

30

HE FRICTION SENSITIVITY
OBLIQUE IMPACT SENSITIVITY OF EXPLOSIVES
(THE SKID TEST)

J. H. Van Velkinburgh

DEVELOPMENT DIVISION

JULY - SEPTEMBER 1971
SANL 900-001

For
Lawrence Livermore Laboratory
Livermore, California

df
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER



Mason & Kanger - Silas Mason Co. Inc.
Pantex Plant

P. O. BOX 647
AMARILLO, TEXAS 79105
806-335-1581

operated for the
ATOMIC ENERGY COMMISSION
under

U.S. GOVERNMENT Contract DA-11-173-AMC-487 (A)

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately-owned rights.

DISCLAIMER

**Portions of this document may be illegible
in electronic image products. Images are
produced from the best available original
document.**

HE FRICTION SENSITIVITY
OBLIQUE IMPACT SENSITIVITY OF EXPLOSIVES
(THE SKID TEST)

J. H. Van Velkinburgh

DEVELOPMENT DIVISION

This is the study of the frictional sensitivity of explosives and the mechanism of frictional initiation. It is also the use and study of a sensitivity test for large bare explosive charges in oblique impact.

July - September 1971

SANL 900-001

Section A

HE FRICTION SENSITIVITY OBLIQUE IMPACT SENSITIVITY OF EXPLOSIVES (THE SKID TEST)

ABSTRACT

Additional oblique impact tests were performed on RX-25-AA in an attempt to determine its initiation threshold.

Several more oblique impact tests were conducted on the LX-10-0 variants. Experimental results from some of the tests conducted last period on the LX-10-0 variant are presented (accelerometer records had not been analyzed at the close of the last reporting period).

An instrumented vertical drop and oblique impact test series was begun on LX-10-0 Lot 710-2.

No experimental work was performed using the HE friction sensitivity apparatus.

DISCUSSION

Two additional oblique impact tests were conducted on RX-25-AA in an attempt to determine an initiation threshold. One test was conducted at 14° , 0.44 feet onto the standard sanded skid surface. A reaction level III was experienced. Testing at lower heights at the 14° impact angle was not attempted. A test was done at 45° , 5' to evaluate an Adiprene-based floor-covering. No reaction was observed; however, handling risks should not be assumed to be known over a floor covering because only one test was done. Figs. 1 through 4 give acceleration histories for these tests. Table I gives pertinent test information.

Several additional oblique impact tests using the three compositional variations of LX-10-0 were carried out. Accelerometer records from some of the tests performed last period had not been analyzed at the end of the reporting period and are included now. Table II gives pertinent test parameters. Figs. 5 through 42 give acceleration histories for these tests.

An instrumented vertical drop and oblique impact test series was started on LX-10-0 Lot 710-2. These tests were of special interest with respect to dynamic physical properties as the binder was 3-M's Fluorel rather than Du Pont's Viton. Vertical drop tests showed this lot to be significantly less stiff than standard LX-10-0. For the same impact velocity, this lot deformed to a greater extent than did the more usual composition. [A plot of maximum contact spot diameter versus

pre-impact velocity for both this lot and a standard LX-10-0 composition is given in Fig. 43.] Table III lists the test parameters for the vertical drop tests and Figs. 44 through 48 give acceleration histories for these tests. Three oblique impact tests were performed at 45°, 3.5'. No reactions were observed. Table IV lists the test parameters and Figs. 49 through 54 give acceleration histories.

COMMENTS; CONCLUSIONS

Handling risks are significant with RX-25-AA. All operations (including handling) should be reviewed and suitable precautions adopted.

Dynamic mechanical response is changed in LX-10-0 by replacement of the Viton binder with the Fluorel binder.

An instrumented vertical drop and oblique impact test series is planned for RX-04-EC (nominal composition 96/4 HMX/VITON).

Table I. Oblique Impact Test Results (RX-25-AA)

Billet Wt (lbs)	Height (ft)	Impact Angle (°)	Figure No.	Final Rotational Velocity (Rads/sec) (Fastax)	Coefficient of Restitution (Fastax)	Comments
24.61	0.44	14	1,2	—	—	Reaction Level 3
24.58	5.0	45	3,4	15.1	0.43	No Reaction

Table II. Oblique Impact Test Results (LX-10-0 Variants)

45° Impact Angle

Material	Drop Height (in)	Billet Wt (lbs)	Figure No.	Final Rotational Velocity (Rads/sec) (Fastax)	Coefficient of Restitution (Fastax)	
RX-04-EA*	42	23.55	5,6	26.60	0.33	
RX-04-EA*	42	23.54	7,8	25.89	0.35	
RX-04-EA	42	23.31	9,10	26.05	0.30	
RX-04-EB*	42	23.54	11,12	26.11	0.30	
RX-04-EB*	42	23.53	13,14	20.52	0.30	
RX-04-EB	42	23.50	15,16	29.27	0.30	
RX-04-DW*	42	23.47	17,18	—	—	Reaction Level 6
RX-04-DW	42	23.31	19,20	24.59	0.32	
RX-04-DW	42	23.49	21,22	25.05	0.30	
RX-04-DW*	120	66.66	23,24	—	—	Piece Broke Test on Floor Cover Steel Plate on Equator

14° Impact Angle

RX-04-EA*	10.5	23.51	25,26	Indeterminant	—
RX-04-EA*	10.5	23.50	27,28	< 6.0	—
RX-04-EA	10.5	23.33	29,30	< 6.0	—
RX-04-EB*	10.5	23.53	31,32	< 6.0	—
RX-04-EB*	10.5	23.54	33,34	< 6.0	—
RX-04-EB	10.5	23.51	35,36	< 6.0	—
RX-04-DW*	10.5	23.55	37,38	< 7.0	—
RX-04-DW*	10.5	23.53	39,40	Indeterminant	—
RX-04-DW	10.5	23.33	41,42	< 6.0	—

*Tests done last period.

Table III. Vertical Drop Test Results (LX-10-0 Lot 710-2)

<u>Billet Wt (lbs)</u>	<u>Drop Height (in)</u>	<u>Contact Spot Diameter (in)</u>	<u>Figure No.</u>	<u>Coefficient of Restitution Accelerometer</u>	<u>Fastax</u>
23.46	1.5	0.73	44	0.482	Indeterminant
23.44	3.0	0.83	45	0.489	0.48
23.51	12.0	1.14	46	0.449	0.46
23.48	24.0	1.31	47	0.449	0.46
23.49	36.0	1.39	48	0.429	0.45

Table IV. Oblique Impact Test Results (LX-10-0 Lot 710-2)

45° Impact Angle
3.5' Drop Height

<u>Billet Wt (lbs)</u>	<u>Figure No.</u>	<u>Final Rotational Velocity (Rads/sec) (Fastax)</u>	<u>Coefficient of Restitution (Fastax)</u>
23.46	49,50	28.29	0.30
23.41	51,52	30.44	0.35
23.45	53.54	27.81	0.33

