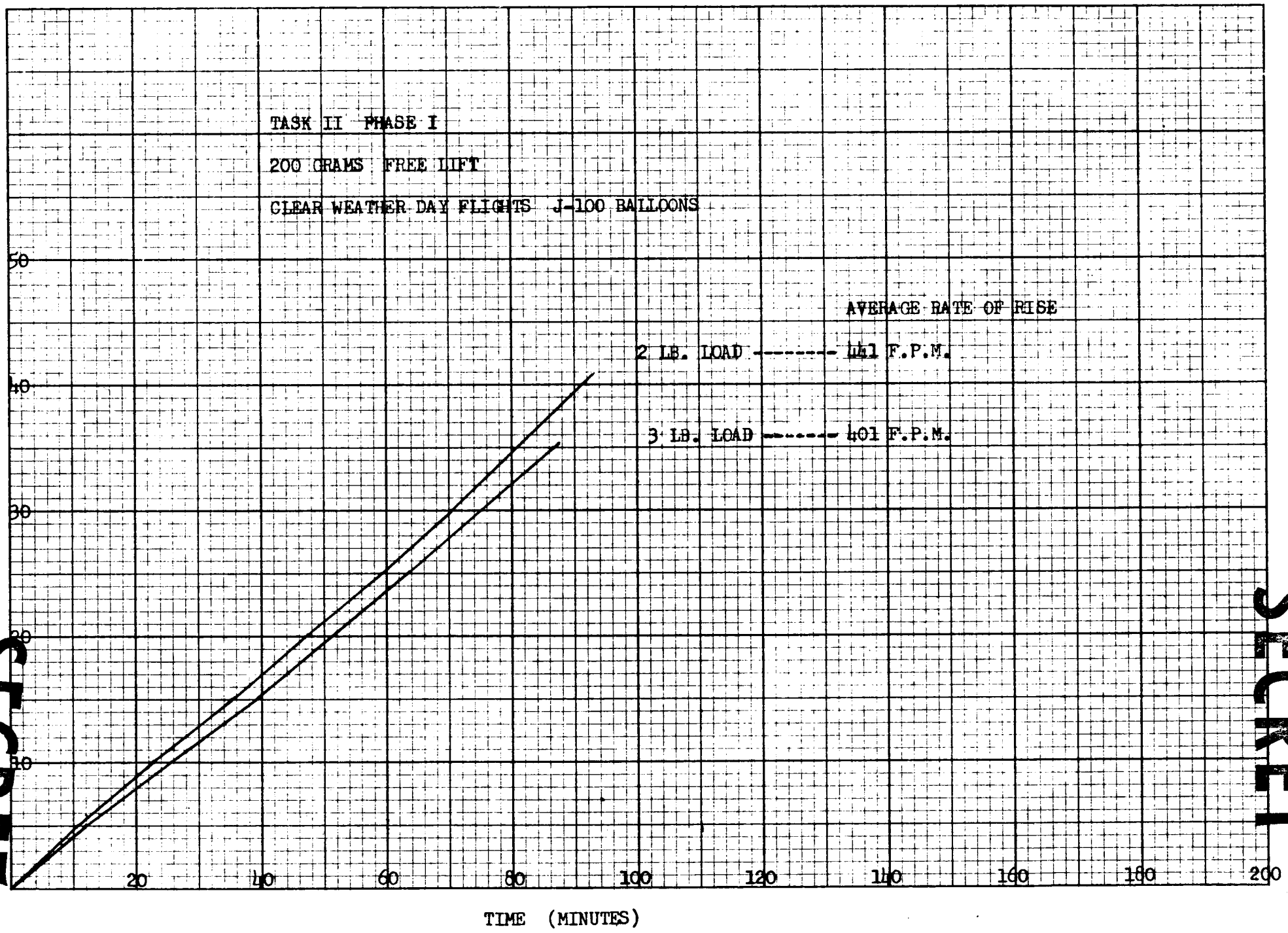

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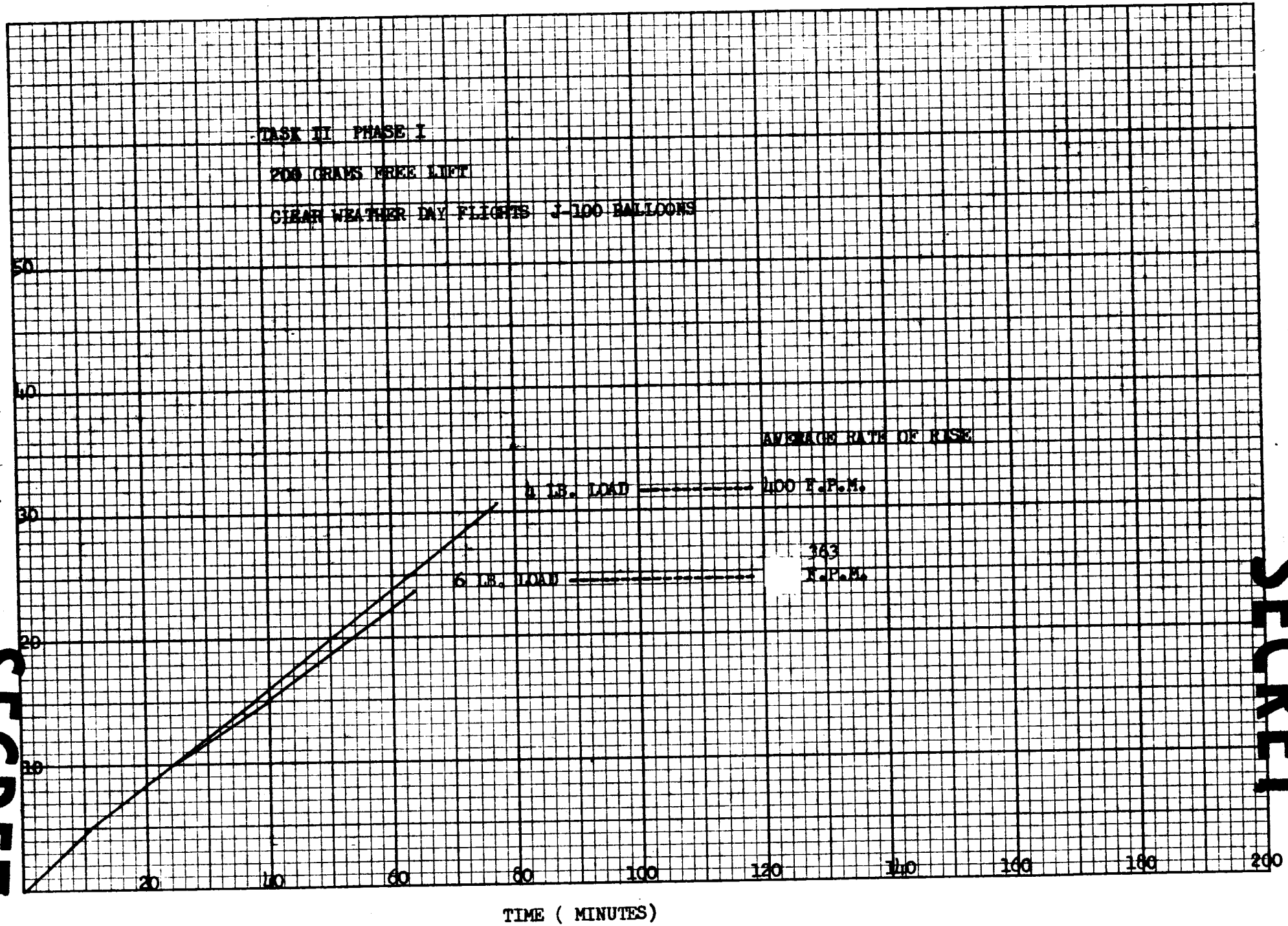

