

AD 721697

RDTR NO. 164  
MARCH 1970

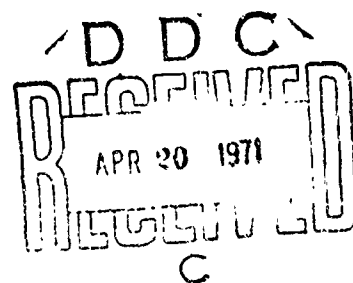
# **MK 45 AIRCRAFT PARACHUTE FLARE OPTIMIZATION PROGRAM**

## **EVALUATION OF EXPERIMENTAL PARACHUTES AND PARACHUTE MATERIALS**

**FLIGHT TEST SERIES NO. 2**

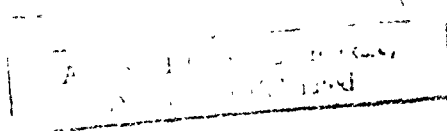


PREPARED BY



**RESEARCH AND DEVELOPMENT DEPARTMENT  
NAVAL AMMUNITION DEPOT, CRANE, INDIANA**

NATIONAL TECHNICAL  
INFORMATION SERVICE



47

NAVAL AMMUNITION DEPOT

CRANE, INDIANA

RDTR NO. 164  
March 1970

MK 45 AIRCRAFT PARACHUTE FLARE OPTIMIZATION PROGRAM  
EVALUATION OF EXPERIMENTAL PARACHUTES & PARACHUTE MATERIALS  
FLIGHT TEST SERIES NO. 2

Prepared By: CLENNETH R. KOCH, R. L. RICHARDSON, J. W. LEONARD

Reviewed By:

J. W. Puckett  
J. W. PUCKETT

Released By:

S. M. Fasig  
S. M. FASIG

## TABLE OF CONTENTS

Page

|                                                      |    |
|------------------------------------------------------|----|
| Abstract - - - - -                                   | ii |
| I. Introduction - - - - -                            | 1  |
| II. Test Flights - - - - -                           | 5  |
| III. Conversion Formula - - - - -                    | 6  |
| IV. Average Descent Velocity Determination - - - - - | 6  |
| V. Discussion of Flight Test Results - - - - -       | 7  |
| VI. Summary - - - - -                                | 12 |
| VII. Recommendations - - - - -                       | 14 |
| Appendix A                                           |    |
| Special Parachute Tests - - - - -                    | 17 |
| Appendix B                                           |    |
| Radar Plots - - - - -                                | 25 |
| Appendix C                                           |    |
| Photographs                                          |    |
| New Parachute Cross Design, Mylar/Dacron Cloth - - - | 31 |
| Flare #K-110 - - - - -                               | 32 |
| Flare K-110 - 350 KIAS - - - - -                     | 33 |
| Flare K-118 - 300 KIAS - - - - -                     | 34 |
| Flare K-133 - 400 KIAS - - - - -                     | 35 |
| Flare K-135 - 350 KIAS - - - - -                     | 36 |
| Flare K-135 - 350 KIAS - - - - -                     | 37 |
| Flare K-136 - 350 KIAS - - - - -                     | 38 |
| Flare K-213 - 350 KIAS - - - - -                     | 39 |
| Flare K-245 - 425 KIAS - - - - -                     | 40 |
| Flare K-247 - 450 KIAS - - - - -                     | 41 |

ABSTRACT

This report presents the results of MK 45 Aircraft Parachute Flare Developmental Flight Tests (experimental parachutes and parachute materials) conducted at Naval Weapons Center, China Lake, California, 12 November 1969 through 11 December 1969. The basis for choice of chutes and materials for these tests was derived<sup>1</sup> from RDTR #163. Data obtained from these flight tests indicate the cross type parachute using Cerex Cloth (.85 oz/sqyd) to exhibit the most advantageous characteristics for incorporation into the MK 45 APF system. The data also indicates that a strength problem exists when the same canopy material (Cerex) is used on the present MK 45 APF flat circular chute. A third system utilizing a cross parachute with a Mylar/Dacron laminate cloth was evaluated. This chute also had cloth failures from the parachute snatch loading forces.

I. INTRODUCTION

A. NAD Crane has made local studies to determine the optimum parachute configuration and material for incorporation into the MK 45 APF<sup>1,2</sup>, RDTR #163 and RDTR #130. The three most significant factors to be considered are: average descent velocity, parachute cost, and flare stability.

B. Two different parachute configurations incorporating a new spunbonded nylon material (Cerex) were evaluated. The material used was the .85 oz/sqyd, 425 ± 70 CFM cloth.

(1) Thirty cross parachutes were constructed as follows:

|               |                          |          |
|---------------|--------------------------|----------|
| <u>FIG. 1</u> | Do*                      | 17.6 ft. |
|               | Gore width               | 7 ft.    |
|               | Gore length              | 21 ft.   |
|               | Crown thickness          | Single   |
|               | Shroud line length       | 21 ft.   |
|               | No. of shroud line/panel | 4 ft.    |
|               | Shroud material          | Nylon    |
|               | No. hem stitches         | 6-8/in   |
|               | Cotton cord in skirt     | Yes      |

(2) Thirty flat circular parachutes were constructed similar to the present MK 45 APF flat circular chute as follows:

|               |              |        |
|---------------|--------------|--------|
| <u>FIG. 2</u> | Do           | 15'-9" |
|               | No. of gores | 18     |

\* Nominal Diameter: The computed diameter of parachute canopy, which equals the diameter of a circle having the same total area as the total area of the drag-producing surface.

CROSS PARACHUTE

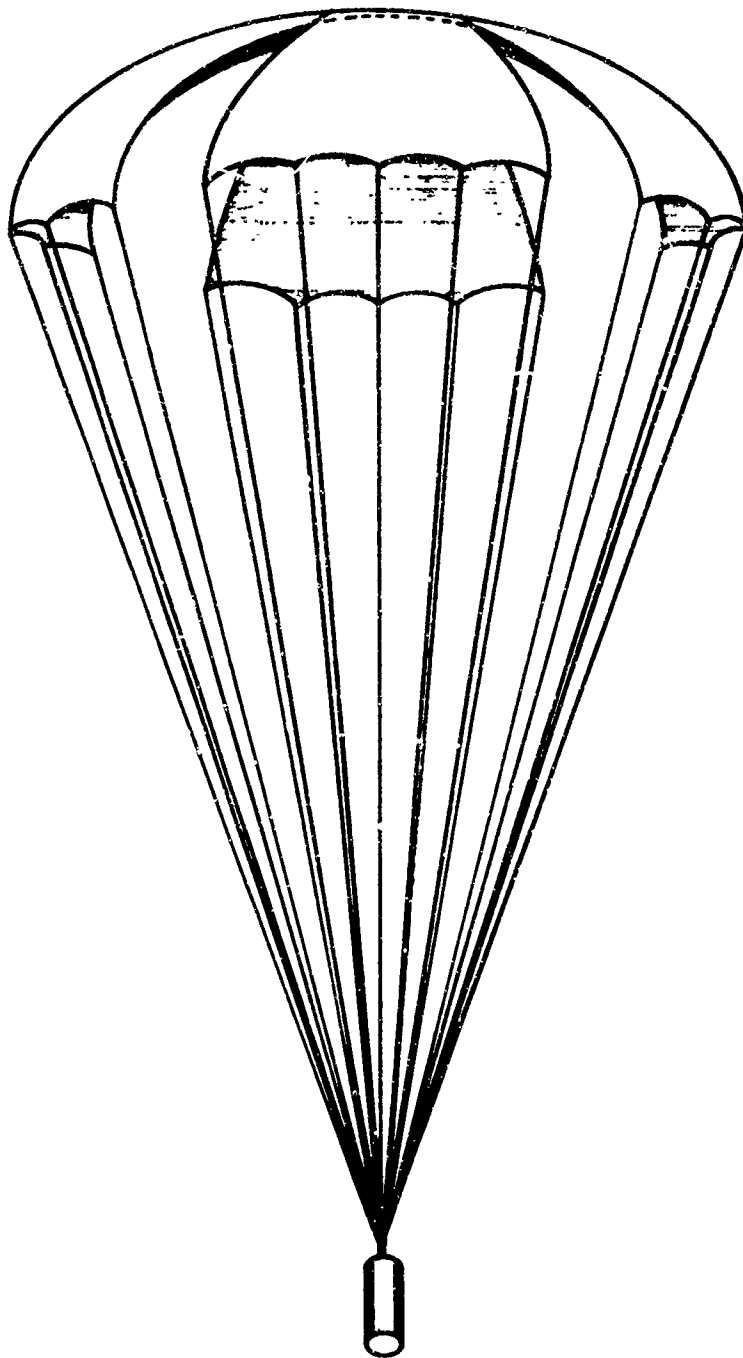


FIGURE #1

FLAT CIRCULAR PARACHUTE

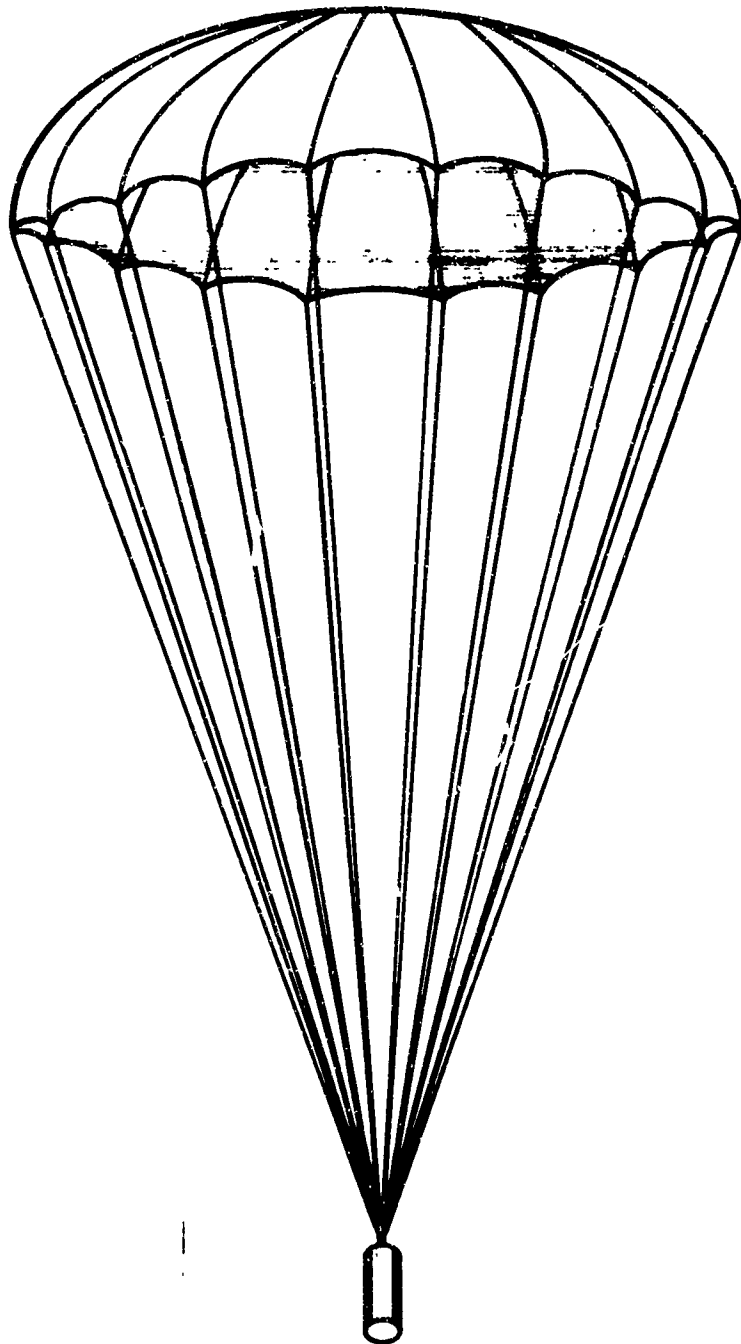


FIGURE #2

RDTR No. 164

|                      |              |
|----------------------|--------------|
| No. of shroud lines  | 18           |
| Shroud line length   | 15'-9"       |
| Shroud line material | nylon *      |
| Crown tape           | 5/4 nylon ** |
| Hem stitches         | 6-8/in ***   |
| Hem tape             | 11/16 cotton |
| Cotton cord in skirt | Yes          |

Present Production MK 45 Parachute as follows:

\* Cotton

\*\* 11/16 cotton

\*\*\* 12-16/in

C. Fifty Cross parachutes incorporating a new mylar/dacron (M/D) laminate cloth were also evaluated. The material used was 1/4 mill Mylar reinforced with Dacron threads.