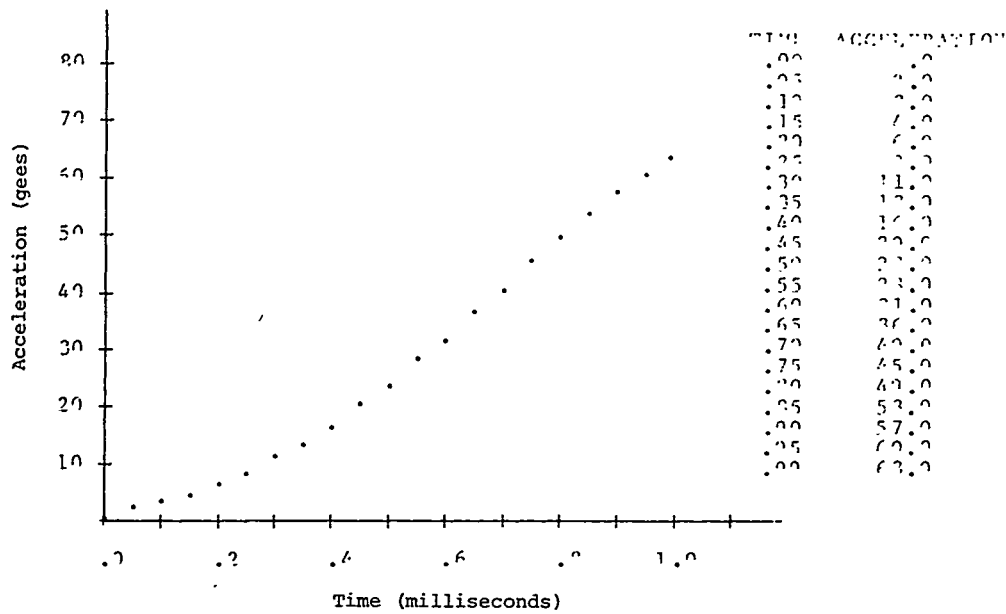


Fig. 1. RX-25-AA
14°, 0.44'
Normal Acceleration
Reaction Level 3

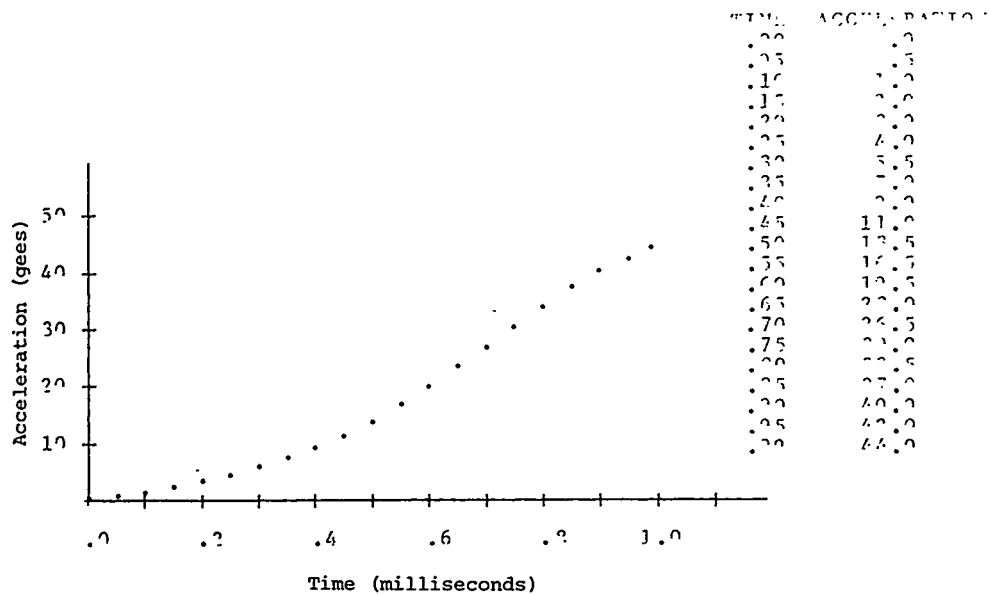
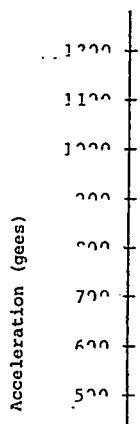
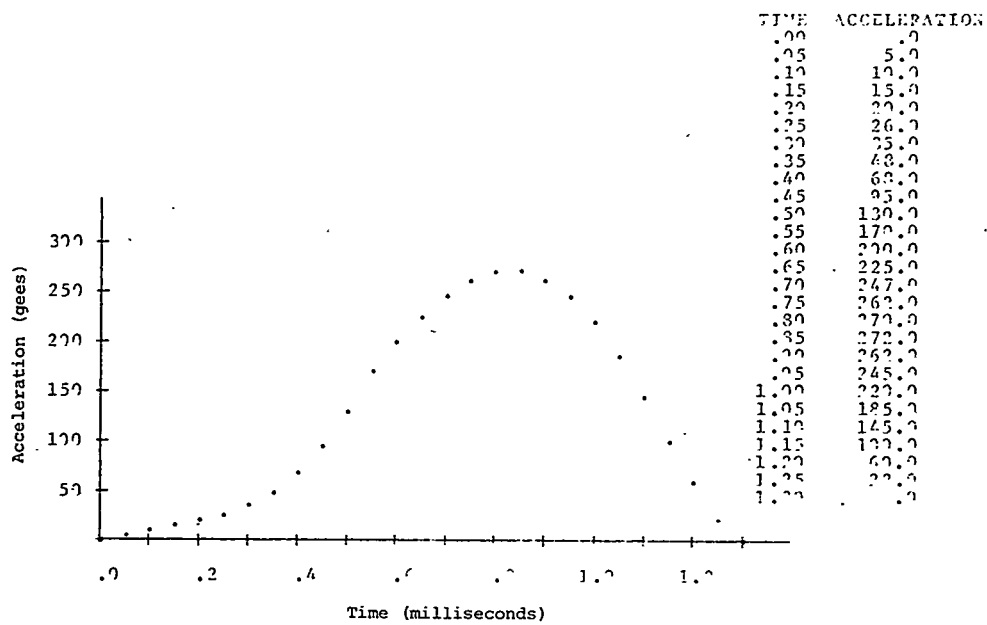


Fig. 2. RX-25-AA
14°, 0.44'
Rotational Acceleration
Reaction Level 3



TIME	ACCELERATION
.00	100.0
.05	100.0
.10	100.0
.15	100.0
.20	100.0
.25	100.0
.30	100.0
.35	100.0
.40	100.0
.45	100.0
.50	100.0
.55	100.0
.60	100.0
.65	100.0
.70	100.0
.75	100.0
.80	100.0



TIME	ACCELERATION
.00	5.0
.05	5.0
.10	10.0
.15	15.0
.20	20.0
.25	26.0
.30	25.0
.35	48.0
.40	60.0
.45	85.0
.50	130.0
.55	170.0
.60	200.0
.65	225.0
.70	247.0
.75	260.0
.80	270.0
.85	270.0
.90	260.0
.95	245.0
1.00	220.0
1.05	185.0
1.10	145.0
1.15	100.0
1.20	60.0
1.25	20.0
1.30	5.0