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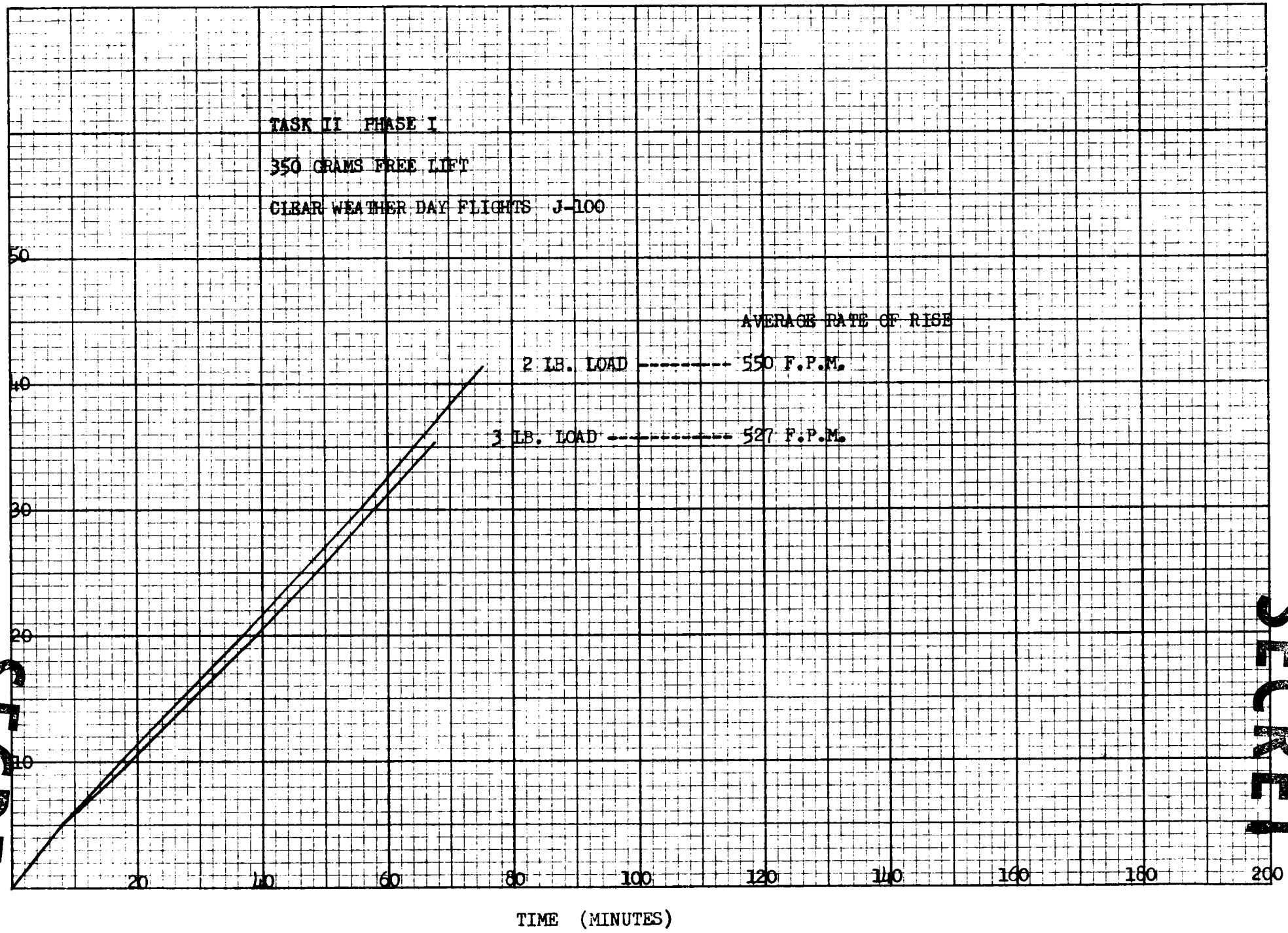

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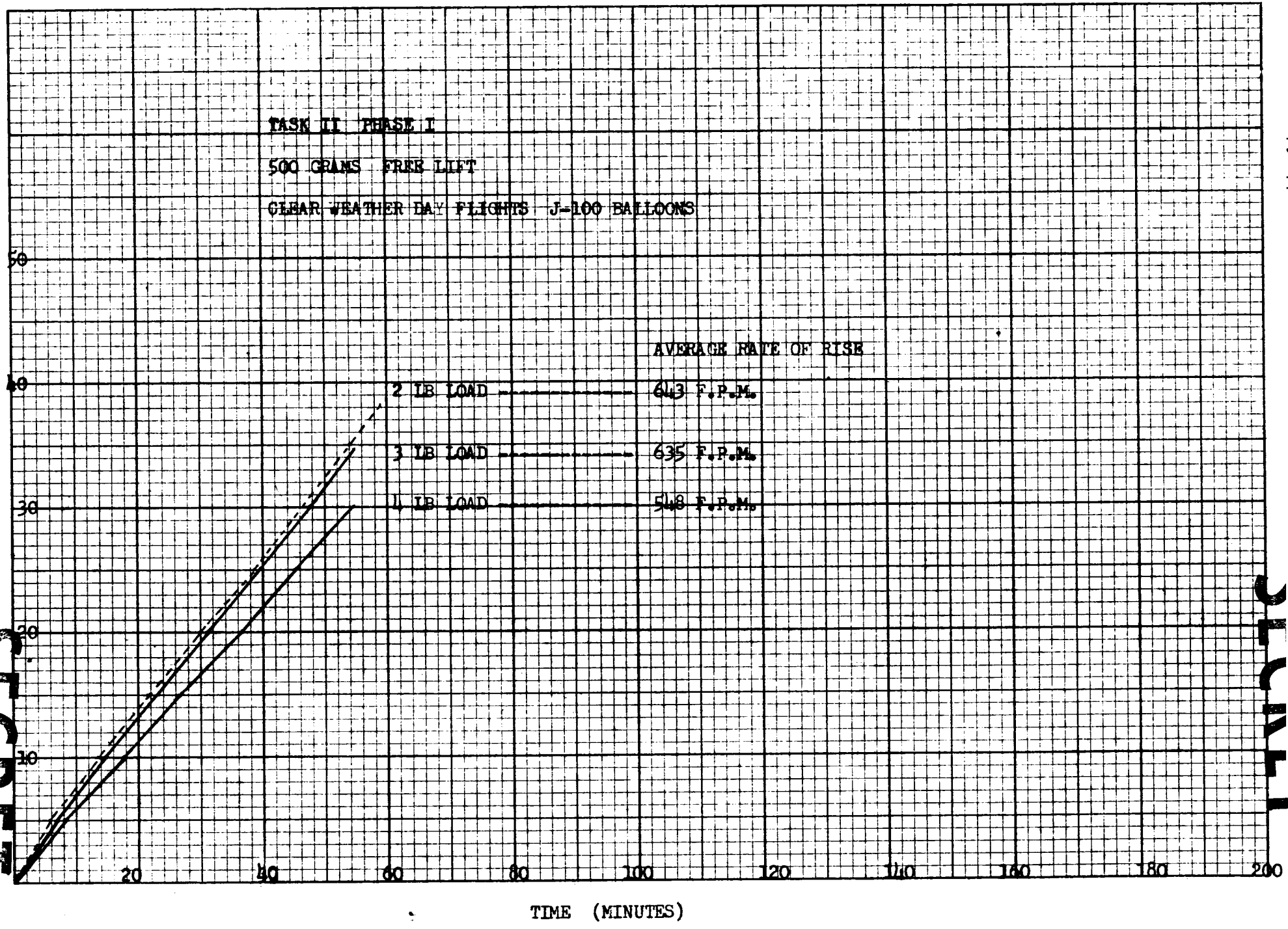

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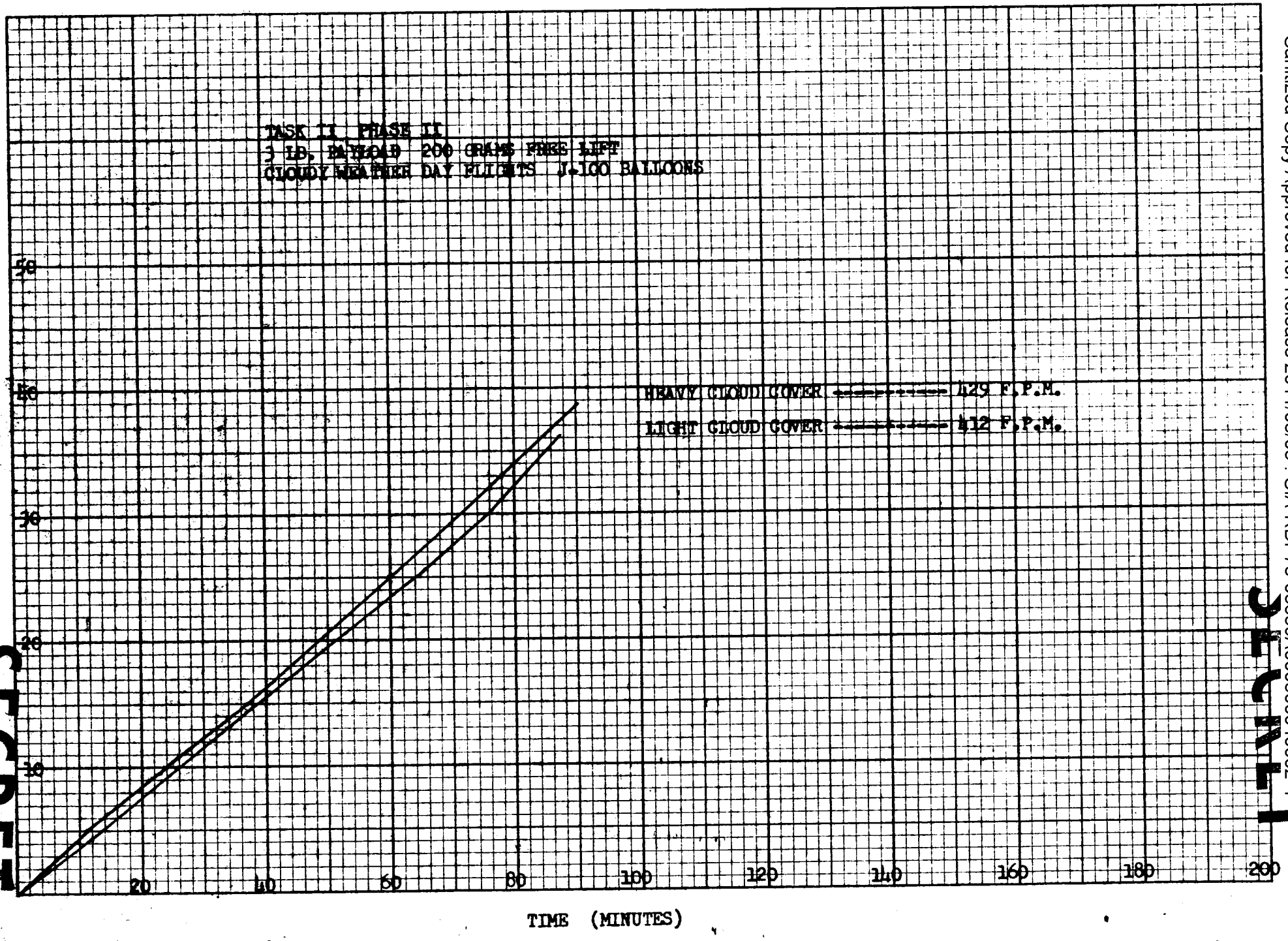