(1) The fifty Cross parachutes were constructed as follows:

|         |                      |          |
|---------|----------------------|----------|
| FIG. #1 | Do                   | 16.8 ft. |
|         | Gore width           | 6.33 ft. |
|         | Gore length          | 20.6 ft. |
|         | Crown thickness      | Double   |
|         | Shroud line length   | 20.6 ft. |
|         | Shroud line material | nylon    |
|         | No shroud line/panel | 5        |

All 110 of these experimental parachutes were assembled into MK 45 APF's at NAD Crane.



## II. TEST FLIGHTS

A total of 148 MK 45 APF's were flight tested at aircraft speeds of 200 through 450 KIAS. The 148 consisted of the 110 experimental parachutes plus 38 standard MK 45 APF's. The standard flares were launched to provide a basis for comparison.

All flight tests were conducted at Naval Weapons Center, China Lake, California. An A-4 aircraft was utilized for all tests. Fuze settings, aircraft air speed, and launch altitude varied as shown in Appendix A. The aircraft carried 20 flares mounted 4 each on 5 external Multiple Stores Bomb Racks (MSBR), and two flares were launched on each pass over the drop zone. Radar was employed to determine average flare descent velocity of the first flare of each pair released, (typical radar plots are shown in Appendix B), and 16mm photographic coverage was employed to obtain data on chute stability and any malfunctions that might arise on the second flare released. These flights extended over a period of 30 days. The results, therefore, should be considered in light of many different environmental (meteorological) conditions.

The MK 45 APF's were numbered as follows:

1. P-150 thru P-187 Std Production MK 45 APF's.
2. K-100 thru K-149 MK 45 APF's utilizing the cross  
parachute fabricated of Mylar/Dacron cloth.
3. K-188 thru K-217 MK 45 APF's utilizing the flat circular  
parachute fabricated of Cerex cloth.

4. K-218 thru K-247 MK 45 APF's utilizing the cross  
parachute fabricated of Cerex cloth.

Several parachutes were recovered. These were inspected and photographs were made of the damage which would have affected chute performance. These photographs appear in Appendix C. Each photograph is identified as to test number, launch speed, fuze setting, parachute ejection velocity, and parachute configuration and material.

### III. CONVERSION FORMULA

Because the test flights were conducted using production MK 45 APF's as a base comparison, and because of the widely different meteorological conditions encountered over the total evaluation period, the average descent velocity of each parachute/candle system evaluated had to be converted to a nominal average descent velocity using the following formula:

$$\frac{\text{Experimental Parachute (Nom) Average Descent Velocity}}{\text{Experimental Parachute (Test) Ave. Descent Velocity}} = \frac{\text{Production MK 45 Parachute (Nom Average Descent Velocity 8 ft/sec)}}{\text{Production Mk 45 Parachute (Test) Ave. Descent Velocity}}$$

### IV. AVERAGE DESCENT VELOCITY DETERMINATION

The average descent velocity was computed by using the time and distance from candle ignition to the lowest point of the candle trajectory. It should be understood that in some instances during positive descent, the parachute/candle system became buoyant and thus changed to negative descent near the end of candle burn. This negative descent was not considered in the final

determination of the average descent velocity.

V. DISCUSSION OF FLIGHT TEST RESULTS

The following specific information provides test parameters and data that was obtained from launchings of the parachute configurations listed previously.

A. Cross parachute Do = 16.8', Mylar/Dacron material (50 chutes total) - Parachutes were fabricated by G. T. Schjeldahl Co.

(1) All flares were dropped from external MSBR's mounted on an A-4 aircraft.

(2) Aircraft speed varied from 250 to 400 KIAS, and fuze settings of 500 and 1000 ft. were used.

(3) Parachute deployment velocity varied from 200 to 250 ft/sec.

(4) The following malfunctions were noted:

(a) Nine flares were lost because of a bomb rack solenoid failure. This caused the flares to drop with the entire lanyard attached.

(b) One lanyard broke at flare release from aircraft.

(c) One chute was a streamer.

(d) Twelve chutes were extensively damaged on opening, causing the flare to have faster than normal descent velocity.

(e) The remaining twenty-seven flares looked OK visually during descent; however, later inspection determined there was slight damage to some of the chutes' canopy cloth.

(f) Of the 16 production MK 45 APF's that were dropped in conjunction with the above, there were: Two duds due to rack solinoid failure, one unit had a long delay from launch to ignition (12.4 secs.), one chute was a streamer, and one lanyard broke at flare release from aircraft.

(5) The following descent velocities were obtained:

| Production MK 45 Chute                  | Cross Chute Do = 16.8' (M/D)          |
|-----------------------------------------|---------------------------------------|
| <u>Avg. Descent Velocity (ft/sec)</u>   | <u>Avg. Descent Velocity (ft/sec)</u> |
| 8.5                                     | 6.7                                   |
| 7.0                                     | 4.7                                   |
| 7.3                                     | 5.5                                   |
| 7.4                                     | 5.3                                   |
| 7.6                                     | 6.9                                   |
| <u>7.9</u>                              | 4.2                                   |
| 6   45.7                                | 4.5                                   |
| 7.61 ft/sec                             | 2.7                                   |
|                                         | 6.5                                   |
|                                         | 3.3                                   |
| Conversion Formula (Para. III, Page 4): | 5.0                                   |
| $\frac{x}{5.08} = \frac{8}{7.61}$       | 6.1                                   |
|                                         | <u>4.7</u>                            |
|                                         | 13   66.1                             |
|                                         | 5.08 ft/sec                           |

Nominal average descent velocity = 5.35 ft/sec

B. Flat Circular Parachute, 15.9' diameter, Cerex cloth  
(30 chutes total) - parachutes were fabricated by Raven Industries.

(1) All flares were dropped from external MSBR's mounted on an A-4 aircraft.

(2) Aircraft speed varied from 200 to 450 KIAS, and fuze settings of 500 and 1000 ft. were used.

(3) Parachute deployment velocity varied from 195 to 250 ft/sec.

(4) The following malfunctions were noted:

(a) One lanyard broke at flare release from aircraft.

(b) One flare had the end cap to eject, but parachute and candle never ejected.

(c) One flare released at 350 (KIAS) with 500 ft. fuze setting, deployed chute at 195 ft/sec. The cloth on this chute tore about 1 inch above the top stitching in the hem tape, a distance of approximately 4 feet around the periphery of the chute.

(d) The remaining twenty-seven flares performed satisfactorily.

(5) The ten production MK 45 APF's dropped in conjunction with above, performed satisfactorily.

(6) The following descent velocities were obtained:

## Production MK 45 Chute

## Flat Circular Chute Do = 15.9' (Cerex)

Avg. Descent Velocity (ft/sec)Avg. Descent Velocity (ft/sec)

5.9  
7.1  
8.6  
10.5  
7.0  
5 39.1  
7.82 ft/sec

6.5  
8.7  
6.7  
6.9  
7.2  
8.2  
8.4  
6.9  
7.8  
8.2  
8.8  
8.8

Conversion Formula (Para III, Page 4):

$$\frac{X}{8.31} = \frac{8.0}{7.82}$$

$$13 \frac{7.7}{100.8}$$

8.31 ft/sec

Nominal Avg. descent velocity = 8.5 ft/sec

C. Cross Parachute, Do = 17.6', Cerex cloth (30 chutes total) - Parachutes were fabricated by Raven Industries.

(1) All flares were dropped from external MSBR's mounted on an A-4 aircraft.

(2) Aircraft speed varied from 200 to 450 (KIAS), and fuze setting of 500 and 1000 ft. were used.

(3) Parachute deployment velocity varied from 195 to 250 ft/sec.

(4) The following malfunctions were noted:

(a) One flare had the lanyard to pull out of the nicopress sleeve on flare release from aircraft.

(b) One flare released at 425 (KIAS) with 500 ft. fuze setting, deployed chute at 205 ft/sec. The cloth on this chute tore about 1/2 inch above the stitching in the hem tape, a distance of approximately 8 in. along the hem.

(c) A second flare released at 450 (KIAS) and 500 ft. fuze setting, deployed chute at 215 ft/sec. The cloth on this chute tore (as above) a distance of approximately 20 inches along the hem.

(d) The remaining twenty-seven flares performed satisfactorily.

(5) Eleven of the twelve production MK 45 APF's performed satisfactorily. The fuze on the other flare was still on safe when recovered from the range.

(6) The following descent velocities were obtained:

| Production MK 45 Chute                |  | Cross Chute, Do = 17.6' (Cerex)       |  |
|---------------------------------------|--|---------------------------------------|--|
| <u>Avg. Descent Velocity (ft/sec)</u> |  | <u>Avg. Descent Velocity (ft/sec)</u> |  |
| 7.0                                   |  | 6.6                                   |  |
| 6.8                                   |  | 5.7                                   |  |
| 7.7                                   |  | 2.9                                   |  |

|               |     |
|---------------|-----|
| 7.4           | 3.6 |
| <u>4.5</u>    | 5.1 |
| 5 <u>33.4</u> | 3.7 |
| 6.68 ft/sec   | 3.5 |

3.9

2.5

3.6

4.5

3.9

Conversion Formula (Para III, page 4):

4.9

$$\frac{x}{4.28} = \frac{8}{6.68}$$

5.1

4.715 64.2

4.28 ft/sec

Nominal avg. descent velocity = 5.14 ft/sec

All the aforementioned flight test data are included in Appendix A.

VI. SUMMARY

A. The following resulted from the flight testing herein reported.

(1) A potential strength problem was found in the present MK 45 parachute configuration when the Cerex cloth was substituted for present woven nylon cloth. Although only one chute failure was found, it was at a deployment velocity of only 215 ft/sec. It should be noted that a 350 KIAS aircraft release and a 3.5 sec.



fuze delay would develop a 275 ft/sec parachute deployment under the same environmental conditions. No difference was found in the instability of the flare by substituting the Cerex cloth, it was still in the range of  $\pm 40-45^\circ$  from vertical. This chute also had a faster corrected average descent velocity 8.5 ft/sec vs. 8 ft/sec for the production MK 45 chute.