Fig. 4. RX-25-AA
45°, 5'
Floor Covering Test
Rotational Acceleration

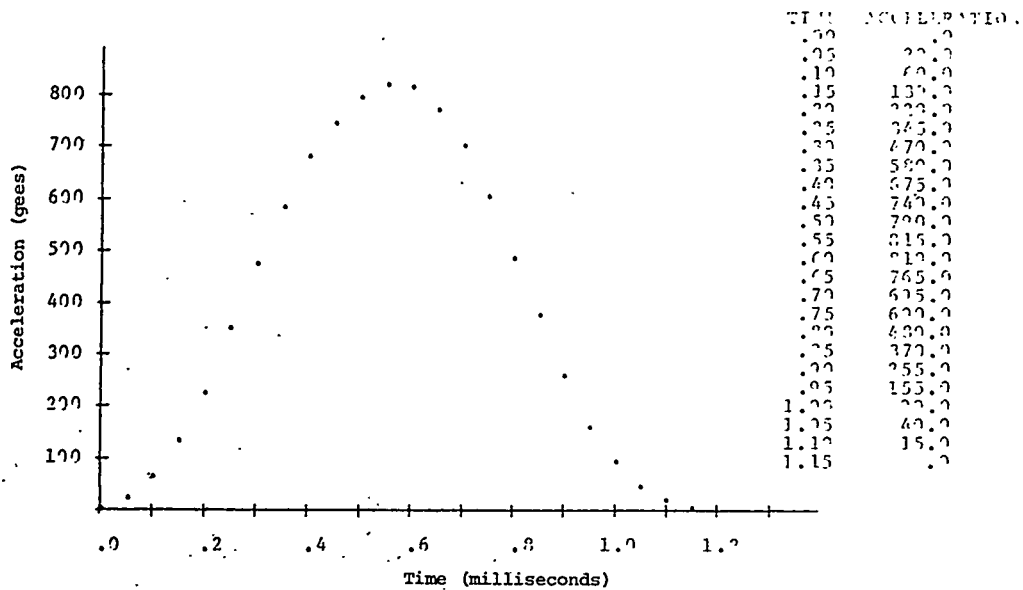


Fig. 5. RX-04-EA
45°, 3.5'
Normal Acceleration

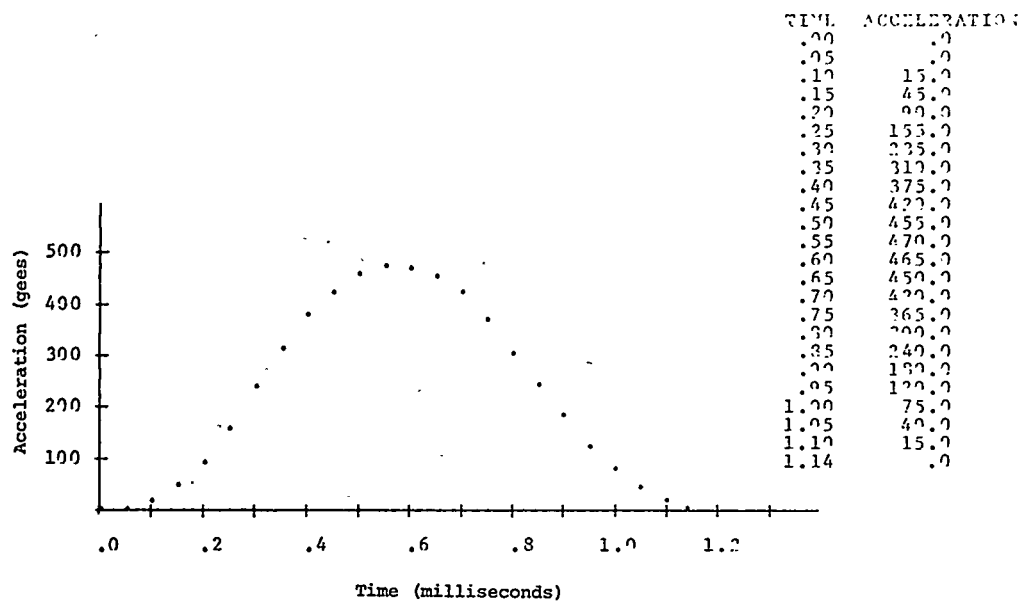


Fig. 6. RX-04-EA
45°, 3.5'
Rotational Acceleration

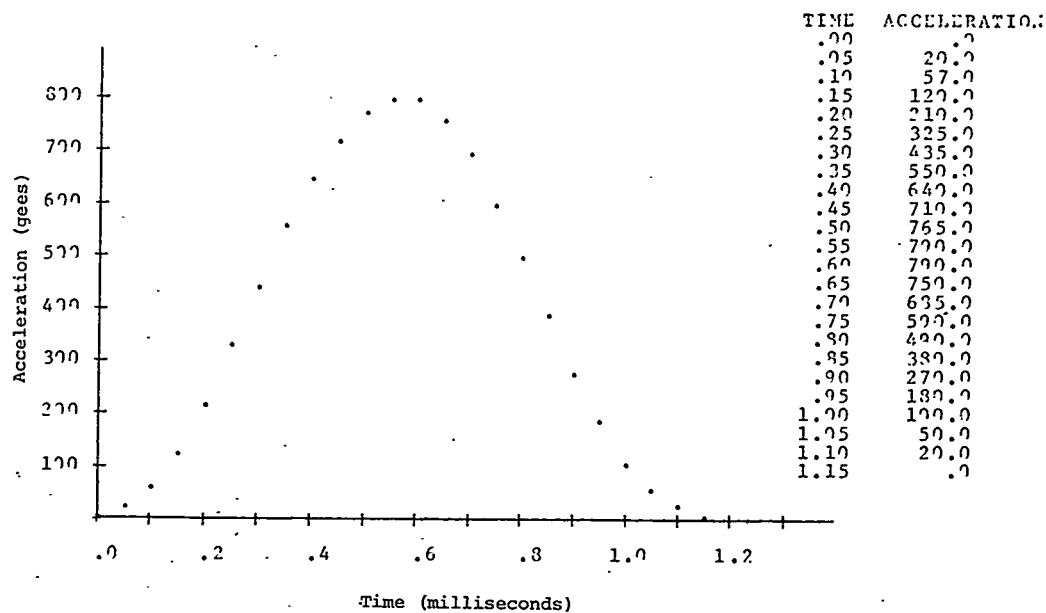


Fig. 7. RX-04-EA
45°, 3.5'
Normal Acceleration

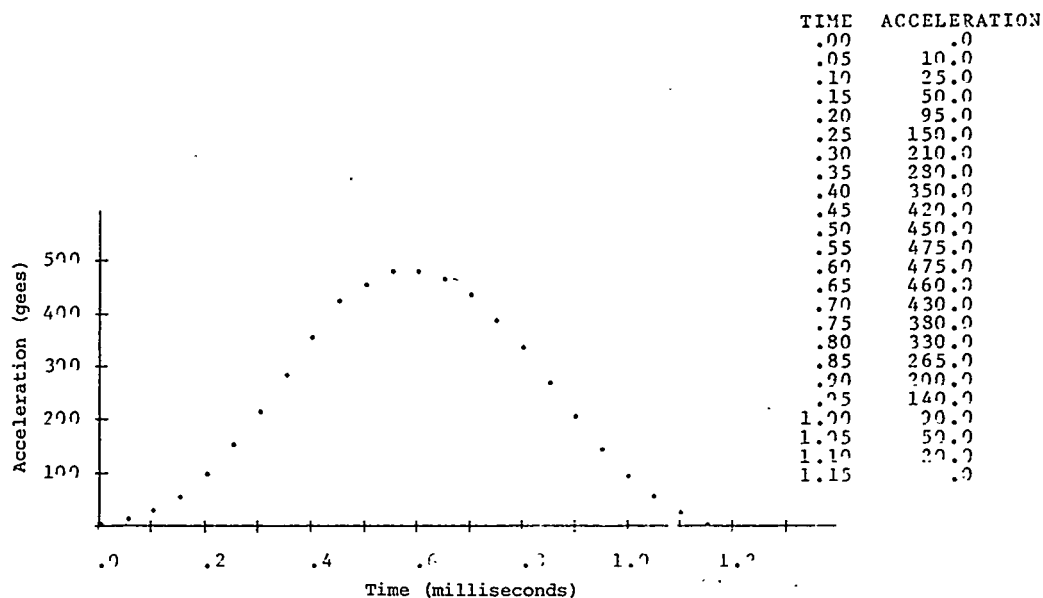


Fig. 8. RX-04-EA
45°, 3.5'