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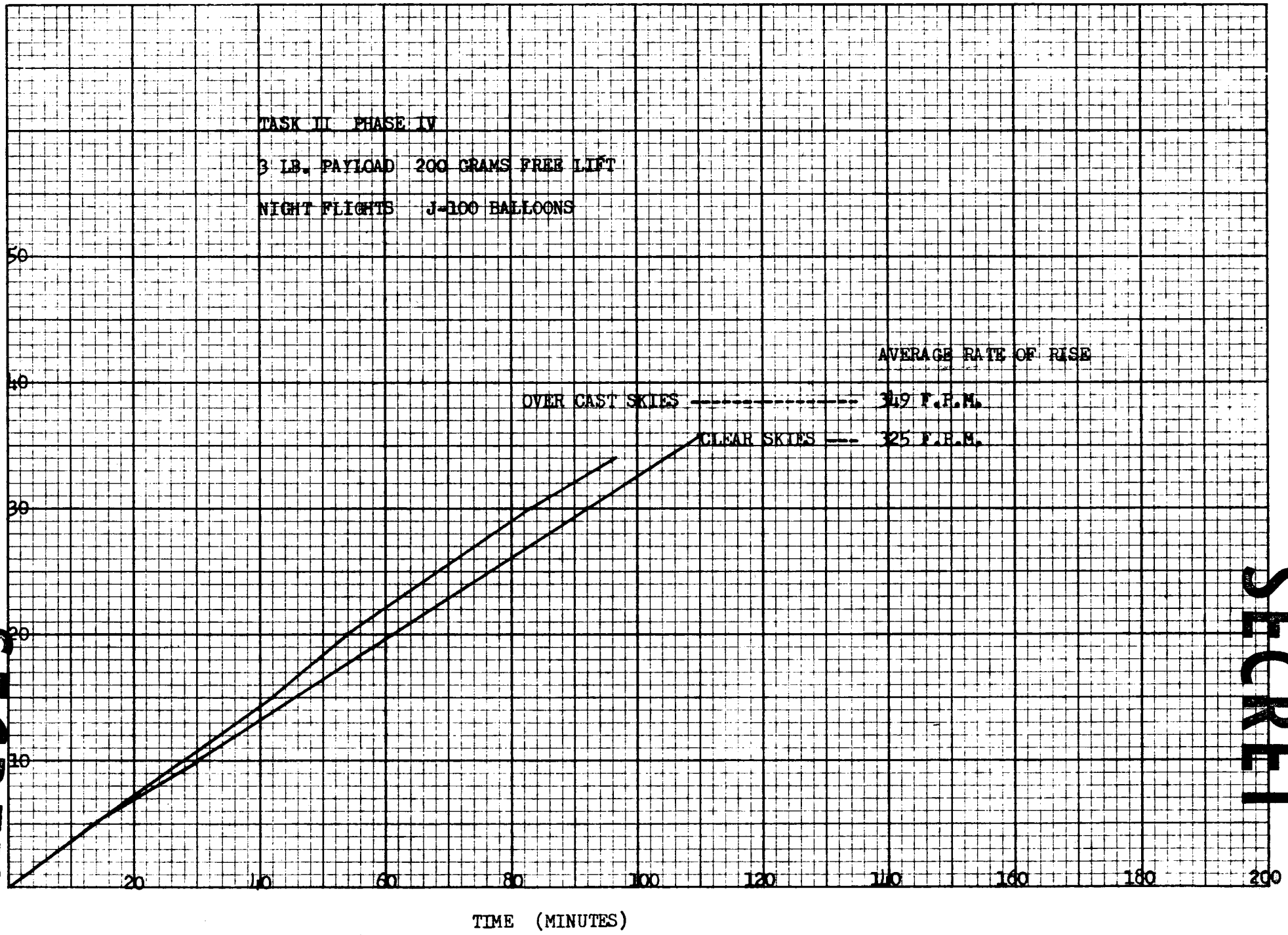

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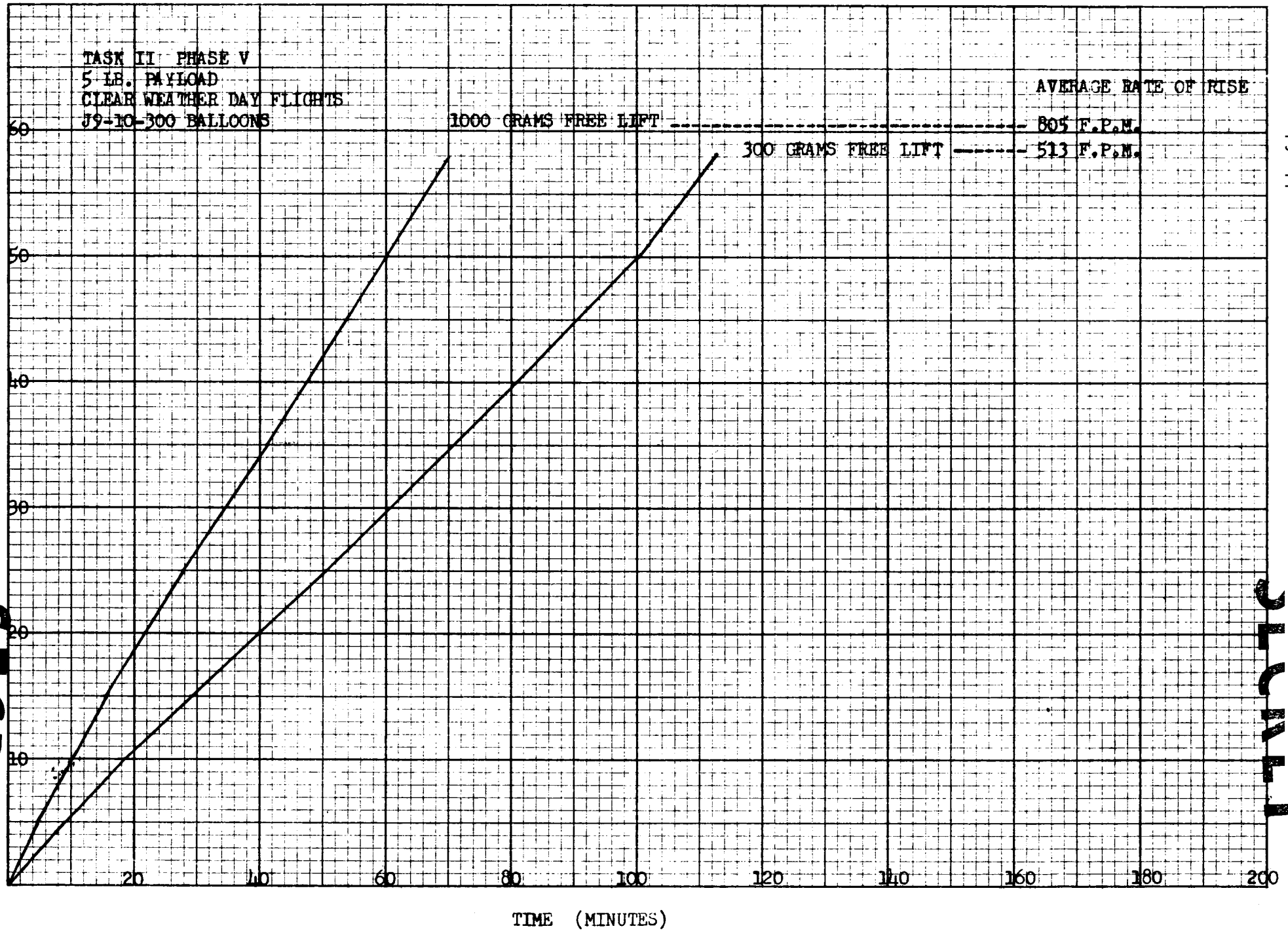