(2) The Cross parachute fabricated of the same Cerex cloth performed very well. Slight damage (hem tears) was found on two chutes which were deployed at 205 and 215 ft/sec. This damage was very minor and it is felt that it is not a problem at present. This chute and material had very good stability  $\pm 5^\circ$  from vertical axis in most cases. This chute exhibited a much slower corrected average descent velocity 5.14 ft/sec vs. 8 ft/sec for the production MK 45 chute, a 36% reduction.

(3) The Cross parachute fabricated of the Mylar/Dacron laminate material had an obvious strength problem at snatch loading, when deployment velocity was above 200 ft/sec. (It should be mentioned at this time, that unknown until after parachutes were evaluated, the cloth furnished for these parachutes was fabricated differently than cloth used in<sup>1</sup> RDTR #163. This fact may or may not have a bearing on the results that were obtained). If the chute was not damaged badly enough to cause it to squid, the damage did not seem to adversely affect the stability  $\pm 3^\circ-4^\circ$  from vertical axis or the descent velocity. Even though most chutes

showed some cloth damage, their corrected average descent velocity of 5.35 ft/sec was much slower than the Production MK 45 Parachute; a 33% reduction.

VII. RECOMMENDATIONS

It is recommended that a smaller cross parachute (approximately 16 ft. panel length,  $D_o = 13-13.5$  ft) fabricated of .85 oz/yd. 425  $\pm$  70 CFM Cerex flare cloth be further evaluated. This program indicates that Cerex cloth exhibits the strength to withstand the snatch loading required for this diameter parachute. A parachute of this diameter, fabricated of Cerex cloth, should provide the same average descent velocity as the present production MK 45 APF chute, plus exhibit a sizable reduction in parachute cost and increase the flare's stability.

REFERENCES

1. Koch, Clenneth R., RDTR #163, MK 45 Aircraft Parachute Flare Optimization Program, Preliminary Evaluation of Experimental Parachutes and Parachute Materials, Flight Test Series No. 1, U. S. Naval Ammunition Depot, Crane, Indiana.
2. Koch, Clenneth R., RDTR #130, MK 24-Size Candle Parachute Destruct Configuration Optimization Program, U. S. Naval Ammunition Depot, Crane, Indiana.

ACKNOWLEDGMENT

I wish to express thanks to Lee Jameson of the G. T. Schjeldahl Company, Northfield, Minnesota, and to Gene Hanson and Dean Boettcher of Raven Industries, Sioux Falls, South Dakota, for their helpful assistance in preparing for and carrying out this development program.

| SPECIAL PARACHUTE TESTS |              |                       |                 |                               |                    |                         |                        |                          |                        |                                                                                                              |
|-------------------------|--------------|-----------------------|-----------------|-------------------------------|--------------------|-------------------------|------------------------|--------------------------|------------------------|--------------------------------------------------------------------------------------------------------------|
| APPENDIX A              |              |                       |                 |                               |                    |                         |                        |                          |                        | REMARKS                                                                                                      |
| FLARE TYPE              | FUZE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | LAUNCH TO CHUTE OPENING | IGNITION TO CHUTE DUMP | TOTAL RUNNING TIME (SEC) | DATE OF DESCENT (AVE)* |                                                                                                              |
| K-100 CROSS             | 500          | 400                   |                 |                               |                    |                         |                        |                          |                        | DIED BACK SOLENOID MALFUNCTION                                                                               |
| K-101 "                 | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| P-150 MK-45             | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| P-151 "                 | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| K-102 CROSS             | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| K-103 "                 | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| K-104 "                 | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| K-105 "                 | "            | "                     |                 |                               |                    |                         |                        |                          | "                      | "                                                                                                            |
| K-106 "                 | "            | "                     | 5.2             | 240                           | 7.5                |                         |                        | 242                      |                        | Chute Damaged at Opening.                                                                                    |
| K-107 "                 | "            | "                     | 7.2             | 215                           | 7.8                | 8.2                     |                        | 247                      | C                      | Burned Out On Ground. $\pm 3^\circ$ Oscillation. Candle Arcended into its Smoke the last 13 Seconds of E. I. |
| P-152 MK-45             | "            | "                     | 6.2             | 225                           | 7.2                | 7.8                     | 249                    | 253                      | 8.5                    | $\pm 40^\circ$ Oscillation                                                                                   |
| P-153 "                 | "            | "                     | No Record       | 230                           | 5.8                | No Record               | 232                    | 235                      | C                      | $\pm 35^\circ$ Oscillation.                                                                                  |
| K-108 CROSS             | "            | "                     | 7.3             | 215                           | 7.8                | 10.3                    |                        | 243                      |                        | Flare Separated from Chute at 60 Seconds.                                                                    |
| K-109 "                 | "            | "                     | 7.2             | 215                           | 8.2                |                         |                        | 175                      | C                      | Damaged Chute. Squidged to Ground.                                                                           |
| K-110 "                 | "            | 350                   | 6.1             | 220                           | 6.5                | 6.9                     | 231                    | 235                      | C                      | $\pm 2^\circ$ Oscillation. Candle Arcended into its Smoke the last 37 Seconds of E. I.                       |
| K-111 "                 | "            | "                     | 6.4             | 215                           | 6.6                | 7.9                     | 226                    | 236                      | 6.7                    | $\pm 3^\circ$ to $\pm 5^\circ$ Oscillation.                                                                  |
| K-112 "                 | "            | "                     | 7.8             | 210                           | 8.5                | 8.8                     | 234                    | 237                      | 4.7                    | $\pm 4^\circ$ Oscillation.                                                                                   |
| K-113 "                 | "            | "                     | 5.5             | 225                           | 6.4                | 7.2                     | 235                    | 238                      | C                      | Damaged Chute. One Panel held by one shroud line. Chute still had good stability.                            |
| P-154 MK-45             | "            | "                     | 4.1             | 250                           | 4.5                | 4.9                     | 236                    | 242                      | 7.0                    | $\pm 30^\circ$ Oscillation.                                                                                  |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE.

## APPENDIX A

## EXPERIMENTAL PARACHUTE TESTS

| FLARE NO | TYPE  | FUZE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH TO EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | IGNITION TO CHUTE OPENING | IGNITION DUMP | TOTAL BURNING TIME (SEC) | RATE OF DESCENT (AVE.)* | REMARKS                                                                                          |
|----------|-------|--------------|-----------------------|--------------------|-------------------------------|--------------------|---------------------------|---------------|--------------------------|-------------------------|--------------------------------------------------------------------------------------------------|
| P-155    | MC-45 | 500          | 350                   |                    |                               |                    |                           |               |                          | C                       | Dud. Lanyard Broke on Release from Rack. Slight Damage to Chute on Opening.                      |
| K-114    | CROSS | "            | "                     | 7.7                | 200                           | 8.4                | 8.4                       | 232           | 234                      | 5.5                     | Worked O.K.                                                                                      |
| K-115    | "     | "            | 300                   | 6.3                | 218                           | 6.9                | 7.0                       | 242           | 245                      | C                       | ±2° Oscillation. Chute Looked good on Film.                                                      |
| K-116    | "     | "            | "                     | 5.7                | 215                           | 6.2                | 6.5                       | 235           | 240                      | 5.3                     | ±4° Oscillation.                                                                                 |
| K-117    | "     | "            | "                     | 6.0                | 215                           | 6.9                | 7.4                       | 161           | 174                      | C                       | Fast Burning Candle. ±3°-±5° Oscillation. Upward into smoke last 6 seconds. Chute looked good.   |
| K-118    | "     | "            | "                     | 5.2                | 220                           | 6.5                | 6.5                       | 233           | 236                      | 6.9                     | ±3°-±4° Oscillation.                                                                             |
| K-119    | "     | "            | "                     | 6.1                | 215                           | 6.7                | 7.0                       | 232           | 236                      | C                       | ±3°-±5° Oscillation. Chute looked Good. Candle ascended into smoke last 6 seconds.               |
| P-156    | MC-45 | "            | "                     |                    | 205                           | 6.2                |                           |               | 239                      |                         | Streamer Chute. Burned out on ground.                                                            |
| P-157    | "     | "            | "                     | 6.2                | 210                           | 7.2                | 7.2                       | 228           | 237                      | C                       | ±45° Oscillation.                                                                                |
| K-120    | CROSS | "            | "                     | 6.2                | 210                           | 7.6                | 8.1                       | 235           | 239                      | 4.2                     | ±2°-±3° Oscillation. Candle up into smoke the last 31 seconds of B. T.                           |
| K-121    | "     | "            | "                     | 5.6                | 220                           |                    |                           |               |                          | C                       | All 4 shroud lines tore loose from one pane! at Chute opening. Streamer to ground.               |
| K-122    | "     | "            | "                     | 4.5                | 230                           | 5.9                | 6.9                       | 226           | 232                      | 4.5                     | ±3°-±4° Oscillation.                                                                             |
| K-123    | "     | "            | "                     | 5.6                | 220                           | 7.2                | 7.2                       | 220           | 234                      | C                       | ±2°-±4° Oscillation. Slight Damage at Opening. Candle up into smoke the last 19 seconds of B. T. |
| K-124    | "     | "            | "                     |                    |                               |                    |                           |               |                          |                         | Dud. Solenoid Failure on Rack                                                                    |
| K-125    | "     | "            | "                     | 3.9                | 242                           | 6.0                |                           |               | 120                      | C                       | Chute Badly Damaged. Squided                                                                     |
| P-158    | MC-45 | "            | 250                   | 7.3                | 200                           | 8.6                | 10.0                      | 236           | 239                      | 7.3                     | ±45° Oscillation.                                                                                |
| P-159    | "     | "            | "                     | 6.5                | 203                           | 7.4                | 7.4                       | 236           | 240                      | C                       | ±45° Oscillation.                                                                                |
| K-126    | CROSS | "            | "                     | 5.1                | 212                           | 6.9                | 7.6                       | 208           | 219                      | 2.7                     | ±3° Oscillation. Very slow descent.                                                              |
| K-127    | "     | "            | "                     | 5.4                | 210                           | 6.4                | 6.8                       | 225           | 234                      | C                       | ±3° Oscillation. One Panel Damaged on Opening                                                    |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE.