Rotational Acceleration

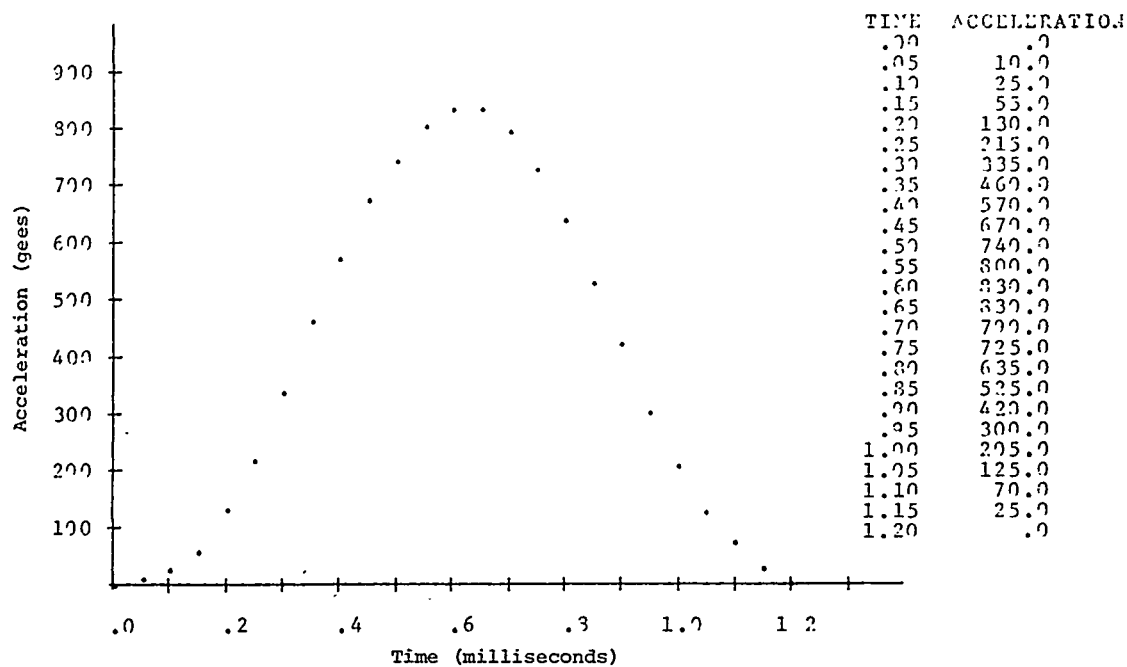


Fig. 9. RX-04-EA
45°, 3.5'
Normal Acceleration

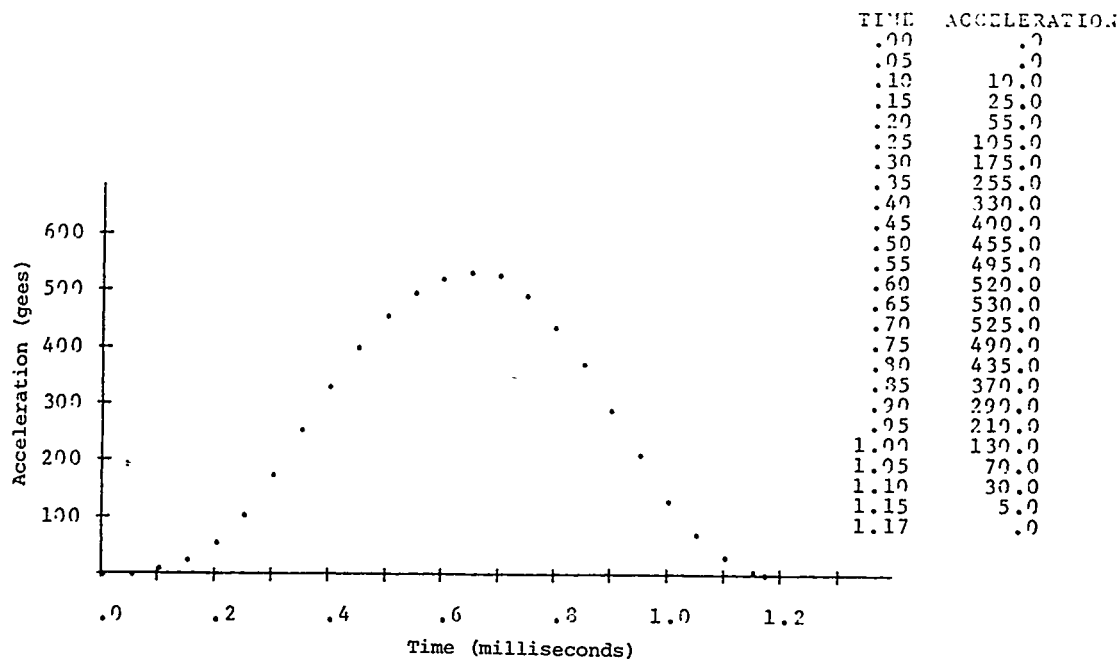


Fig. 10. RX-04-EA
45°, 3.5'
Rotational Acceleration

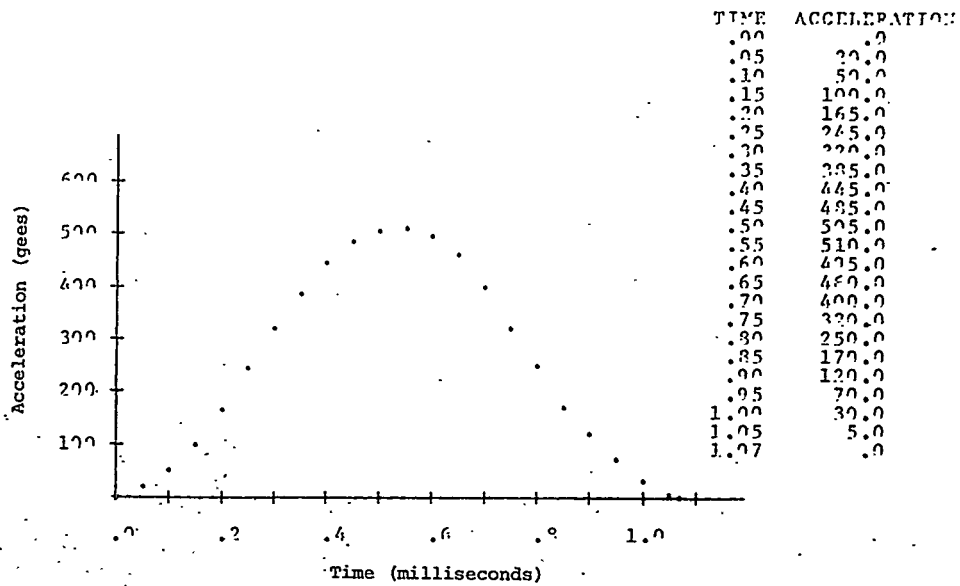


Fig. 11. RX-04-EB
45°, 3.5'
Normal Acceleration

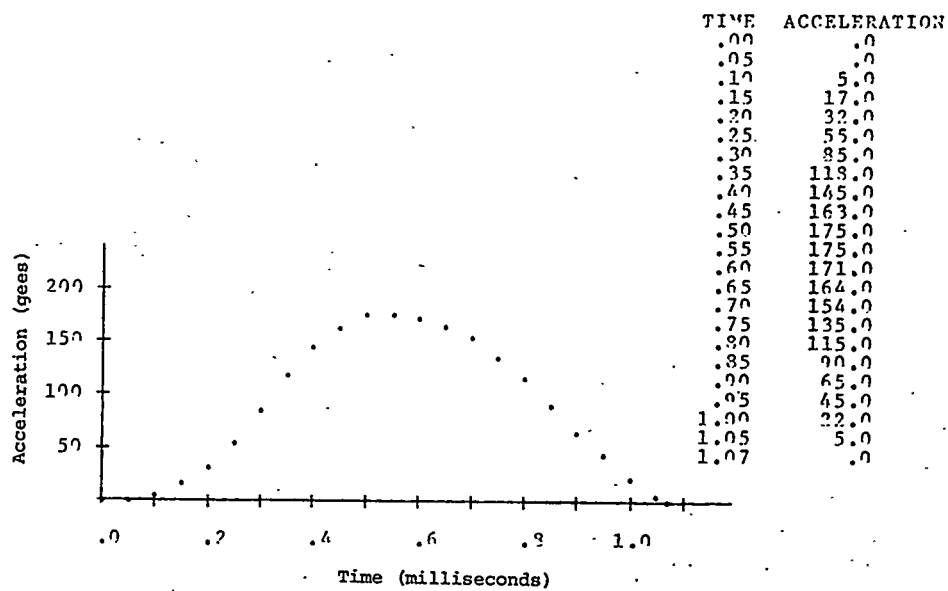


Fig. 12. RX-04-EB
45°, 3.5'
Rotational Acceleration