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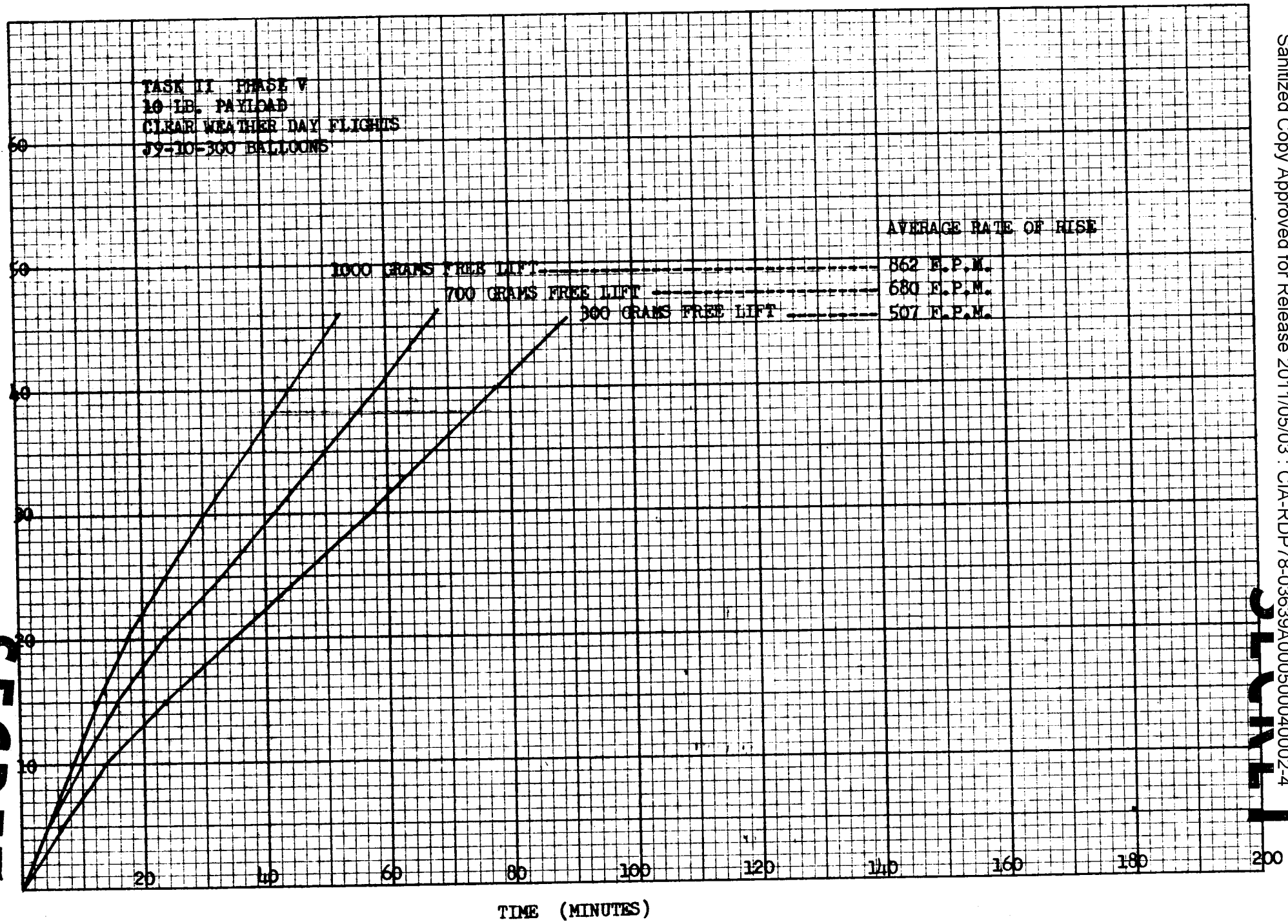

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GRAY B. TASK II FLIGHT TEST DATA (AVERAGE) J-300 BALLOONS

TIME SPENT IN EACH 5,000 FOOT LEVEL (HOURS)

	Payload (lbs)	Free-lift (grams)	Average Altitude (ft.)	Average Asc. Rate (ft./min.)	Free SFC to 5,000	5-10,000	10-15,000	15-20,000	20-25,000	25-30,000	30-35,000	35-40,000	40-45,000	Total Time (hrs.)
Daytime Clear Skies	2	50	41,530	260	.403	.378	.375	.331	.311	.288	.258	.220	.044	2.61
	2	100	38,809	342	.230	.280	.278	.246	.250	.221	.221	.161	—	1.89
	2	200	41,680	441	.175	.206	.210	.158	.155	.185	.183	.168	.021	1.56
	2	350	41,150	660	.135	.168	.166	.165	.160	.153	.140	.145	.031	1.25
	2	500	35,018	643	.090	.128	.138	.135	.143	.128	.121	.105		1.01
	3	50	33,661	227	.428	.416	.410	.378	.338	.295	.196	—		2.48
	3	100	36,455	317	.276	.258	.285	.271	.255	.233	.225	.068		1.91
	3	200	36,312	401	.155	.230	.223	.211	.203	.206	.188	.011		1.47
	3	350	35,285	527	.131	.156	.173	.160	.161	.155	.150	.008		1.13
	3	500	34,730	635	.103	.131	.143	.138	.138	.133	.126	—		.92
	4	200	30,776	400	.178	.220	.228	.213	.215	.207	.028	—		1.29
	4	500	29,510	548	.133	.156	.155	.156	.153	.152	—	—		.90
	6	200	23,741	375	.133	.205	.203	.225	.175	—	—	—		1.06
	5.75	620	23,100	651	.100	.115	.147	.141	.076	—	—	—		.59
Daytime-Light clouds	3	200	36,004	412	.215	.212	.210	.210	.212	.190	.100	.032		1.45
Daytime, heavy clouds	3	200	38,730	429	.176	.218	.212	.198	.191	.180	.181	.130		1.50
Night, clear skies	3	200	35,563	325	.220	.263	.268	.256	.266	.255	.258	.046		1.84
Night, heavy clouds	3	200	34,013	348	.218	.241	.232	.205	.232	.240	.232	—		1.63
Daytime clear weather														
Age Product														.87
24 months none	3	200	20,820	398	.203	.211	.216	.203	.035	—				
24 months 5 min.@200#	3	200	21,227	410	.178	.220	.215	.195	.180	.183	.048			1.25
19-20 months none	3	200	31,367	403	.183	.223	.227	.207	.213	.182	.050			1.30
13-15 months none	3	200	37,518	389	.176	.233	.236	.220	.213	.196	.100			1.38
3 months 5 min.@200#	3	200	24,143	449	.187	.215	.222	.215	.205	.188	.185			

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CHART B.(cont.) TASK II FLIGHT TEST DATA (AVERAGES) JN-10-300 BALLOON TIME SPENT IN EACH 5,000 FOOT INTERVAL (HOURS)

Pay Load (lbs)	Free Lift (grams)	Average Altitude (ft.)	Average Ast. Rate (ft./min.)	0-5,000	5-10,000	10-15,000	15-20,000	20-25,000	25-30,000	30-35,000	35-40,000	40-45,000	45-50,000	50-55,000	55-60,000	Total Time (hrs)
5	300	58,187	513	.147	.163	.173	.177	.175	.178	.170	.166	.156	.155	.138	.082	1.91
5	1000	57,505	806	.080	.085	.095	.095	.106	.113	.108	.105	.110	.103	.108	.052	1.17
10	300	45,352	507	.106	.120	.166	.180	.185	.185	.173	.165	.178	.013	—	—	1.50
10	700	44,212	680	.080	.082	.100	.132	.157	.142	.138	.148	.130	.030	—	—	1.13
10	1000	44,220	868	.078	.068	.078	.080	.088	.110	.120	.117	.113	.030	—	—	.90

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A. DISCUSSION

A study of the foregoing data reveals the following general conclusions:

1.) By choosing the proper payload-free lift combination, a J-100 balloon can be made to burst at an altitude ranging from 23,000 feet, with a 6 lb. load, to 40,000 feet, with a 2 lb. load, in a period of time varying from one hour with 500 grams free lift, to two and one-half hours with 50 grams free lift.

2.) J-100 dayflights display an ascensional rate which is somewhat higher toward the end of the flight than at the beginning.

3.) J-100 nightflights have a lower ascensional rate than dayflights, and slow down toward the latter part of the flight.

4.) J9-10-300 dayflights can be used to achieve altitudes ranging from 45,000 feet with 10 lb. loads, to 58,000 feet with 5 lb. loads, in a period of time of from 55 minutes with 1000 grams of free lift, to 114 minutes with 300 grams of free lift.