# APPENDIX A

| EXPERIMENTAL PARACHUTE TESTS |       |              |                       |                    |                               |                    |                           |                        |                          |                        |                                                                                                                                           |
|------------------------------|-------|--------------|-----------------------|--------------------|-------------------------------|--------------------|---------------------------|------------------------|--------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| FLARE NO                     | TYPE  | FUZE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH TO EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | IGNITION TO CHUTE OPENING | IGNITION TO CHUTE DUMP | TOTAL BURNING TIME (SEC) | RATE OF DESCENT (AVE)* | REMARKS                                                                                                                                   |
| K-128                        | CROSS | 500          | 250                   | 5.8                | 205                           | 7.3                | 7.5                       | 227                    | 236                      | 7.3                    | +2°-+3° Oscillation.<br>Damaged Chute at Ejection.                                                                                        |
| K-129                        | "     | "            | "                     | 5.8                | 205                           | 6.2                | 7.1                       | 222                    | 235                      | C                      | +3° Oscillation.<br>One Panel Damaged at Opening.                                                                                         |
| K-130                        | "     | 1000         | 400                   | 9.5                | 205                           | 9.9                | 11.3                      | 208                    | 223                      | 6.5                    | +2°-+4° Oscillation.<br>Damaged Panel on Opening. Candle in Smoke Last 12 sec. Before Dump. B.T. less than 3 Minutes.                     |
| K-131                        | "     | "            | "                     | 8.6                | 210                           |                    | 9.4                       |                        |                          |                        |                                                                                                                                           |
| P-160                        | MC-45 | "            | "                     | 8.3                | 210                           | 8.9                | 10.0                      | 229                    | 233                      | 7.4                    | +45° Oscillation.                                                                                                                         |
| P-161                        | "     | "            | "                     | 9.9                | 205                           | 10.9               | 11.1                      | 224                    | 228                      | C                      | +45° Oscillation.                                                                                                                         |
| K-132                        | CROSS | "            | "                     |                    |                               |                    |                           |                        |                          |                        | Dud. Solenoid Failure On Rack.<br>+2°-+4° Oscillation.<br>Two Panels Damaged at Ejection                                                  |
| K-133                        | "     | "            | "                     | 8.8                | 210                           | 9.4                | 10.1                      | 225                    | 237                      | C                      |                                                                                                                                           |
| K-134                        | "     | "            | 350                   | 8.3                | 210                           | 9.5                | 10.4                      | 229                    | 239                      | 3.3                    | +2°-+4° Oscillation.<br>+2°-+3°. 1 Panel Damaged. Candle up into Smoke last 9 sec of B.T. Fast Burning Candle                             |
| K-135                        | "     | "            | "                     | 9.7                | 205                           | 10.2               | 10.9                      | 175                    | 184                      | C                      | Damaged Chute. 150 seconds to impact.                                                                                                     |
| K-136                        | "     | "            | "                     |                    | 205                           | 10.5               |                           |                        | 215                      |                        |                                                                                                                                           |
| K-137                        | "     | "            | "                     |                    |                               |                    |                           |                        |                          | C                      | Dud. Lanyard Broke at Release.<br>+45° Oscillation. Dropped too low ground<br>Impact at 210 seconds.                                      |
| P-162                        | MC-45 | "            | "                     | 9.9                | 205                           | 10.2               | 12.6                      |                        | 243                      | 7.6                    | Dropped too low. Ground impact at 42 sec.<br>May have been Chute damage. Chute Burned.                                                    |
| P-163                        | "     | "            | "                     | 9.9                | 205                           | 10.2               | 11.9                      |                        | 245                      | C                      |                                                                                                                                           |
| K-138                        | CROSS | "            | 300                   | 8.9                | 205                           | 9.5                | 10.0                      | 167                    | 176                      | 5.0                    | +2°-+4° Oscillation. Fast Burning Candle.<br>+2°-+3° Oscillation. Damaged Panel on Opening<br>Candle up into Smoke Last 8 seconds of B.T. |
| K-139                        | "     | "            | "                     | 10.1               | 205                           | 11.2               | 11.0                      | 168                    | 183                      | C                      |                                                                                                                                           |
| K-140                        | "     | "            | "                     | 8.7                | 205                           | 9.4                | 10.1                      | 168                    | 186                      | 6.1                    | +2°-+4° Oscillation - Good Stability<br>+2°-+3° Oscillation. Damaged Panel on Opening<br>Candle up into smoke last 6 sec. before Dump     |
| K-141                        | "     | "            | "                     | 10.4               | 205                           | 11.0               | 11.6                      | 180                    | 181                      | C                      | Candle Tore Off Chute on Opening. 28 Sec<br>to Impact. Burned out on Ground.                                                              |
| K-142                        | "     | "            | "                     | 8.3                | 205                           | 8.5                |                           |                        |                          |                        |                                                                                                                                           |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE

| EXPERIMENTAL PARACHUTE TESTS |               |              |                       |                 |                               |                    |                         |                        |                          | APPENDIX A             |                                                                                                                                   |
|------------------------------|---------------|--------------|-----------------------|-----------------|-------------------------------|--------------------|-------------------------|------------------------|--------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| FLARE NO                     | TYPE          | FUSE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | LAUNCH TO CHUTE OPENING | IGNITION TO CHUTE DUMP | TOTAL BURNING TIME (SEC) | DATE OF DESCENT (AVE)* | REMARKS                                                                                                                           |
| K-143                        | CROSS         | 1000         | 300                   | 10.4            | 205                           | 11.4               | 11.4                    | 171                    | 182                      | C                      | Fast Burning Candle<br>Damaged Panel at Opening                                                                                   |
| P-164                        | MK-45         | "            | "                     | 9.2             | 205                           | 10.0               | 10.2                    | 242                    | 244                      | 7.9                    | +45° Oscillation.                                                                                                                 |
| P-165                        | "             | "            | "                     | 7.6             | 205                           | 8.5                | 8.8                     | 224                    | 231                      | C                      | +45° Oscillation.<br>+2°-24° Oscillation. Fast Burning<br>Candle. Damaged Panel at opening.                                       |
| K-144                        | CROSS         | "            | 250                   | 10.9            | 200                           | 11.5               | 12.2                    | 170                    | 181                      | 4.7                    | +2°-23° Oscillation.                                                                                                              |
| K-145                        | "             | "            | "                     | 8.4             | 200                           | 9.2                | 9.3                     | 167                    | 179                      | C                      | Fast Burning Candle.<br>All Shroud Lines Came off one gore. This<br>Caused Faster Descent Rate.                                   |
| K-146                        | "             | "            | "                     | 10.0            | 200                           | 10.5               | 11.7                    | 167                    | 178                      | 7.6                    | 1 Shroud Line Tore Back from Hem Edge<br>of Gore Approx. 3 ft.                                                                    |
| K-147                        | "             | "            | "                     | 10.5            | 200                           | 11.2               | 11.5                    | 162                    | 174                      | C                      | Bad. Solenoid Failure on Rack.<br>Ejection Charge Exploded on Impact.                                                             |
| K-148                        | "             | "            | "                     | "               | "                             | "                  | "                       | "                      | "                        | "                      | Damaged Panel at Opening.                                                                                                         |
| K-149                        | "             | "            | "                     | 10.3            | 200                           | 11.5               | 11.8                    | 170                    | 180                      | C                      | Fast Burning Candle.                                                                                                              |
| P-166                        | MK-45         | 1000         | 400                   | 10.4            | 200                           | 11.0               | 12.5                    | 199                    | 208                      | 5.9                    | Unstable +30°-+45° Oscillation.<br>Very Unstable - Small Amount of Comp. Lost<br>at Bolt Explosion.                               |
| P-167                        | "             | "            | "                     | 10.0            | 200                           | 11.2               | 11.4                    | 204                    | 218                      | C                      | More Stable. Lost Drogue Chute.                                                                                                   |
| K-188                        | Flat<br>Circ. | "            | "                     | 10.4            | 200                           | 11.5               | 11.5                    | 225                    | 234                      | 6.5                    | Stable. Lost Drogue Chute.<br>Stable. Shroud Lines Entangled. May have<br>been Reason For Early Collapse. Faster<br>Descent Rate. |
| K-189                        | "             | "            | "                     | 9.6             | 205                           | 9.7                | 10.0                    | 212                    | 212                      | C                      | Unstable - Partial Collapse at 206 seconds<br>Shroud Lines Burned.                                                                |
| K-190                        | "             | "            | "                     | 9.2             | 205                           | 10.0               | 10.0                    | 177                    | 200                      | 8.7                    | Unstable - Lost Drogue Chute.<br>More Oscillation than MK 45                                                                      |
| K-191                        | "             | "            | "                     | 9.4             | 205                           | 10.0               | 10.2                    | 218                    | 230                      | C                      | Lost Drogue Chute.                                                                                                                |
| K-192                        | "             | "            | "                     | 10.5            | 200                           | 11.0               | 12.3                    | 213                    | 224                      | 6.7                    | More Oscillation than MK 45                                                                                                       |
| K-193                        | "             | "            | "                     | 10.0            | 200                           | 10.8               | 11.2                    | 213                    | 225                      | C                      | Lost Drogue Chute.                                                                                                                |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE.



APPENDIX A

EXPERIMENTAL PARACHUTE TESTS

| FLARE NO | TYPE       | FUZE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH TO EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | IGNITION TO CHUTE DUMP | TOTAL BURNING TIME (SEC) | RATE OF DESCENT (AVE)* | REMARKS |                                                                                    |
|----------|------------|--------------|-----------------------|--------------------|-------------------------------|--------------------|------------------------|--------------------------|------------------------|---------|------------------------------------------------------------------------------------|
| P-168    | MS-45      | 1000         | 300                   | 9.8                | 205                           | 10.2               | 11.2                   | 183                      | 210                    | 7.1     | Unstable - Explosive Bolt Failed. Shroud Lines Burned Causing Early Collapse.      |
| P-169    | "          | "            | "                     | 9.2                | 205                           | 10.0               | 10.0                   | 220                      | 235                    | C       | Stable First Half of Burning Time                                                  |
| K-194    | Flat Circ. | "            | "                     | 10.0               | 200                           | 10.2               | 11.5                   | 225                      | 225                    | 6.9     | Then Very Unstable.                                                                |
| K-195    | "          | "            | "                     | 9.8                | 205                           | 10.4               | 10.4                   | 209                      | 217                    | C       | Very Unstable Last Half of Burning Time.                                           |
| K-196    | "          | "            | "                     | 11.2               | 210                           | 11.5               | 12.6                   | 213                      | 223                    | 7.2     | Stable All The Way.                                                                |
| K-197    | "          | "            | "                     | 10.0               | 200                           | 11.0               | 10.4                   | 185                      | 209                    | C       | Early Explosive Bolt. Finished Burning On Ground.                                  |
| K-198    | "          | "            | "                     | 9.2                | 205                           | 9.8                | 10.5                   | 208                      | 215                    | 8.2     | Unstable - Shroud Lines Fouled Up.                                                 |
| K-199    | "          | "            | "                     | 10.4               | 200                           | 10.6               | 11.4                   | 208                      | 216                    | C       | More Stable - Partial Collapse at 185 Sec. Stable first Half of Burning Time. Then |
| P-170    | MS-45      | 500          | 200                   | 6.2                | 195                           | 6.7                | 7.6                    | 226                      | 236                    |         | Very Unstable. No Radar Coverage.                                                  |
| P-171    | "          | "            | "                     | 6.0                | 195                           | 7.0                | 7.2                    | 217                      | 231                    | C       | Stable First Half of Burning Time                                                  |
| K-202    | FLAT CIRC. | 500          | "                     | 7.5                | 195                           | 8.0                | 8.3                    | 208                      | 213                    | 8.4     | Then Very Unstable.                                                                |
| K-203    | "          | "            | "                     | 7.2                | 195                           | 8.0                | 8.2                    | 202                      | 214                    | C       | Stable First Half of Burning Time                                                  |
| K-204    | "          | "            | "                     | 7.1                | 195                           | 7.3                | 8.5                    | 206                      | 224                    | 6.9     | Then Unstable.                                                                     |
| K-205    | "          | "            | "                     | 7.0                | 195                           | 7.6                | 8.2                    | 203                      | 215                    | C       | Stable, Shroud Lines Seemed Fouled Up.                                             |
| P-172    | MS-45      | "            | "                     | 7.6                | 195                           | 8.0                | 8.4                    | 200                      | 215                    | 8.6     | Stable First Half of Burning Time                                                  |
| P-173    | "          | "            | "                     | 6.4                | 195                           | 7.5                | 7.2                    | 211                      | 223                    | C       | Then Unstable.                                                                     |
| K-206    | Flat Circ. | "            | "                     | 6.2                | 195                           | 7.7                | 7.5                    | 210                      | 224                    | 7.8     | Unstable.                                                                          |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE