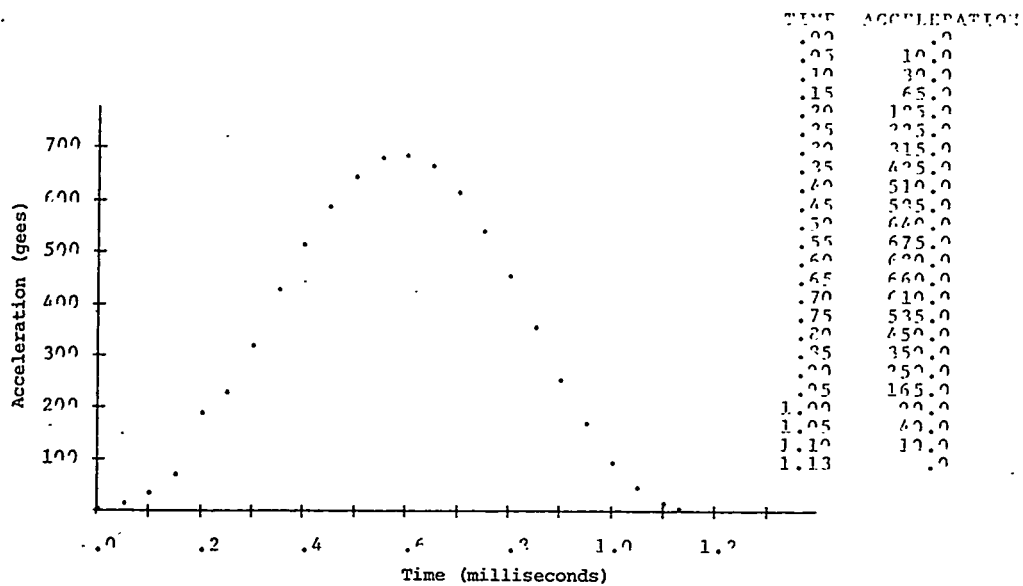


Fig. 13. RX-04-EB
45°, 3.5'
Normal Acceleration

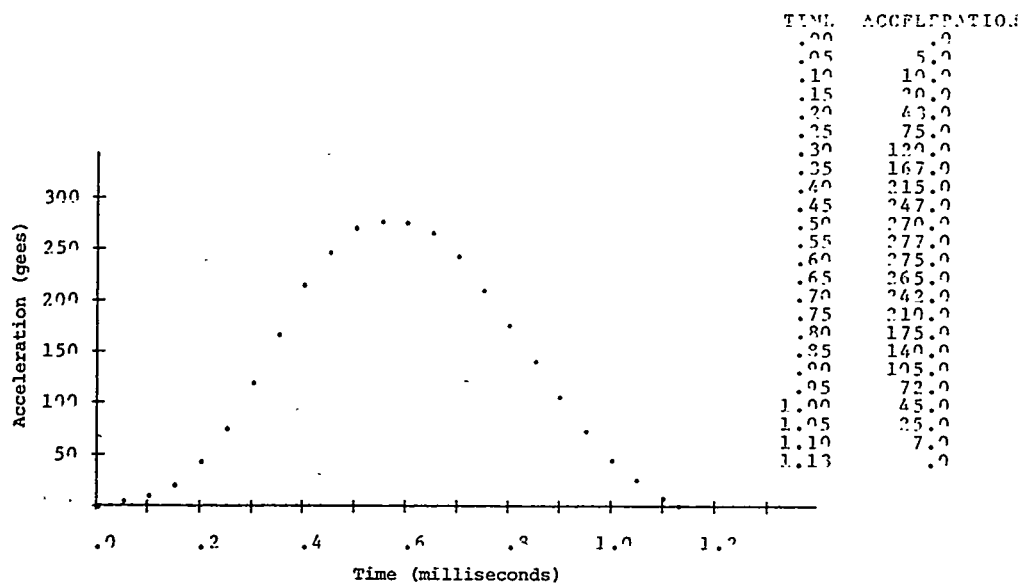


Fig. 14. RX-04-EB
45°, 3.5'
Rotational Acceleration

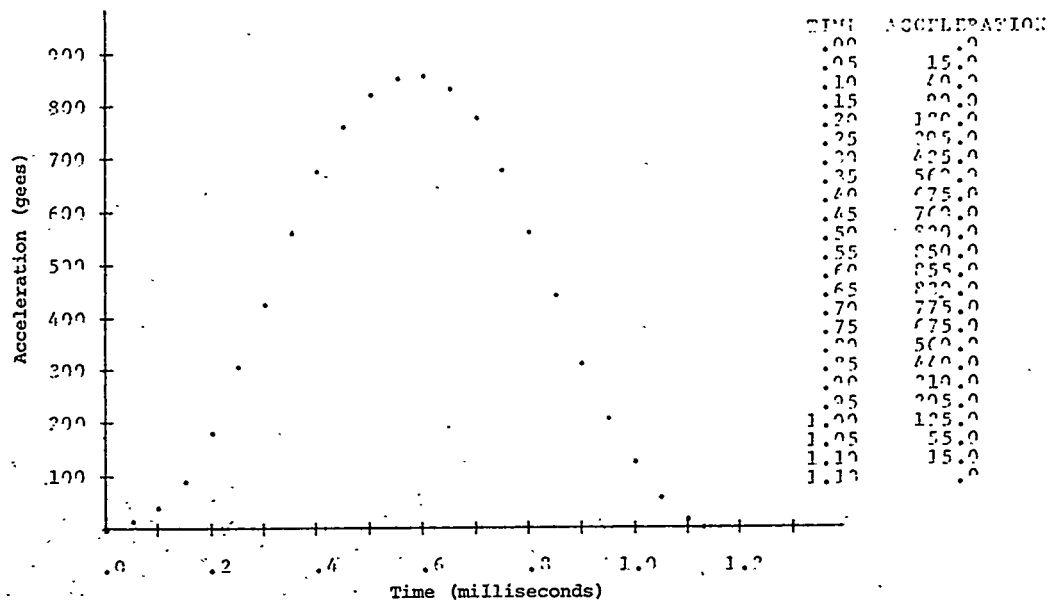


Fig. 15. RX-04-EB
45°, 3.5'
Normal Acceleration

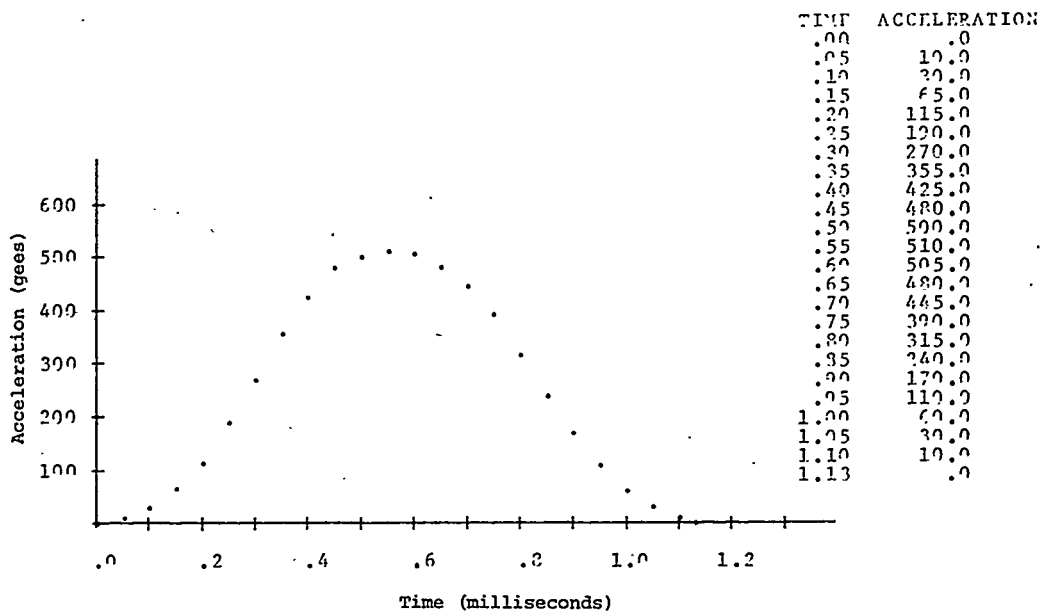


Fig. 16. RX-04-EB
45°, 3.5'
Rotational Acceleration

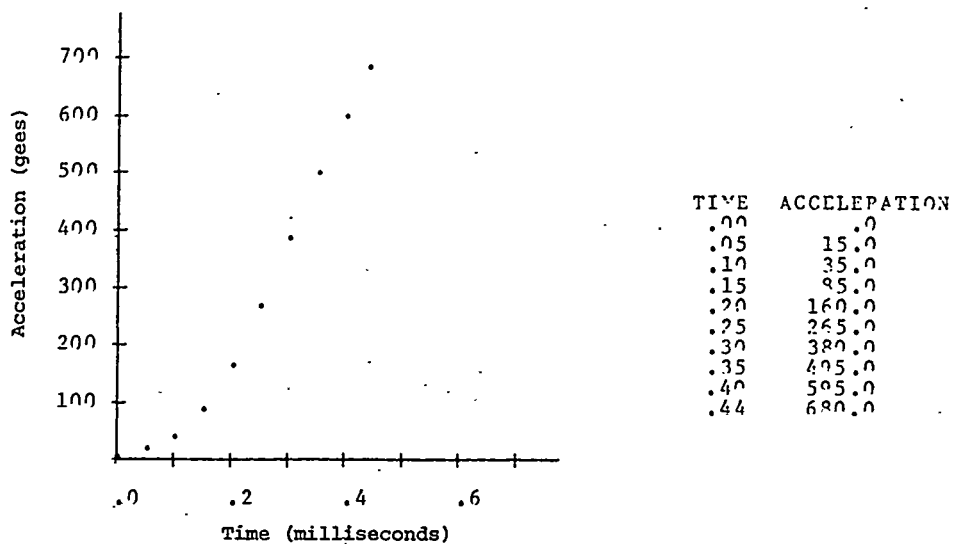