5.) J9-10-300 dayflights have a characteristic rate of rise which slows down with altitude, especially with high free lifts.

6.) It was seen earlier in the report that J9-10-300 early morning flights have a lower ascensional rate than afternoon flights.

7.) J-100 dayflights carried out under conditions of overcast skies, perform in a similar manner as those flown under conditions of clear skies, except that the rate of rise toward the end of the flight is slightly higher.

8.) J-100 balloons can be used, without conditioning, up to a period of 15 months without an appreciable reduction in performance.

9.) The rate of rise can be predicted within 10% by use of the formulas:

$$\text{J-100 Balloons} = 340 \frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}} = \text{feet/minute}$$

$$\text{J9-10-300 Balloons} = \cancel{546} \times 420 \text{ (5 LB. LOAD)} \times 500 \text{ (10 LB. LOAD)} \frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}} = \text{feet/minute}$$

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But, because of conditions beyond our control, these formulae do not apply to nighttime or early morning flights.

For these particular cases reliance must be based on experimental data.

10.) It was seen that diffusion of inflation gas is a factor to contend with if balloons are allowed to stand at room temperature for any length of time over ten minutes after inflation. This can be especially serious in the case of low free lifts.

11.) It is evident that great care must be exercised in weighing off payload and free lift during inflation. This is especially true in the case of low free lifts.

12.) A good deal of reliance can be placed on the uniformity of performance of these balloons. Based on ground and flight burst tests and actual field testing (see "Operation Raindrop"), it can be expected that 80-85% of balloons launched with the same payload and free lift will burst at the same altitude ± 3000 feet, and at the same rate of rise ± 10% of average.

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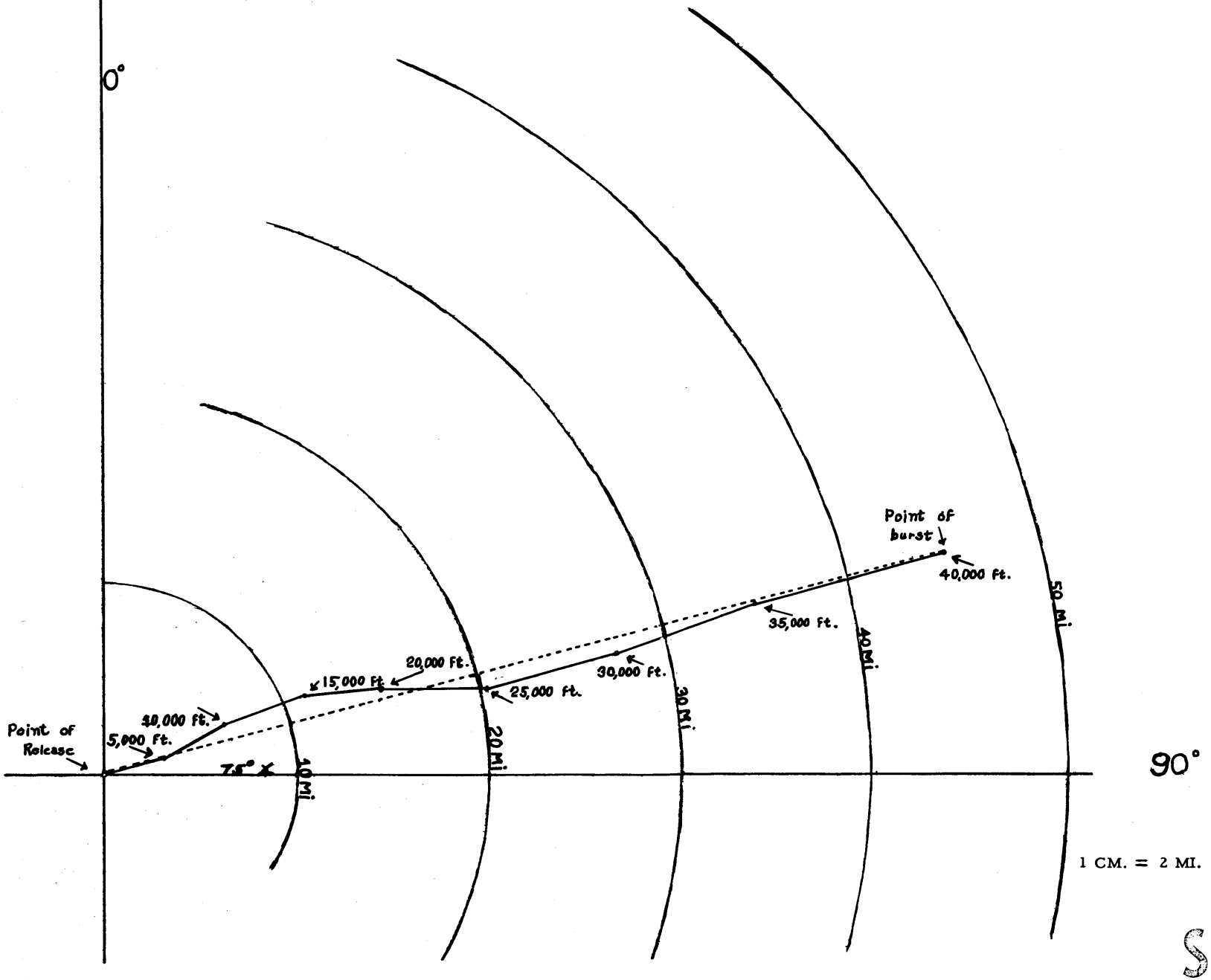
Fig. 13 Trajectory Plotted From Wind Data



1 CM. = 2 MI.

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CHOOSING PAYLOAD AND FREE LIFT

EXAMPLE

The following wind data has been received:

ALTITUDE (FEET)	VELOCITY (M.P.H.)	DIRECTION (TOWARD)
SFC - 5,000	8	75°
5 - 10,000	10	60°
10 - 15,000	12	70°
15 - 20,000	12	85°
20 - 25,000	18	90°
25 - 30,000	25	75°
30 - 35,000	29	70°
35 - 40,000	44	75°
40 - 45,000	50	60°

PROBLEM

The falling characteristics of the leaflets is such that, in order to hit the target, the balloons should burst at an altitude of 40,000 feet and 50 miles away from the launching site. What payload and free lift combination should be used? (Assume daytime, clear-weather conditions.)

PROCEDURE

A glance at the flight test data chart B, indicates that a J-100 balloon will burst at an altitude of approximately 40,000 feet, only if it is carrying a payload of around 2 lbs. The remaining problem is to determine the proper free lift. The wind data indicates that the average wind speed between surface and 40,000 feet is 20 miles per hour. Thus in order to travel a distance of 50 miles the balloons should have a flight time of 2.5 hours. Consulting the flight test data chart once more, we see that balloons having 40 grams of free lift and a 2 lb. payload will spend an average of 2.6 hours in flight. Hence it appears that the proper payload, free-lift combination to use is 2 lbs. with 50 grams

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free lift. To obtain a more accurate idea of the distance such a balloon will travel, the direction and distance traveled in each 5,000 foot level should be plotted as in figure 13.

Since the flight test data chart shows that the ascensional rate increases somewhat with altitude, we can calculate the distance traveled in each 5,000 foot level by multiplying wind speed (M.P.H.) in each level by time (Hrs.) spent in each level. Wind direction in each 5,000 foot level is obtained from the wind data. A plot of these values, (fig. 13), shows that a balloon carrying a 2 lb. payload and having a free lift of 50 grams will, under these particular wind conditions, burst at 40,000 feet and a distance of 45 miles from the launch site in a direction 75° from the launch site.

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BALLOON SCATTER

Since the diameter at which a neoprene balloon will burst varies somewhat depending on the individual balloon, it is evident that if a number of balloons, all having exactly the same payload and free lift, are sent aloft they will not all burst at exactly the same altitude. Moreover, the flight test data indicates that the ascensional rate varies somewhat even if the balloons all have the same payload and free lift. Hence it can be expected that, if a number of balloons are sent aloft, all having the same payload and free lift, they will burst in a rectangle; the dimensions of which depends on the variations inherent in the balloons themselves, (disregarding wind conditions.) The dimensions of this rectangle can be calculated by referring to the test data. Using the data from the 2 lb. load, 200 gram free lift flight tests for example, we see that these balloons burst at an altitude of 40,000 ± 2,000 feet, at a rate of rise of 440 ± 15 feet per minute at least 80% of the time. (See fig. 14.)