# APPENDIX A

## EXPERIMENTAL PARACHUTE TESTS

| FLARE NO    | TYPE | PUZE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO IGNITION | LAUNCH TO CHUTE OPENING | IGNITION TO CHUTE DUMP | TOTAL BURNING TIME (SEC) | RATE OF DESCENT (AVE) * | REMARKS                                                                                         |
|-------------|------|--------------|-----------------------|-----------------|-------------------------------|--------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------------------------------------------------------------------------------------|
| K-207       | Flat | 500          | 200                   | 7.0             | 195                           |                    |                         |                        |                          |                         | End Cap Ejected but the Chute & Canister Did Not Eject from the Outer Tube.                     |
| K-208       | "    | "            | "                     | 3.4             | -215                          | 3.6                | 4.2                     | 217                    | 225                      | 8.2                     | Unstable. Post Ejection Delay.                                                                  |
| K-209       | "    | "            | "                     | "               | 195                           | 6.9                | 7.2                     | 207                    | 207                      | C                       | Unstable. No Record of Ejection Delay. Stable First Half of Burning Time                        |
| K-210       | "    | "            | "                     | 6.4             | 195                           | 8.0                | 7.3                     | 199                    | 216                      | 8.8                     | Then Unstable.                                                                                  |
| K-211       | "    | "            | "                     | 6.0             | 195                           | 7.3                | 6.8                     | 210                    | 221                      | C                       | Stable First Half Only. Chute Never Fully Collapsed After Explosive Bolt Fired.                 |
| P-174 MK-45 | "    | "            | "                     | 6.9             | 195                           | 7.7                | 8.2                     | 222                    | 226                      | 10.5                    | Stable. Dropped too low therefore the Canister Hit the Ground Burning.                          |
| P-175       | "    | "            | "                     | 6.0             | 195                           | 7.9                | 7.2                     | 222                    | 234                      | C                       | Unstable.                                                                                       |
| K-212       | Flat | "            | 350                   | 7.4             | 210                           | 7.4                | 8.5                     | 210                    | 219                      | 8.8                     | Unstable.                                                                                       |
| K-213       | "    | "            | "                     | 6.4             | 215                           | 7.4                | 7.0                     | 147                    | 193                      | C                       | Stable. 4 Ft. Tear in Chute along Bottom Hem Seam. Early Exp. Bolt. Finished Burning on Ground. |
| K-214       | "    | "            | 400                   | 7.9             | 210                           | 8.0                | 9.2                     | 201                    | 210                      | 7.7                     | Unstable.                                                                                       |
| K-215       | "    | "            | "                     | 7.0             | 215                           | 7.5                | 7.8                     | 210                    | 210                      | C                       | Unstable.                                                                                       |
| K-216       | "    | "            | 450                   | "               | "                             | "                  | "                       | "                      | "                        | "                       | Lanyard Broke Approx. 1 Foot from Base. Duct. Never Pulled Pin out of Striker.                  |
| K-217       | "    | "            | "                     | 6.2             | 230                           | 7.0                | 8.0                     | 202                    | 202                      | C                       | Stable First Half of Burning Time Then Unstable.                                                |
| P-176 MEALS | "    | "            | 200                   | 7.2             | 195                           | 7.9                | 8.5                     | 219                    | 220                      | 7.0                     | Unstable.                                                                                       |
| P-177       | "    | "            | "                     | 7.0             | 195                           | 7.2                | 7.4                     | 192                    | 214                      | C                       | Unstable. Lost Large Amount of Comp. When Exp. Bolt Fired.                                      |
| K-220 CROSS | "    | 500          | "                     | 6.5             | 195                           | 7.3                | 8.0                     | 204                    | 204                      | 5.7                     | Stable. Looked Like Burned Shroud Lines. Early Collapse.                                        |
| K-221       | "    | "            | "                     | 6.6             | 195                           | 7.3                | 7.4                     | 201                    | 216                      | C                       | Stable. Upward last 20 seconds before Exp. Bolt Fired.                                          |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE

| EXPERIMENTAL PARACHUTE TESTS |       |              |                       |                    |                               |                         |                        |                          |                        |         | APPENDIX A                                                                           |
|------------------------------|-------|--------------|-----------------------|--------------------|-------------------------------|-------------------------|------------------------|--------------------------|------------------------|---------|--------------------------------------------------------------------------------------|
| FLARE NO                     | TYPE  | FUSE SETTING | AIRCRAFT SPEED (KIAS) | LAUNCH TO EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO CHUTE OPENING | IGNITION TO CHUTE DUMP | TOTAL BURNING TIME (SEC) | RATE OF DESCENT (AVE)* | REMARKS |                                                                                      |
| K-222                        | CROSS | 500          | 200                   | 7.2                | 195                           | 7.6                     | 8.5                    | 216                      | 223                    | 2.9     | Very Stable. Upward into Smoke before Exp. Bolt Fired.                               |
| K-223                        | "     | "            | "                     | 6.8                | 195                           | 7.1                     | 7.2                    | 215                      | 222                    | C       | Stable.                                                                              |
| P-178                        | MK-45 | "            | "                     | 6.9                | 195                           | 7.0                     | 8.0                    | 197                      | 211                    | 6.8     | Unstable. Lost Comp. as Explosive Bolt Fired                                         |
| P-179                        | "     | "            | "                     | 7.2                | 195                           | 7.5                     | 7.8                    | 220                      | 230                    | C       | Unstable.                                                                            |
| A-224                        | CROSS | "            | "                     | 7.0                | 195                           | 7.5                     | 8.1                    | 221                      | 227                    | 3.6     | Stable. Upward into Smoke Last 20 Sec. Before Collapse.                              |
| K-225                        | "     | "            | "                     | 6.0                | 195                           | 6.9                     | 6.8                    | 216                      | 218                    | C       | Stable. Upward into smoke last 20 Sec. before collapse.                              |
| K-226                        | "     | "            | 400                   | NO RECORD          | 230                           | 6.8                     | NO RECORD              | 177                      | 208                    | 5.1     | Stable. Early Collapse, Streamer, then Burned Shroud Lines.                          |
| K-227                        | "     | "            | "                     | NO                 | NO                            | NO                      | NO                     |                          |                        | C       | Lanyard Pulled out of Nico-Press Dud. Sleeve did not Pull Pin.                       |
| K-228                        | "     | "            | 390                   | RECORD             | 215                           | 7.8                     | RECORD                 | 204                      | 225                    | 3.7     | Stable. Chute Dumped Before Exp. Bolt Fired May Have Burned Shroud Lines.            |
| K-229                        | "     | "            | "                     | 5.6                | 230                           | 6.8                     | 6.2                    | 146                      | 206                    | C       | Stable. Early Collapse. May have Burned Shroud Lines. Lost Comp. During Burning Time |
| P-180                        | MK-45 | "            | 200                   | 7.2                | 195                           | 7.7                     | 8.4                    | 203                      | 220                    | 7.7     | Unstable. 30° to 45° Oscillation.                                                    |
| P-181                        | "     | "            | "                     | 6.0                | 195                           | 6.7                     | 6.8                    | 222                      | 231                    | C       | Unstable. 30° to 45° Oscillation.                                                    |
| K-230                        | CROSS | "            | "                     | 6.0                | 195                           | 6.3                     | 7.6                    | 211                      | 225                    | 3.5     | Very Stable. Slow Descent Rate. Up into Smoke at 180 seconds.                        |
| K-231                        | "     | "            | "                     | 6.0                | 195                           | 6.2                     | 6.6                    | 215                      | 223                    | C       | Very Stable. Slow Descent Rate. Upward into Smoke last 30 seconds.                   |
| K-232                        | "     | "            | "                     | 6.5                | 195                           | 7.4                     | 7.4                    | 193                      | 215                    | 3.9     | Stable. Slow Descent Rate.                                                           |
| K-233                        | "     | "            | "                     | 6.9                | 195                           | 7.0                     | 7.8                    | 178                      | 216                    | C       | Stable. Streamer at 178 seconds. Before Exp. Bolt Fired.                             |
| K-234                        | "     | "            | "                     | 7.5                | 195                           | 8.2                     | 8.8                    | 198                      | 213                    | 2.5     | Stable. Slow Descent Rate. Upward last 20 seconds before Exp. Bolt Fired.            |
| K-235                        | "     | "            | "                     | 7.0                | 195                           | 8.0                     | 7.6                    | 175                      | 222                    | C       | Stable. Streamer at 175 seconds. Hit Ground Burning.                                 |
| P-182                        | MK-45 | 1000         | 300                   | 9.0                | 205                           | 10.0                    | 10.4                   | 191                      | 222                    | 7.4     | Unstable. Streamer-Dropped Comp. & Hit Ground Burning.                               |

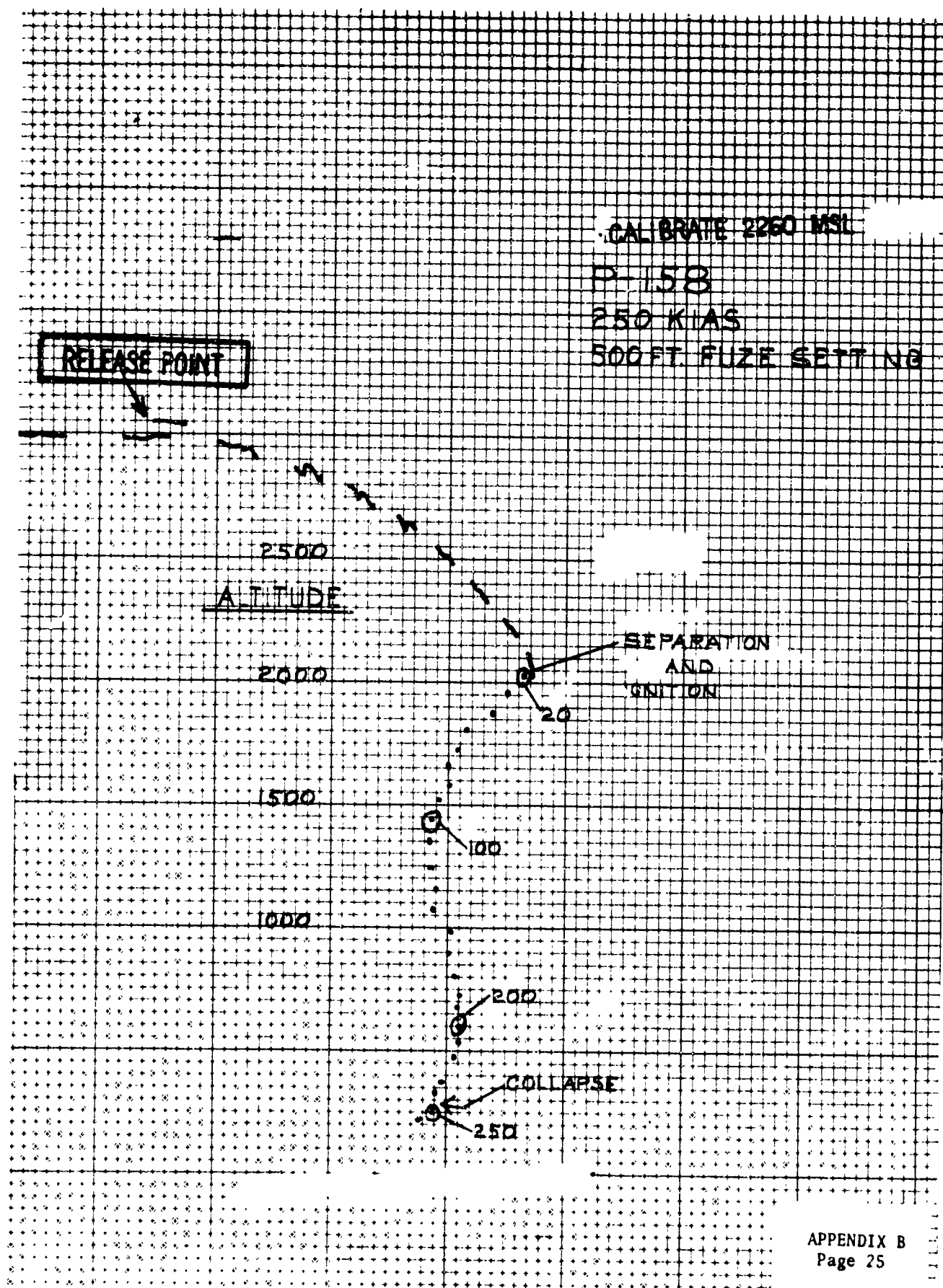
\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLARE

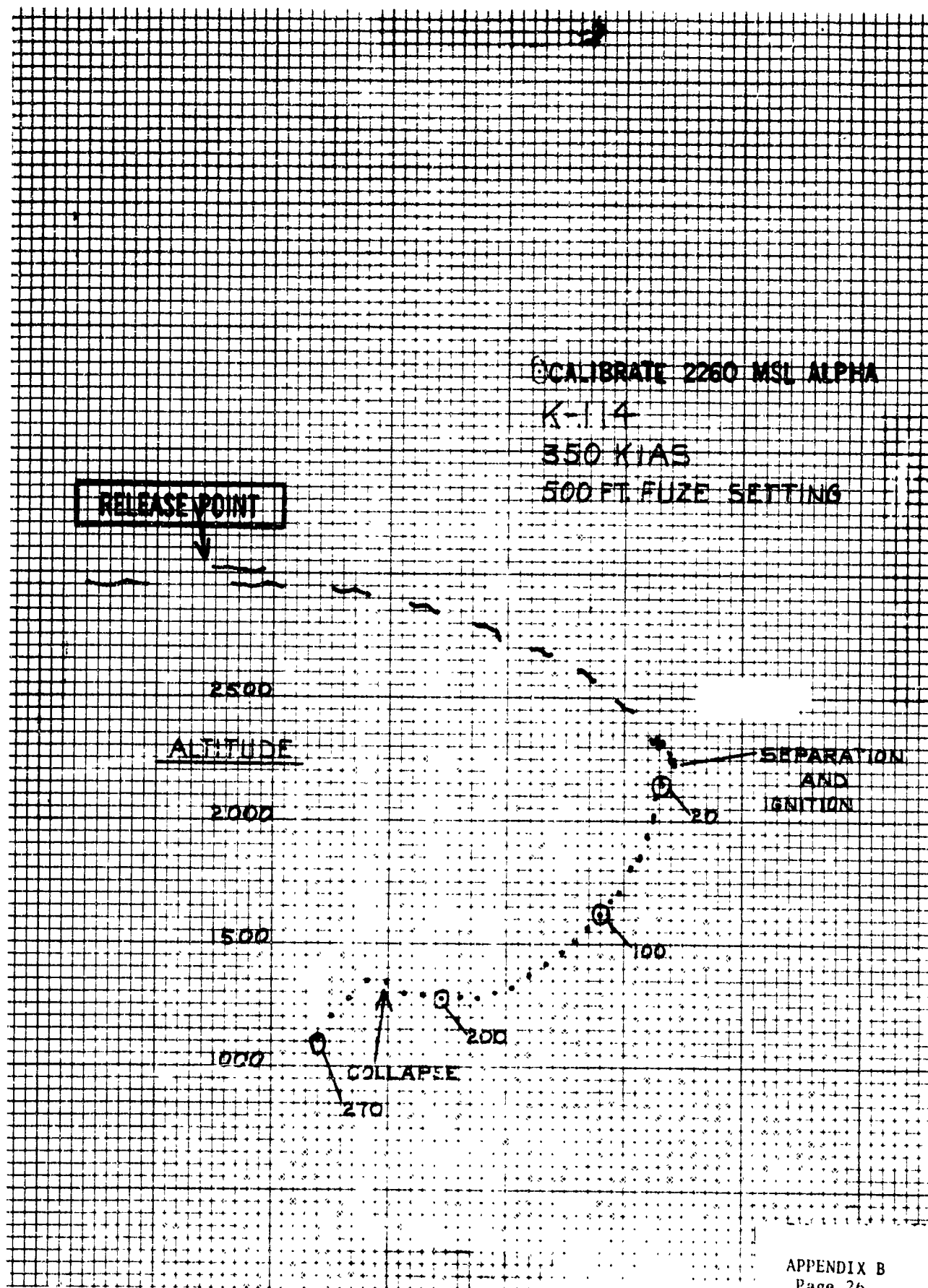
APPENDIX A.