Fig. 17. RX-04-DW
45°, 3.5'
Normal Acceleration
Reaction Level 6

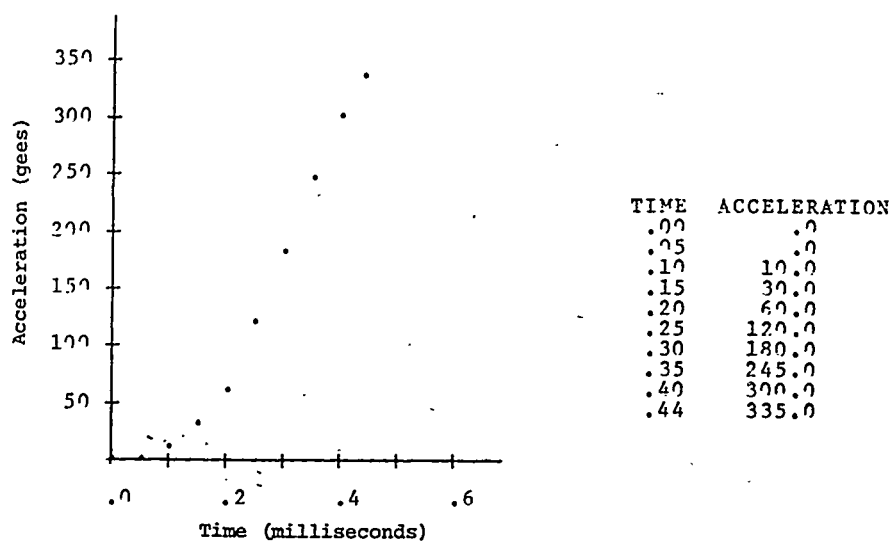


Fig. 18. RX-04-DW
45°, 3.5'
Rotational Acceleration
Reaction Level 6

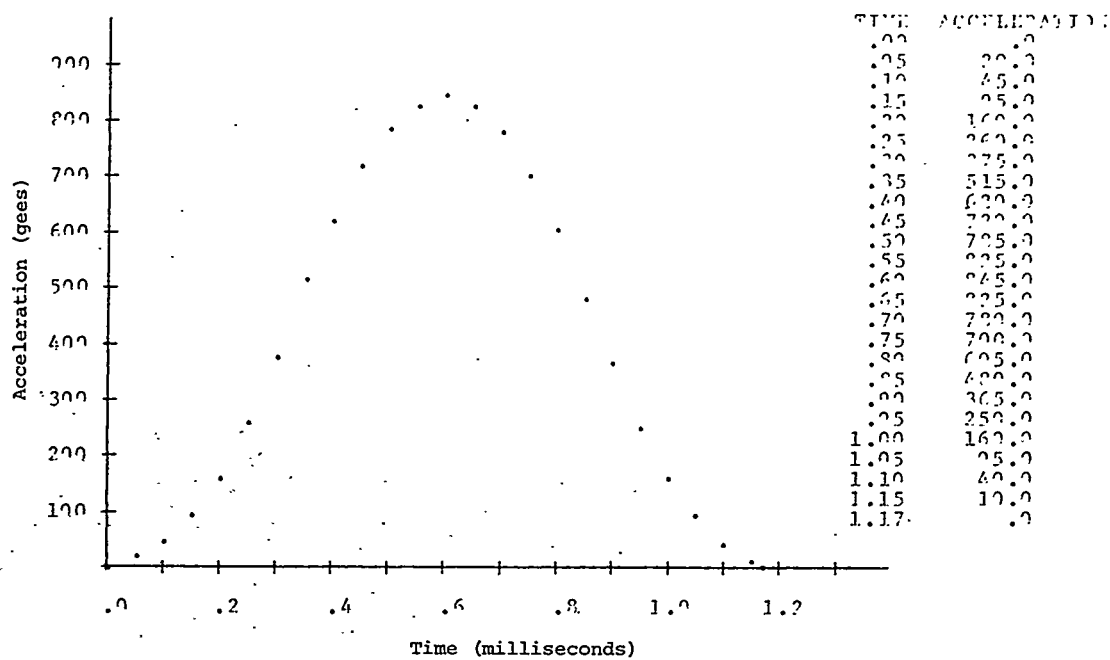


Fig. 19. RX-04-DW
45°, 3.5'
Normal Acceleration

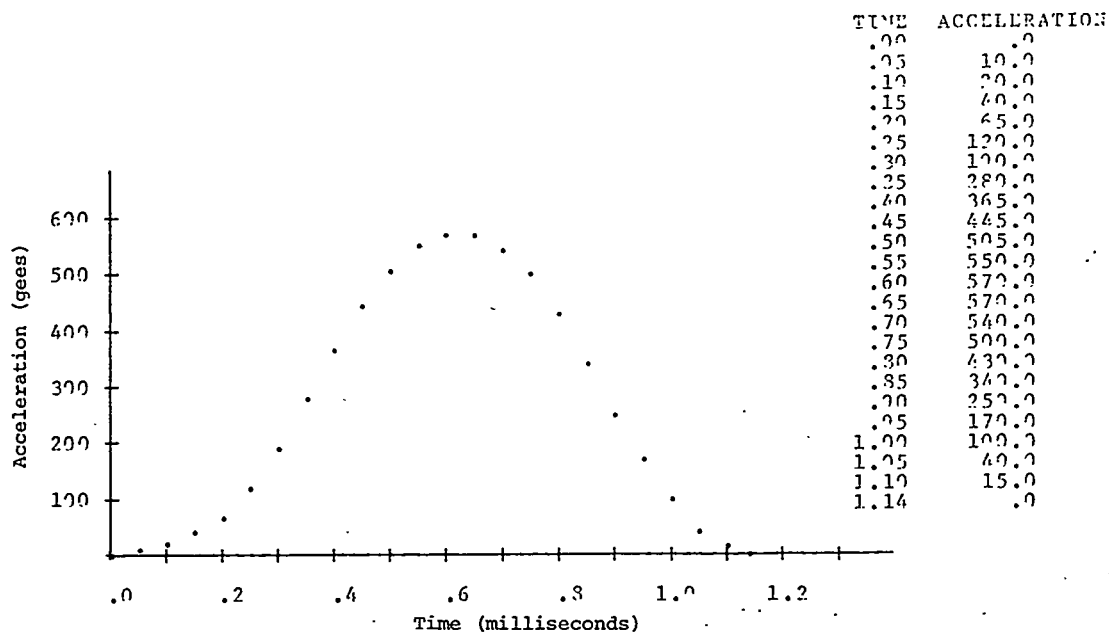


Fig. 20. RX-04-DW
45°, 3.5'
Rotational Acceleration

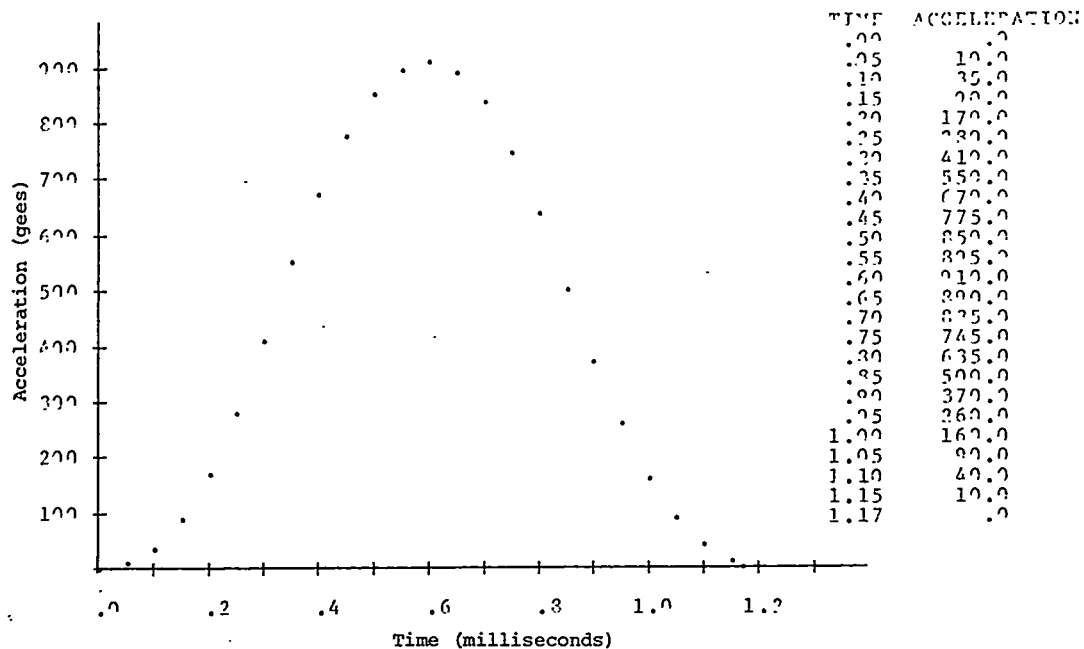