2 LB LOAD - 50 GRAMS FREE LIFT

ALTITUDE (FEET)	37,792	40,092	40,020	44,882	40,397
RATE OF RISE (FT./MIN.)	434	455	449	453	416

Since the altitude is dependent on payload and the rate of rise is proportional to $\frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}}$ it can be seen that variations introduced in the free lift through error in making up the payload and weighing off, can alter the performance of the balloon to some extent. It is also evident that an error in free lift will alter the rate of rise to a far greater extent than an error in making up the payload. For example, if it is intended that the payload be 2 lbs. and the free lift should be 50 grams, and through an error the balloon actually had 60 grams of free lift the difference theoretically, between actual and expected rate of rise will be:

$$\text{a) intended} = 340 \frac{(50)^{1/2}}{(1080)^{1/3}} = 235 \text{ feet/minute}$$

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b) actual = $340 \frac{(60)^{1/2}}{(1080)^{1/3}}$ = 256 feet/minute

This rate of rise is about 10% higher than intended.

With the higher free lifts an error of 10 grams will not make such a large difference, e.g.:

a) intended = $340 \frac{(500)^{1/2}}{(1530)}$ = 655 feet/minute

b) actual = $340 \frac{(510)^{1/2}}{(1540)^{1/3}}$ = 660 feet/minute

This rate of rise is only about .1% higher than intended.

Thus it can be seen that insofar as rate of rise is concerned a high degree of control is necessary when weighing off balloons with low free lift. Considerable more latitude is permissible with high free lifts although, of course, it is obvious that accuracy is to be desired in any case.

It can be shown that the theoretical rate of rise will not be greatly changed if a small error is made in making up the payload. For example if the payload is intended to be 2 lbs. and through an error is made up to be actually 50 grams more than 2 lbs., then:

a) intended rate of rise = $340 \frac{(50)^{1/2}}{(1080)^{1/3}}$ = 235 ft./min.

b) actual rate of rise = $340 \frac{(50)^{1/2}}{(1080+50)^{1/3}}$ = 236 ft./min.

The greatest need for accuracy then, is in giving the balloon the correct free lift. In practice this is the point at which the balloon is brought into balance with its payload and free-lift weight, just before removing the free-lift weight and releasing.

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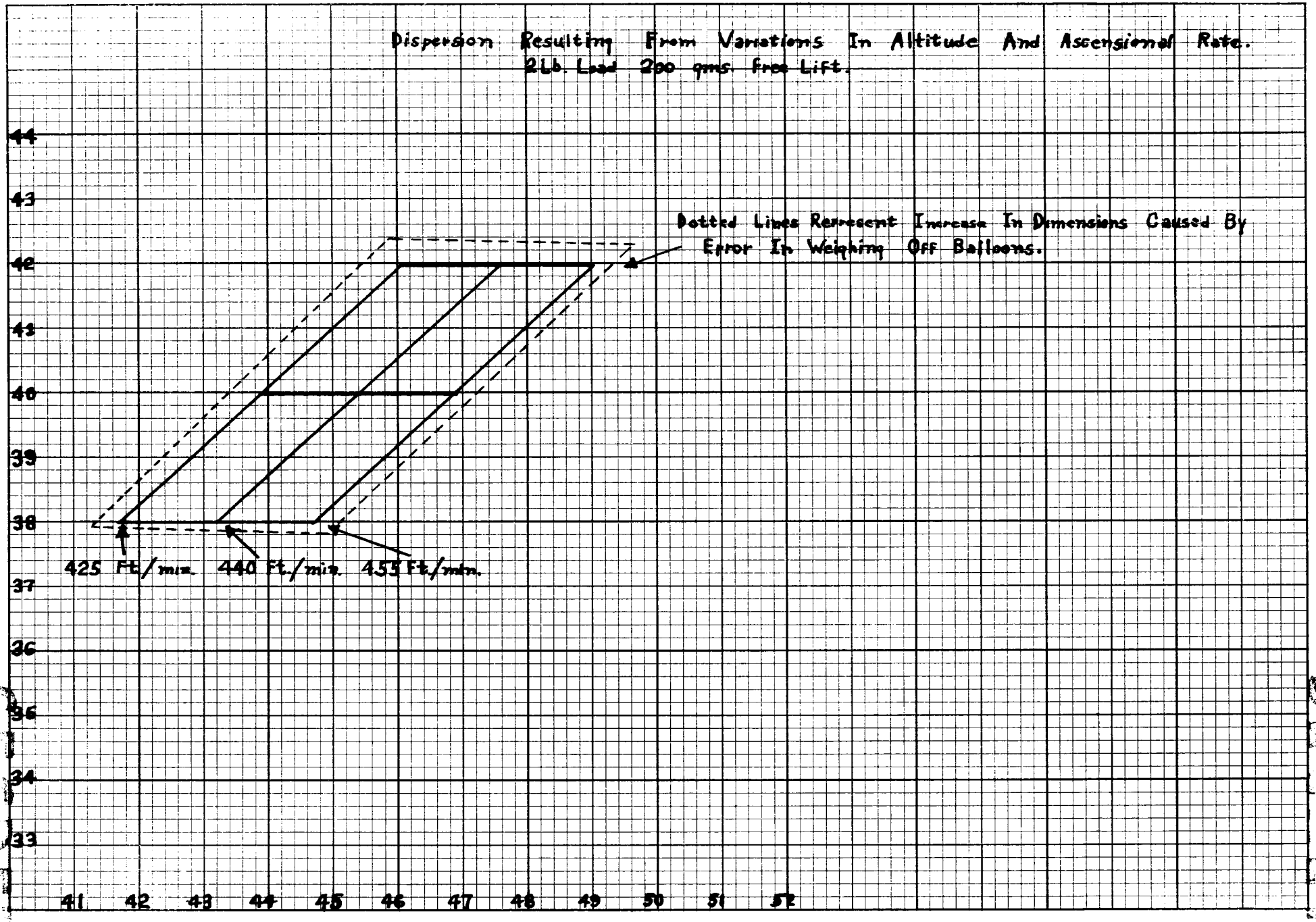
NO. 325 10 DIVISIONS PER INCH BOTH WAYS 70 BY 100 DIVISIONS. CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS. PRINTED IN

Fig. 14. NORMAL BALLOON SCATTER (DISREGARDING WIND VARIATIONS.)



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LAUNCHING PROCEDURE

A. Balloon Handling and Preheating Procedures

Neoprene balloons are strong and highly expansible but, because of their extreme thinness at burst altitude (1/10,000th of an inch), their performance is seriously affected by any scrapes or scratches incurred prior to release. A minor scratch when the balloon is at flaccid diameter, becomes a major flaw when the balloon approaches its bursting dimensions. It is recommended that, if possible, rubber or cotton gloves should be used when handling balloons. In any event balloons should never be allowed to come in contact with rough surfaces.

If it is necessary to preheat balloons the following procedure is recommended:

1.) Bring water to a temperature of 190-200°F.

2.) Bath should be ; a) big enough to allow water to reach all parts of balloon; b) made of smooth porcelain or non-corrosive metal to prevent snags; c) have a metal tray or pan over the heat source to cover hot spots.

3.) Seal neck of balloon with string or heavy rubber band. Hold balloon neck in hand and gently ease balloon into the bath.

4.) Use a heavy rubber glove or a hard rubber rod to help complete submersion. Turn balloon over a few times. Allow balloon to dwell in bath for 5 minutes.

5.) Remove carefully; raise the neck of the balloon out of the bath and fold the remainder onto gloved hand or rod. Allow balloon to drain while removing it from bath.

6.) If outside temperature is cold, balloon must be dried before inflation. Opening folds helps speed drying.

7.) It is not necessary to fly balloons on the same day they are preheated. They may be flown as long as two months after preheating.

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B. INFLATION

In calculating gross lift, it should be remembered that the gross lift includes weight of the balloon + weight of the payload, (this includes carrier carton, leaflets, string, neck-closure), + free-lift. The procedure recommended for inflation is:

1.) Attach valve-cap neck-closure to balloon neck.

2.) Insert inflation nozzle into valve cap.

3.) Commence inflation at a regulator pressure of 20-30 p.s.i.

4.) Attach payload and free-lift weight to neck-closure.

5.) Continue inflation until balloon starts to lift payload and free-lift.

6.) Stop inflation, remove nozzle, close valve-cap, allow balloon to hang in mid-air.

7.) Release or add gas until balloon is perfectly balanced.

8.) Remove free-lift weight and launch balloon.

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VI. OPERATION RAINDROP

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VI. OPERATION RAINDROP

A. OBJECTIVE

The object of this phase of the test program is to carry out an actual leaflet drop as a proof-test of the neoprene balloon mass launching system. Analysis of leaflet returns is expected to give an indication of uniformity of balloon performance as well as effectiveness of impact area saturation.

B. PROCEDURE

1. Preliminary Preparations.

The launching site chosen for the operation was a large, warehouse type building, at the Hawkeye Downs exposition grounds in the city of Cedar Rapids, Iowa. The materials assembled for use in the operation were:

a.) 16 cylinders of Hydrogen gas, (approximately 250 cu. ft. H_2 in each cylinder.)

b.) 100 J-100 neoprene balloons.

c.) 100 polyethylene valve-cap neck-closures.

d.) 100 2 lb. leaflet carriers.

e.) 100 2 lb. packets of leaflets.

f.) 1000 foot roll of nylon cord.

g.) 2 inflation assemblies (hose, pressure-reducer valve, nozzle.)