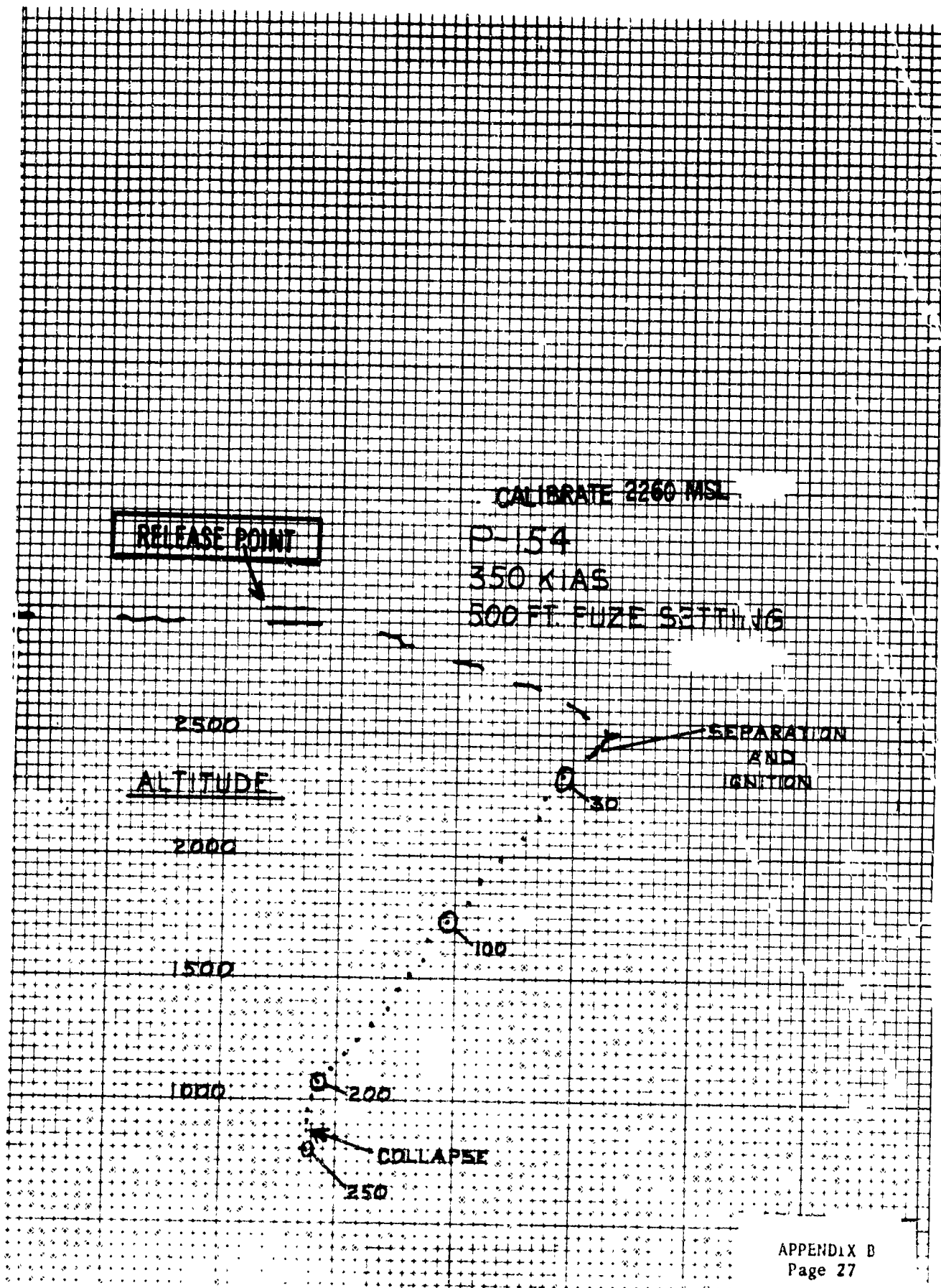
REPERCUSSIVE PARACHUTE TESTS

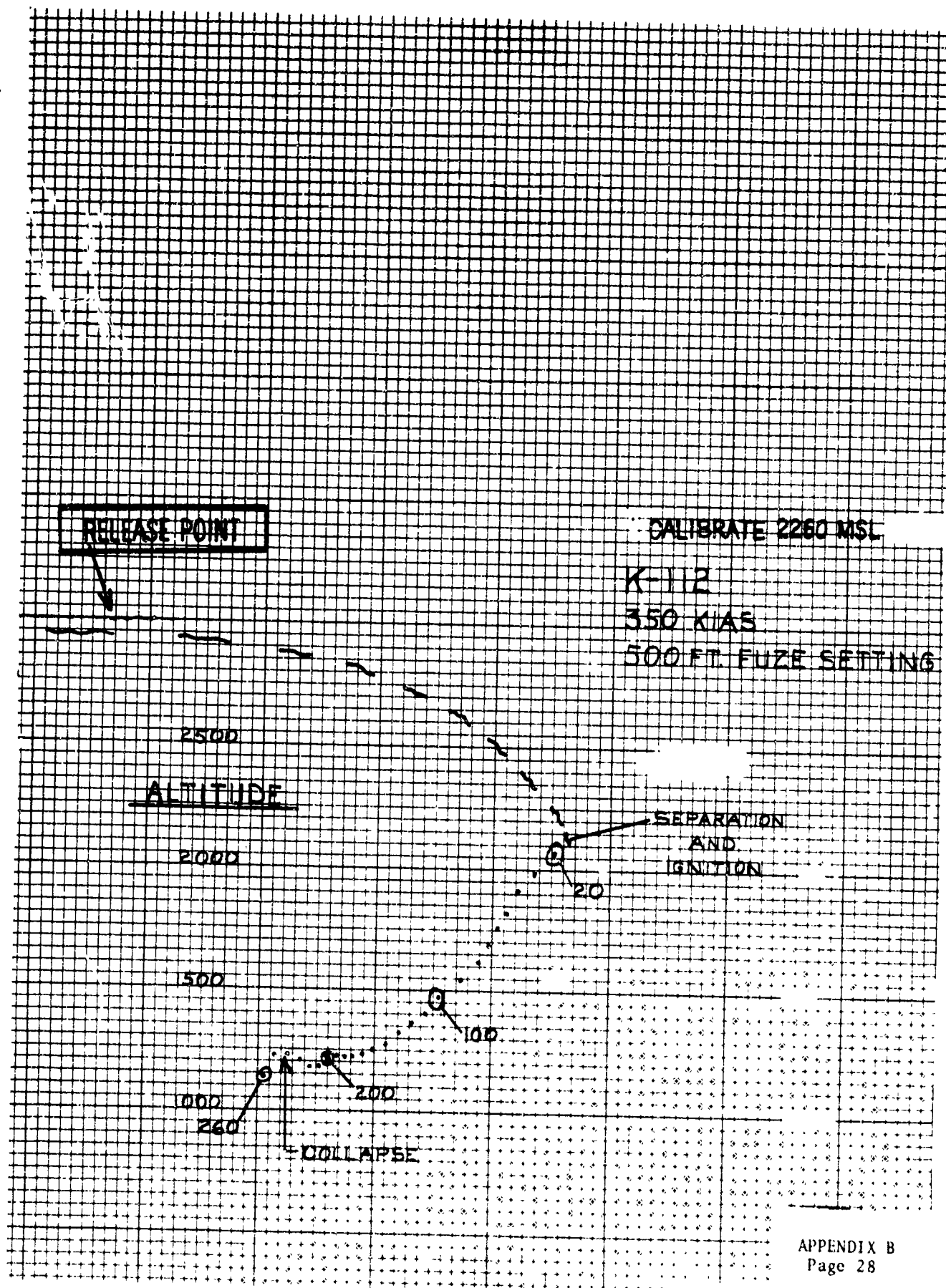
| FLAME TYPE | NO    | CHUTE | SETTING | ALTITUDE SPEED (KIAS) | LAUNCH TO CANDLE EJECTION | PARACHUTE DEPLOYMENT VELOCITY | LAUNCH TO CHUTE IGNITION | LAUNCH TO CHUTE OPENING | IGNITION DUMP | TOTAL BURNING TIME (SEC) | DATE OF DESCENT (AVE)* | REMARKS                                                                            |
|------------|-------|-------|---------|-----------------------|---------------------------|-------------------------------|--------------------------|-------------------------|---------------|--------------------------|------------------------|------------------------------------------------------------------------------------|
| P-143      | MC-45 | 1000  | 300     | 9.6                   | 205                       | 10.0                          | 10.4                     | 209                     | 223           | C                        |                        | Unstable. Stable. Streamer at 185 seconds. Finished burning on ground.             |
| K-236      | CROSS | "     | "       | RECORD                | 205                       | 10.4                          | RECORD                   | 185                     | 220           | 3.6                      |                        | Stable. Lost 10 seconds of Comp. at end of burning time.                           |
| K-237      | "     | "     | "       | 9.0                   | 205                       | 9.8                           | 10.0                     | 206                     | 220           | C                        |                        | Stable.                                                                            |
| K-238      | "     | "     | "       | 9.0                   | 205                       | 9.5                           | 10.6                     | 218                     | 225           | 4.5                      |                        | Stable. Streamer at 162 Sec. Exp. Bolt at 183 Sec. Burned out on ground.           |
| K-239      | "     | "     | "       | 9.6                   | 205                       | 9.8                           | 10.4                     | 162                     | 207           | C                        |                        | Stable. Did not Rise into Smoke at End of Burning Time. Good even rate of descent. |
| K-240      | "     | "     | "       | 10.1                  | 205                       | 10.3                          | 11.1                     | 202                     | 216           | 3.9                      |                        | Stable. Streamer at 181 Seconds. Exp. Bolt Fired on Ground.                        |
| K-241      | "     | "     | "       | 9.2                   | 205                       | 10.3                          | 10.0                     | 181                     | 212           | C                        |                        | DUD. Failed to Set Fuse.                                                           |
| P-184      | MC-45 | "     | 430     |                       |                           |                               |                          |                         |               |                          |                        | Unstable.                                                                          |
| P-185      | "     | "     | "       | 9.6                   | 205                       | 10.6                          | 10.4                     | 215                     | 215           | C                        |                        | Unstable. Lost Some comp. during burning time.                                     |
| P-186      | "     | "     | "       | 10.2                  | 205                       | 10.4                          | 11.4                     | 208                     | 222           | 4.5                      |                        | Unstable.                                                                          |
| P-187      | "     | "     | "       | 9.2                   | 205                       | 9.9                           | 10.0                     | 221                     | 229           | C                        |                        | Stable. Upward Last 20 seconds. Flame Hidden by own smoke.                         |
| K-244      | CROSS | 500   | 425     | 8.8                   | 210                       | 9.8                           | 10.1                     | 205                     | 205           | 4.9                      |                        | Stable. Lost Some comp. during last of burning time.                               |
| K-245      | "     | "     | "       | RECORD                | 205                       | 10.4                          | RECORD                   | 193                     | 207           | C                        |                        | Stable. Upward into own smoke last 10 seconds of burning time.                     |
| K-242      | "     | "     | "       | 7.0                   | 215                       | 7.2                           | 8.0                      | 209                     | 218           | 5.1                      |                        | Stable. Streamer at 207 Seconds. Exp. Bolt Fired on Ground.                        |
| K-243      | "     | "     | "       | 5.3                   | 230                       | 7.0                           | 6.6                      | 207                     | 216           | C                        |                        | Stable.                                                                            |
| K-246      | "     | "     | 450     | 5.0                   | 230                       | 7.5                           | 8.3                      | 208                     | 219           | 4.7                      |                        | Stable.                                                                            |
| K-247      | "     | "     | "       | 7.2                   | 215                       | 8.0                           | 8.0                      | 197                     | 211           | C                        |                        | Stable.                                                                            |