Fig. 21. RX-04-DW
45°, 3.5'
Normal Acceleration

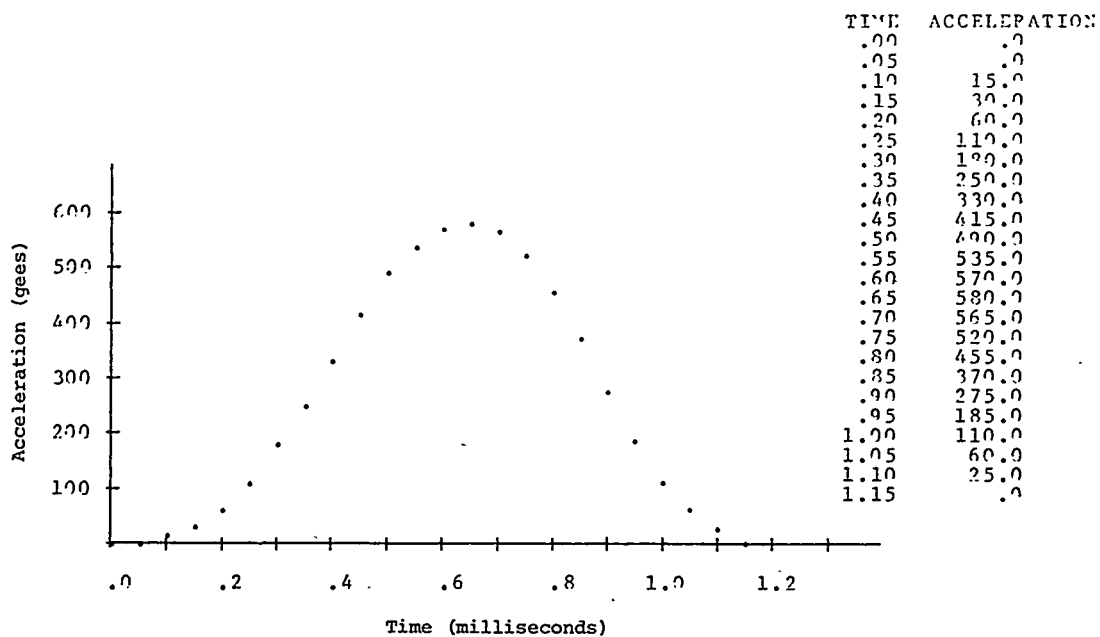


Fig. 22. RX-04-DW
45°, 3.5'
Rotational Acceleration

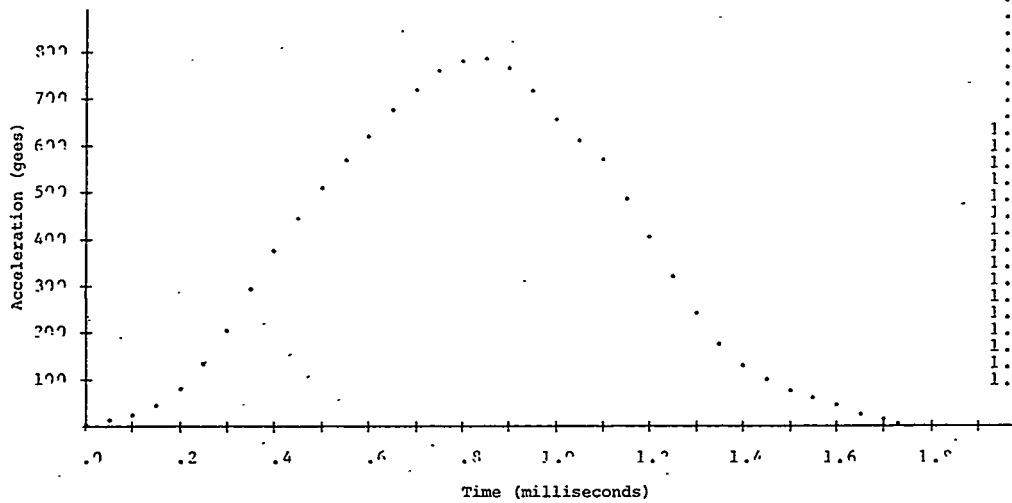


Fig. 23. RX-04-DW
45°, 10'
Floor Covering Test
Steel Plate on Equator
Normal Acceleration

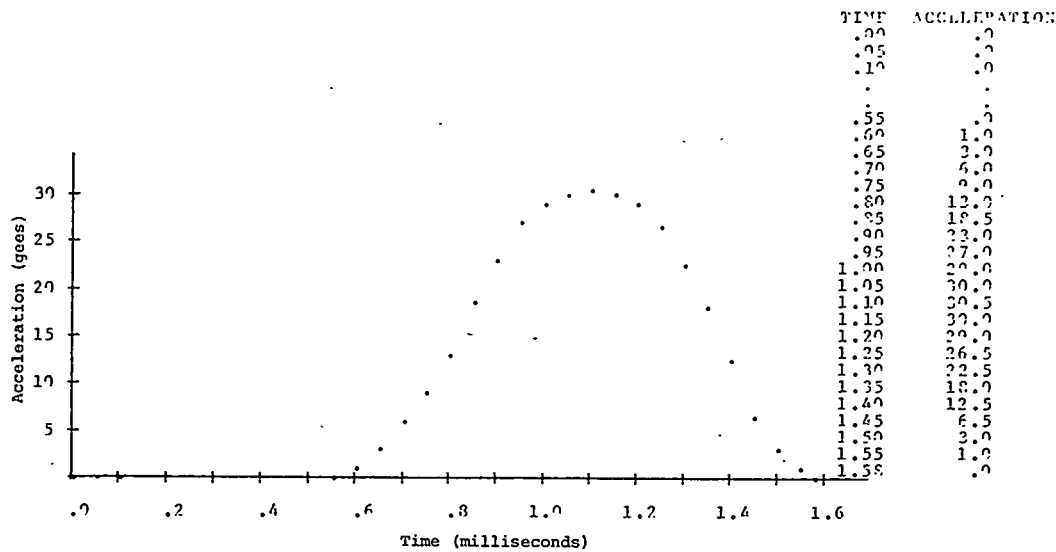


Fig. 24. RX-04-DW
45°, 10'
Floor Covering Test
Steel Plate on Equator
Rotational Acceleration