On the day before the launching, the materials were assembled as follows:

a.) The carriers were assembled with nylon cords attached and numbered from #1 to #100.

b.) The numbered leaflets were loaded into their corresponding carriers in such a way that they did not form too tight a package, in order to assure their release from the carriers when the balloons burst. It was found that a maximum of 550 leaflets weighing 647 grams could be safely packed in

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each carrier. The weight of the carrier, nylon cord, and neck-closure, was 60 grams, making a total payload of 707 grams. The weight of the balloon is an average 105 grams. (Thus: payload (707 grams) + balloon (105 grams) + free lift (200 grams), equals a gross lift of 1012 grams. Since hydrogen at standard temperature and pressure has a lifting force of 32 grams per cubic foot, each balloon requires 31.7 cubic feet of hydrogen, making a total of 3170 cubic feet of hydrogen needed for 100 balloons.)

c.) The plastic valve-cap neck-closures were attached to the balloon.

d.) A table approximately 15 feet long was positioned near the doorway of the warehouse. The loaded carriers and the balloons were placed on the table. The hydrogen tanks were lined up on both sides of the table.

2. Inflation and Launching. (See Pictures)

The inflation was carried out by two men. Each man operated a separate inflation line, thus two balloons were inflated simultaneously. Balloons were inflated at [redacted] Regulator pressure of 20-30 p.s.i. While each balloon was being inflated, a carrier was attached to the neck-closure and a free-lift weight (200 grams) was attached to the carrier. When the balloon was inflated to a point where it just balanced the payload and free-lift weight in mid-air, inflation was stopped, the inflation line withdrawn and a final check was given to assure the balance in mid-air. The free-lift weight was then removed and the balloon was handed to the third member of the team, who walked out the door and released it. The third man also recorded the time of release of each balloon and assisted in changing hydrogen tanks.

Launching commenced at 8:17 A.M., November 6, 1957 and terminated 2 hours and 20 minutes later at 10:37 A.M. A total of 100 balloons were

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Launched. With 550 leaflets per balloon, a total of 55,000 leaflets were used in the operation. Utilizing the test data obtained earlier in the report, it was calculated that these balloons would ascend to 40,000 feet at a rate of rise of approximately 480 ft./min. ($340 \frac{(200)^{1/2}}{(1012)^{1/3}} = 480$ ft./min.) making a total flight time of approximately 1.4 hours. Since a knowledge of the falling characteristics of these particular leaflets was lacking, the time of impact could only be guessed at. Insufficient winds aloft data made it impossible to calculate the approximate point in space at which the balloons would burst. However the balloons were observed to be heading in a direction north east of Cedar Rapids, Iowa, after launching.

C.) TABULATION AND ANALYSIS OF RETURNED LEAFLETS

The returned leaflets were tabulated (see chart and map), and it was learned that:

1.) Some leaflets were found from every one of the 100 balloons sent aloft.

2.) The closest leaflets fell 47.5 miles from the launching site. The furthest leaflets fell 85 miles from the launching site.

3.) Leaflets from 84% of the balloons fell in an area encompassing a rectangle 20 miles long by 10 miles wide, covering an area of 200 square miles.

4.) Of the 55,000 leaflets sent aloft, some 850 (1.55%) were returned and some 2500 (4.5%) were reported as having been found.

5.) Leaflets from 16 different balloons were reported as being seen falling by finders. The falling leaflets were sighted approximately 4 hours after balloons were launched. (i.e. leaflets from balloon #2, launched 10:30 A.M., were seen falling at 2:30 P.M., leaflets from balloon #67 launched 9:A.M. were seen falling at 1:00 P.M., etc.) Some leaflets were reported as being seen falling

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as early as 2 3/4 hours after launching and one observer reported seeing leaflets falling 7 hours after the balloon was launched.

6.) In some cases leaflets from several different balloons were found in the same area. In other cases leaflets from the same balloon were found in several different areas.

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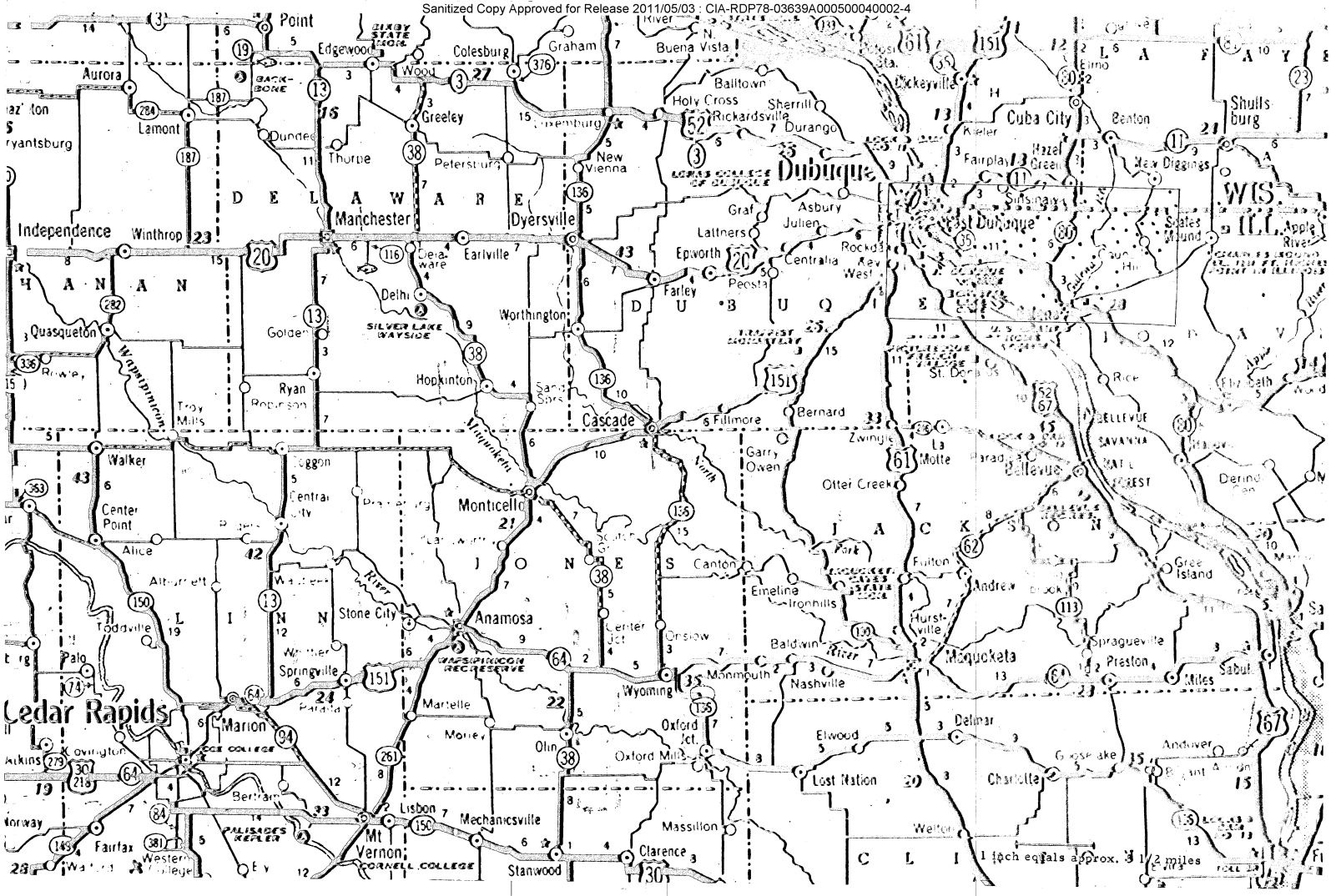

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TABULATION OF RETURNS

LEAFLETS FROM BALLOON #	AMOUNT RETURNED	AMOUNT REPORTED	LEAFLETS FROM BALLOON #	AMOUNT RETURNED	AMOUNT REPORTED
1	4	7	26	5	7
2	7	23	27	3	2
3	12	16	28	6	25
4	8	13	29	6	19
5	6	10	30	3	8
6	3	"Many"	31	11	22
7	4	7	32	6	22
8	3	21	33	11	11
9	4	5	34	10	22
10	10	12	35	8	19
11	9	21	36	9	11
12	7	22	37	7	11
13	8	12	38	9	18
14	9	31	39	8	19
15	8	24	40	13	20
16	7	"Many"	41	14	44
17	8	17	42	11	27
18	13	30	43	5	6
19	4	4	44	[illegible]	19
20	6	18	45	21	32
21	10	26	46	4	7
22	11	28	47	24	32
23	7	19	48	7	"Many"
24	6	13	49	2	5
25	16	21	50	7	24

(continued)

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TABULATION OF RETURNS (continued)