\* C IS CAMERA COVERAGE AND NO RADAR RECORD MADE OF FLAME

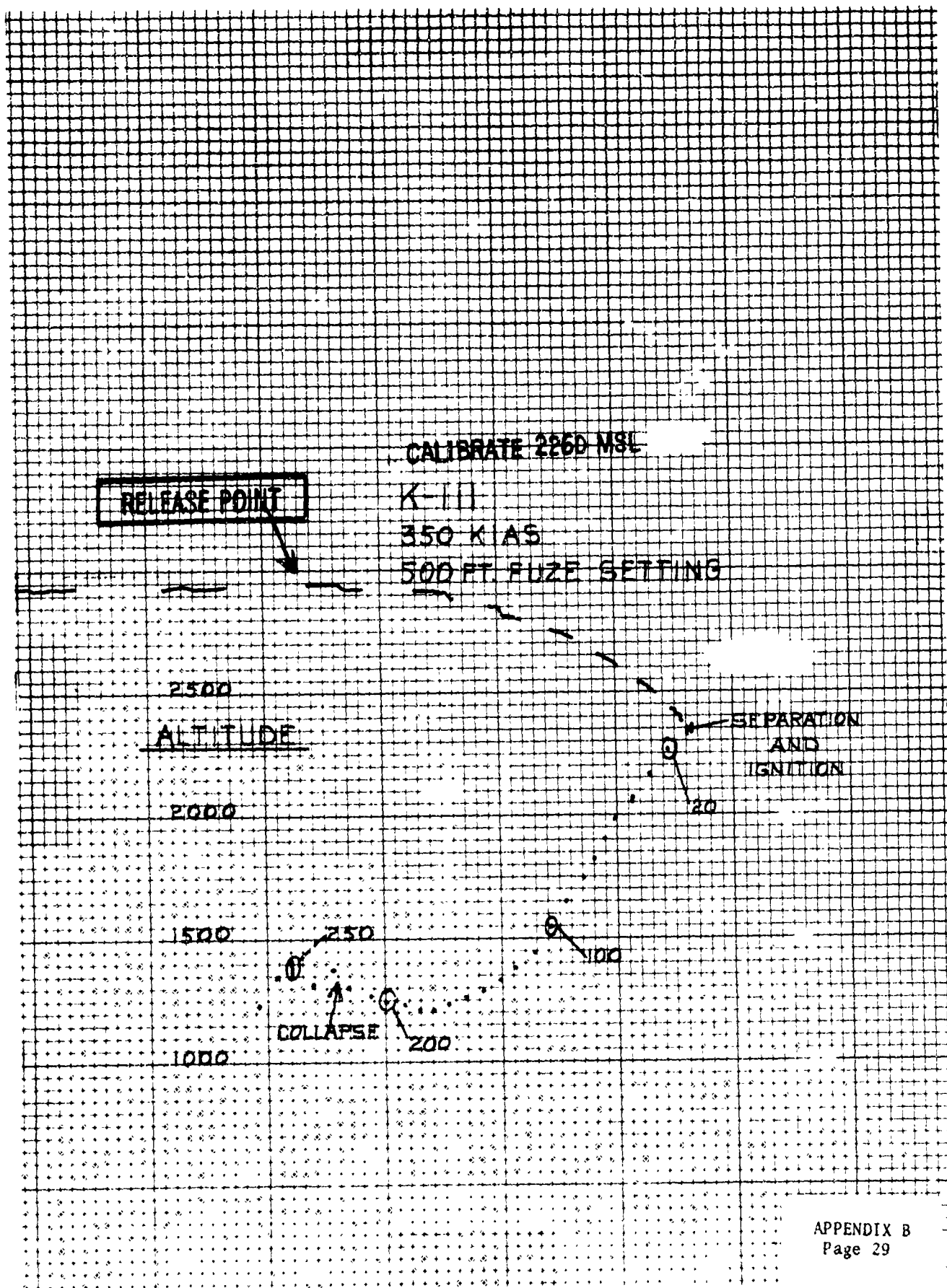












CALIBRATE 2250 MSI  
P-160  
400 KIAS  
1000 FT PUZE SETTING

RELEASE POINT

2500

ALTITUDE

2000

1500

1000

200

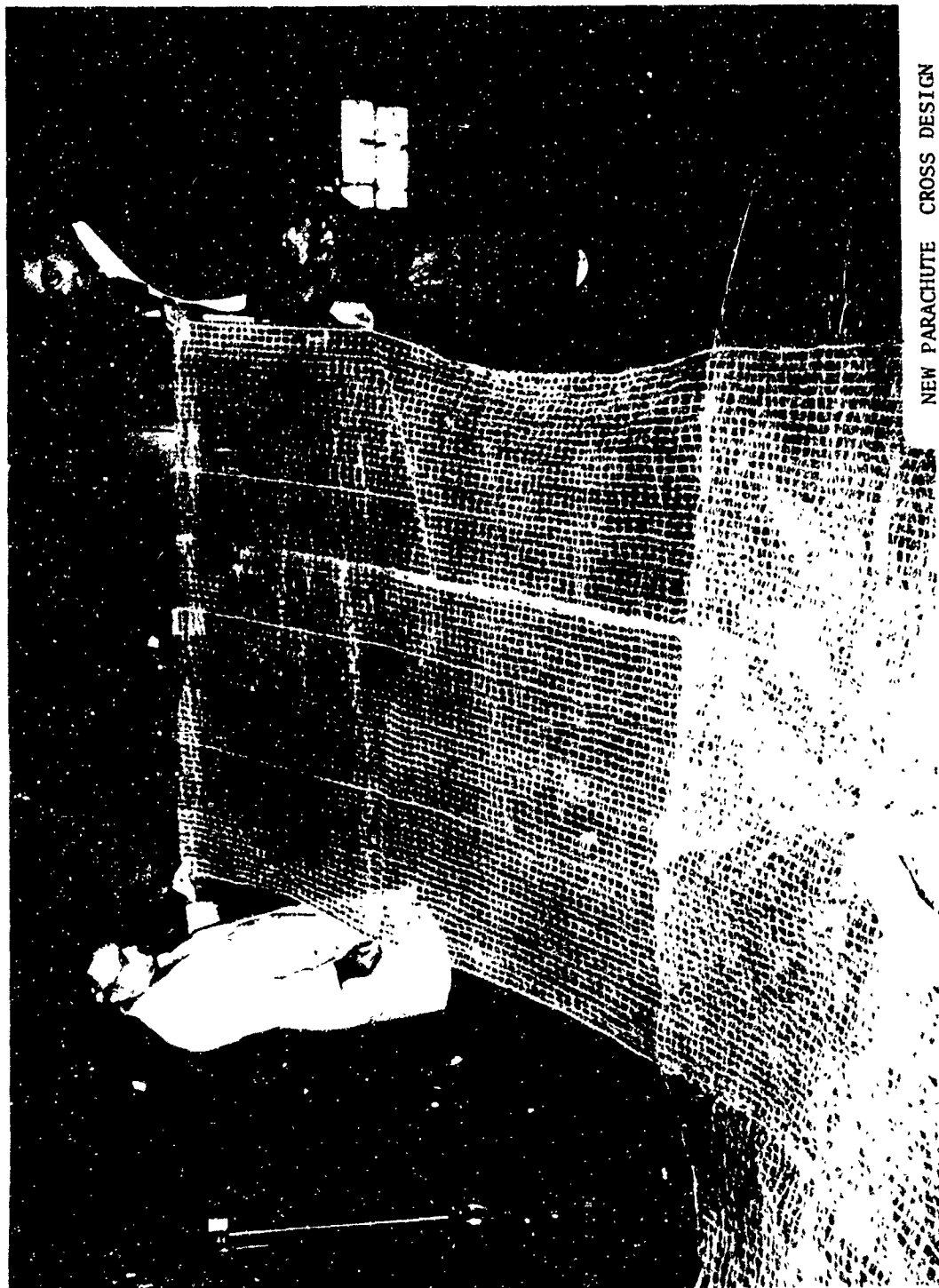
250

COLLAPSE

SEPARATION  
AND  
IGNITION

20

100



NEW PARACHUTE CROSS DESIGN  
MYLAR/DACRON FLARE CLOTH  
SHOWS ONE GORE OF NEW CHUTE



FLARE #K-110  
350 KIAS - 500 FT FUZE SETTING  
CROSS DESIGN WITH MYLAR/DACRON FLARE  
CLOTH  
DEPLOYED AT 220 FT/SEC



FLARE NO. K-110 - 350 KIAS  
500 FT. FUZE SETTING  
CROSS DESIGN WITH MYLAR/DACRON FLARE  
CLOTH  
DEPLOYED AT 220 FT/SEC



FLARE NO. K-118 - 300 KIAS  
500 FT. FUZE SETTING  
CROSS DESIGN MYLAR/DACRON FLARE CLOTH  
SHOWS DAMAGE WHERE DEPLOYMENT BAG  
IS ATTACHED - DEPLOYED AT 220 FT/SEC



FLARE NO. K-133 - 400 KIAS - 1000 FT.  
FUZE SETTING - CROSS DESIGN MYLAR/  
DACRON FLARE CLOTH - SHOWS TAPE PULLED  
LOOSE & OTHER TAPE DAMAGE TO ONE GORE.  
DEPLOYED AT 210 FT/SEC

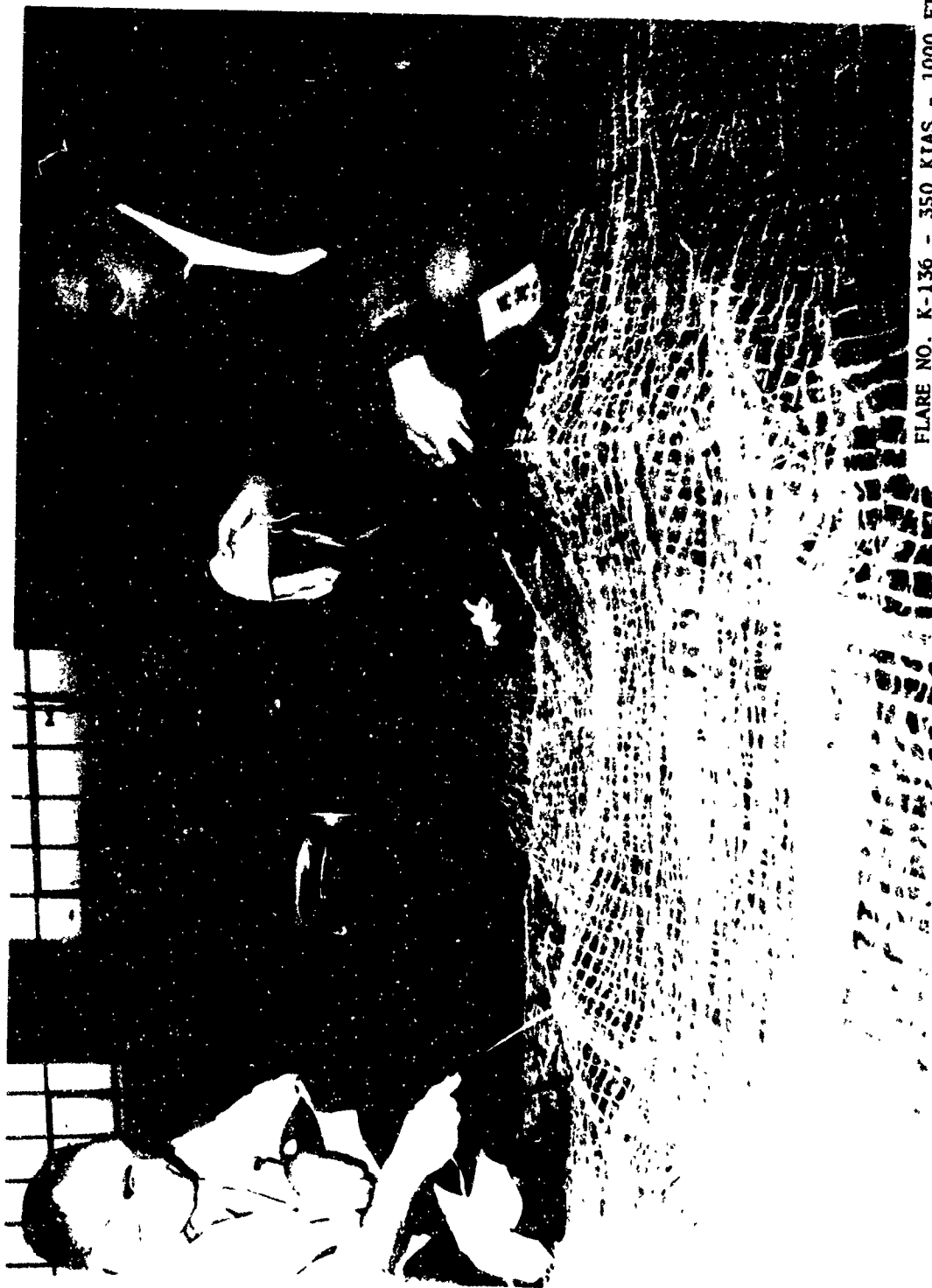


FLARE NO. K-135 - 350 KIAS - 1000 FT  
FUZE SETTING - CROSS DESIGN MYLAR/  
DACRON FLARE CLOTH - SHOWS DAMAGE WHERE  
DEPLOYMENT BAG IS ATTACHED -  
DEPLOYED AT 205 FT/SEC.





FLARE NO. K-135 - 350 KIAS - 1000 FT.  
FUZE SETTING - CROSS DESIGN MYLAR/  
DACRON MATERIAL - SHOWS WHERE TAPE  
TORE LOOSE ON ONE GORE -  
DEPLOYED AT 205 FT/SEC



FLARE NO. K-136 - 350 KIAS - 1000 FT  
FUZE SETTING - CROSS DESIGN MYLAR/  
DACRON FLARE CLOTH - SHOWS DAMAGE TO  
DEPLOYMENT BAG AREA.  
DEPLOYED AT 205 FT/SEC

NOT REPRODUCIBLE



FLARE NO. K-213 - 350 KIAS - 500 FT.  
FUZE SETTING - FLAT CIRCULAR DESIGN  
CEREX FLARE CLOTH - SHOWS DAMAGE TO  
ONE CORE -  
DEPLOYED AT 215 FT/SEC



FLARE NO. K-245 - 425 KIAS - 500 FT  
FUZE SETTING - CROSS DESIGN CEREX FLARE  
CLOTH - SHOWS CLOSE UP OF SLIGHT DAMAGE  
TO ONE GORE. DEPLOYED AT 205 FT/SEC



FLARE NO. K-247 - 450 KIAS - 504 FT  
FUZE SETTING - CROSS DESIGN CORDON FLARE  
CLOTH - SHOWS DAMAGE TO ONE GUN -  
DEPLOYED AT 215 FT/SEC

UNCLASSIFIED

Security Classification

## DOCUMENT CONTROL DATA - R &amp; D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                                                                             |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------|----------------------|
| 1. ORIGINATING ACTIVITY (Corporate author)<br>Research and Development Department<br>Naval Ammunition Depot<br>Crane, Indiana 47522                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | 2a. REPORT SECURITY CLASSIFICATION<br>UNCLASSIFIED                          |                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | 2b. GROUP                                                                   |                      |
| 3. REPORT TITLE<br>MK 45 Aircraft Parachute Flare Optimization Program Evaluation of Experimental Parachutes & Parachute Materials Flight Test Series No. 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                                             |                      |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                             |                      |
| 5. AUTHOR(S) (First name, middle initial, last name)<br>KOCH, CLENNETH R.; RICHARDSON, R. L.; LEONARD, J. W.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                             |                      |
| 6. REPORT DATE<br>16 October 1970                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | 7a. TOTAL NO. OF PAGES<br>41                                                | 7b. NO. OF REFS<br>2 |
| 8a. CONTRACT OR GRANT NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | 9a. ORIGINATOR'S REPORT NUMBER(S)<br>RDTR No. 164                           |                      |
| b. PROJECT NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |                      |
| c.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                                             |                      |
| d.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                                             |                      |
| 10. DISTRIBUTION STATEMENT<br>Distribution of this document is unlimited                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                                                             |                      |
| 11. SUPPLEMENTARY NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 12. SPONSORING MILITARY ACTIVITY                                            |                      |
| 13. ABSTRACT<br><p>This report presents the results of MK 45 Aircraft Parachute Flare Development Flight Tests (experimental parachutes and parachute materials) conducted at Naval Weapons Center, China Lake, California, 12 November 1969 through 11 December 1969. The basis for choice of chutes and materials for these tests was derived<sup>1</sup> from RDTR #163. Data obtained from these flight tests indicate the cross type parachute using Cerex Cloth (.85 oz/sqyd) to exhibit the most advantageous characteristics for incorporation into the MK 45 APF system. The data also indicates that a strength problem exists when the same canopy material (Cerex) is used on the present MK 45 circular chute. A third system utilizing a Cross parachute with a Molle laminate cloth was evaluated. This chute also had cloth failures during parachute snatch loading forces.</p> |  |                                                                             |                      |

DD FORM 1473

(PAGE 1)

UNCLASSIFIED

0102 014 6600

UNCLASSIFIED

Security Classification

| 14<br>KEY WORDS                                                                                                 | LINK A |    | LINK B |    | LINK C |    |
|-----------------------------------------------------------------------------------------------------------------|--------|----|--------|----|--------|----|
|                                                                                                                 | ROLE   | WT | ROLE   | WT | ROLE   | WT |
| 1. Mylar/Dacron Material<br>2. Parachute Flares<br>3. Cerex Material<br>4. MK 45 APF<br>5. Cross Type Parachute |        |    |        |    |        |    |

DD FORM 1473 (10/73)

UNCLASSIFIED