LEAFLETS FROM BALLOON #	AMOUNT RETURNED	AMOUNT REPORTED	LEAFLETS FROM BALLOON #	AMOUNT RETURNED	AMOUNT REPORTED
51	3	3	76	8	"Many"
52	5	8	77	9	20
53	15	26	78	5	28
54	11	23	79	14	14
55	7	17	80	12	"Many"
56	4	5	81	4	5
57	11	30	82	7	7
58	10	18	83	10	31
59	6	9	84	9	13
60	5	16	85	4	12
61	5	12	86	7	18
62	10	13	87	10	43
63	8	11	88	8	"Many"
64	5	33	89	3	5
65	8	22	90	4	10
66	4	9	91	9	13
67	7	11	92	1	1
68	27	39	93	6	19
69	7	16	94	14	33
70	9	"Many"	95	13	24
71	7	20	96	10	24
72	8	14	97	5	20
73	4	5	98	7	23
74	10	12	99	9	13
75	7	10	100	7	23
			TOTAL	800	1600

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LEAFLETS SEEN FALLING

BALLOON #	TIME OF RELEASE	TIME SEEN FALLING	DATE	AMOUNT FOUND	PLACE FOUND
2	10:[illegible] :57	2:30 (4 Hrs)	6 Nov. 57	3	5 Miles W of Scales Mound
10	10:25	2:30 (4 Hrs)	"	3	"
12	09:54	1:45 (4 Hrs)	"	3	6 Miles E of Dubuque
45	08:34	12:20 (4 Hrs)	"	6	Dubuque
45	08:34	12:00 (3½ Hrs)	"	2	"
47	08:50	12:30 (3½ Hrs)	"	1	Near Mississippi River
47	08:50	12:30 (3½ Hrs)	"	1	Dubuque
55	08:35	2:30 (7 Hrs)	"	2	Scales Mound
56	09:48	1:30 (3¼ Hrs)	"	1	East of E. Dubuque
58	09:27	1:15 (2¾ Hrs)	"	4	Menonomie
63	09:01	2:00 (5 Hrs)	"	10	Galena
67	09:15	1:10 (4 Hrs)	"	4	Menonomie
67	09:15	1:10 (4 Hrs)	"	4	"
67	09:15	1:10 (4 Hrs)	"	4	"
68	09:18	1:00 (3¾ Hrs)	"	1	Dubuque
68	09:18	3:00 (5¾ Hrs)	"	1	"
70	08:43)	2:00 (5¼ Hrs)	"		Galena
70	08:43)	2:00 (5¼ Hrs)	"	10	"
73	09:21	1:30 (4 Hrs)	"	1	Rockdale
79	08:39	11:30 (3 Hrs)	"	4	10 Miles W of Dubuque
86	09:45	2:00 (4¼ Hrs)	"	10	Galena
87	09:30	2:00 (4½ Hrs)	"	10	Galena

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PLACES WHERE LEAFLETS WERE FOUND

TOWN	COUNTY	STATE	NO. FOUND	TOWN	COUNTY	STATE	NO. FOUND
Peosta	Dubuque	Iowa	9	Vinegar Hill	Joe Davis	Illinois	12
Cascade	Dubuque	Iowa	2	Bellevue	Jackson	Iowa	3
Rockdale	Dubuque	Iowa	3	St. Donatus	Jackson	Iowa	14
Swiss Valley	Dubuque	Iowa	9	La Motte	Jackson	Iowa	5
Trappist Monastery	Dubuque	Iowa	3	Mt. Oak Tusp.	Lafayette	Wisconsin	1
Centralia	Dubuque	Iowa	1	Schulsberg	Lafayette	Wisconsin	16
Mosaleum	Dubuque	Iowa	9	New Diggings	Lafayette	Wisconsin	13
Dubuque	Dubuque	Iowa	136	Benton	Lafayette	Wisconsin	2
Key West	Dubuque	Iowa	5	Cuba City	Grant	Wisconsin	1
St. Cathrine	Dubuque	Iowa	7	Sinsinawa	Grant	Wisconsin	5
Epworth	Dubuque	Iowa	8	Hazel Green	Grant	Wisconsin	42
Bernard	Dubuque	Iowa	4	Montichello	Jones	Iowa	2
Council Hill	Joe Davis	Illinois	77	Waterloo	Blackhawk	Iowa	1
Galena	Joe Davis	Illinois	109	Unknown	Grant	Wisconsin	4
Gulford	Joe Davis	Illinois	2	"	Joe Davis	Illinois	24
Scales Mound	Joe Davis	Illinois	87	"	Lafayette	Wisconsin	7
East Dubuque	Joe Davis	Illinois	99	"	Dubuque	Iowa	39
Apple River	Joe Davis	Illinois	9	"	Jackson	Iowa	5
Menonime	Joe Davis	Illinois	35				

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D. CONCLUSIONS

It is concluded from the returns that:

1. The uniformity of the J-100 neoprene balloons is such that a large percentage (84%) of the balloons sent aloft burst at approximately the same altitude, with the same rate of rise. If the points of burst were widely scattered it is assumed that the leaflets would have landed in a much larger area than they did.
2. Because of this uniformity in performance, neoprene balloons can be controlled to burst at a predetermined altitude and ascensional rate with a reasonable degree of accuracy, and are quite suitable for this type of operation.

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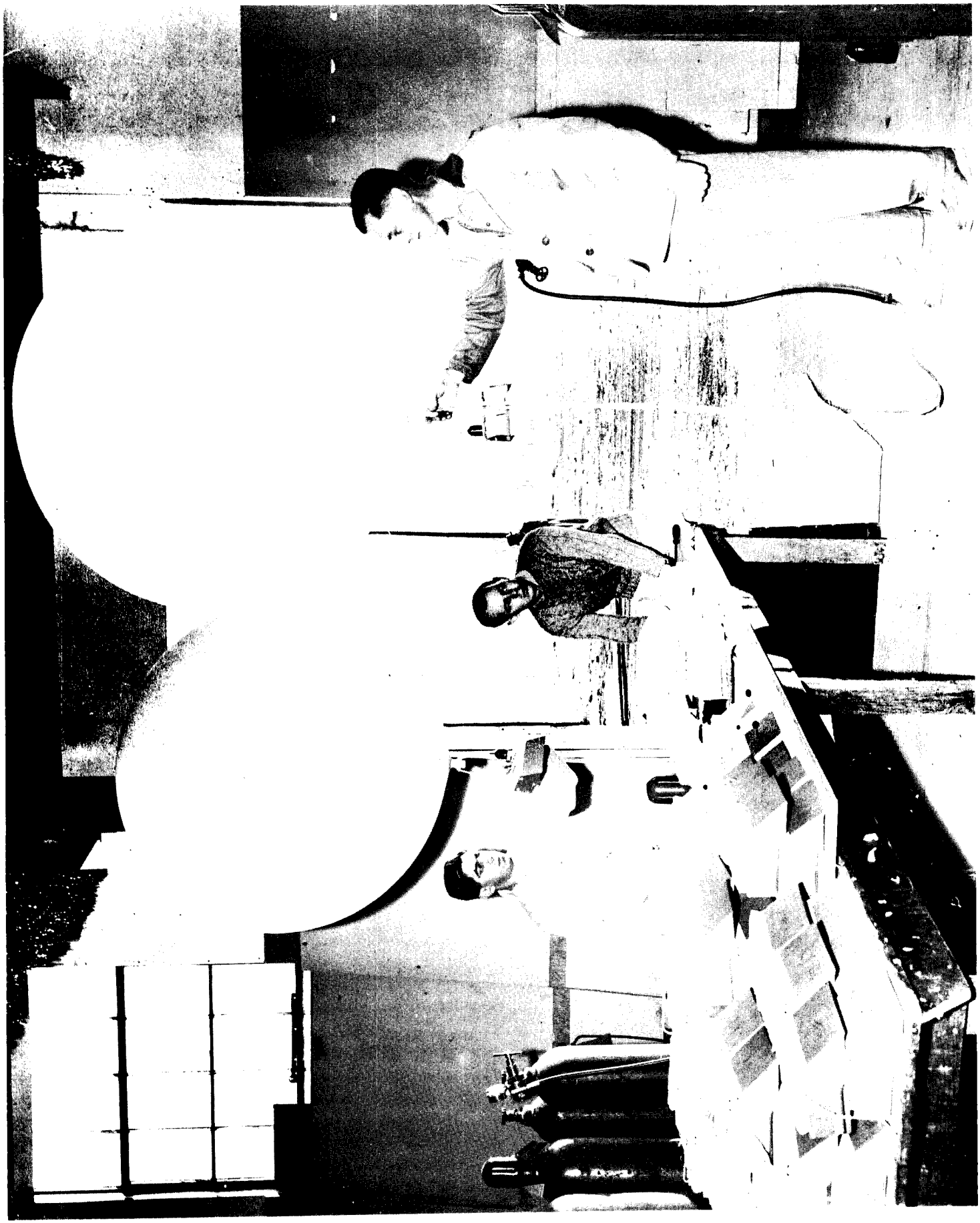

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