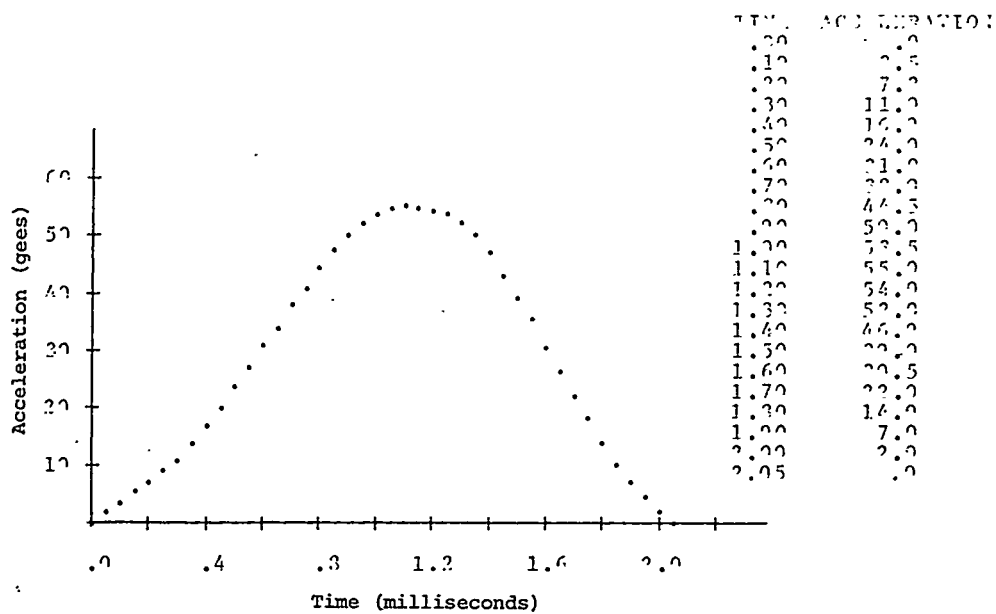


Fig. 25. RX-04-EA
14°, 0.88'
Normal Acceleration

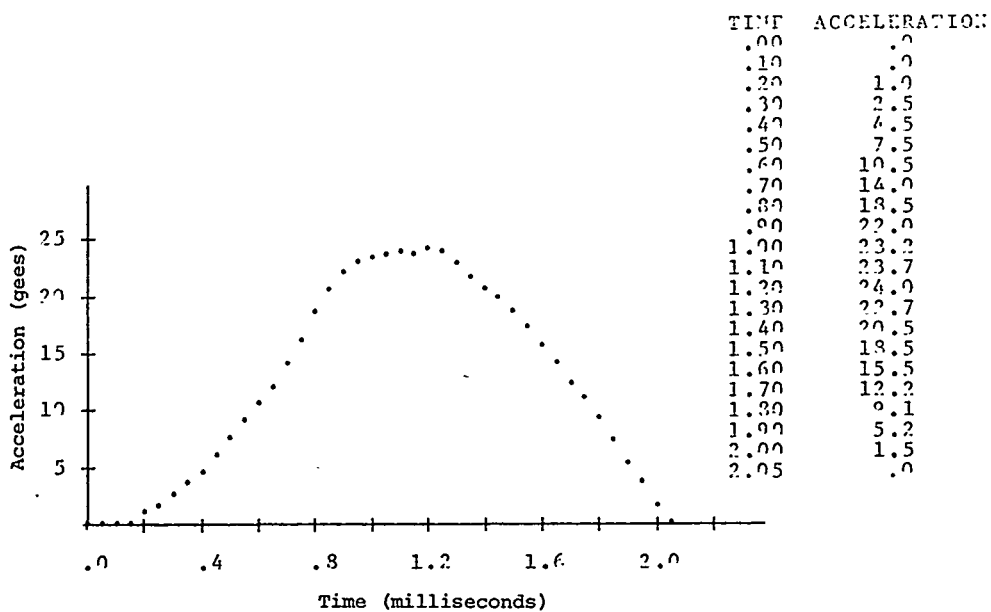


Fig. 26. RX-04-EA
14°, 0.88'
Rotational Acceleration

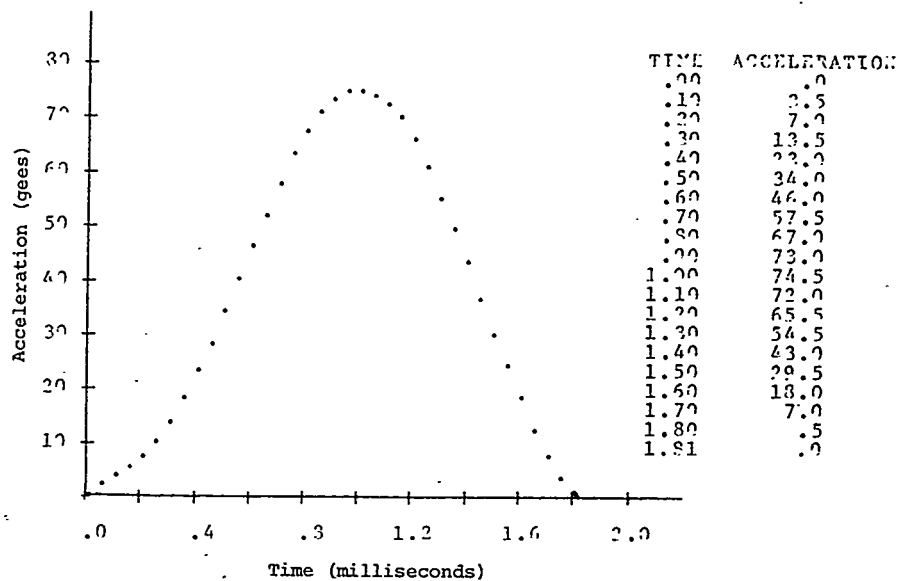


Fig. 27. RX-04-EA
14°, 0.88'
Normal Acceleration

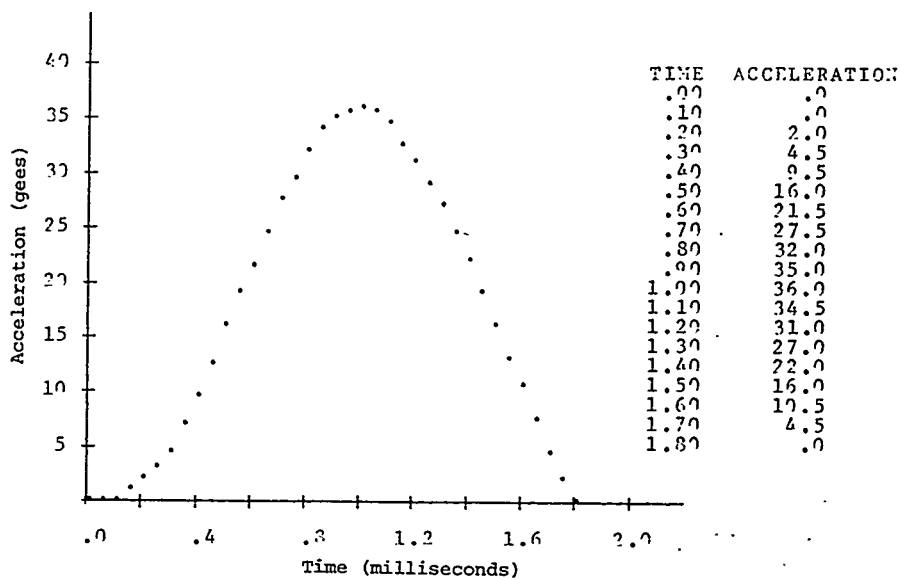


Fig. 28. RX-04-EA
14°, 0.88'
Rotational Acceleration

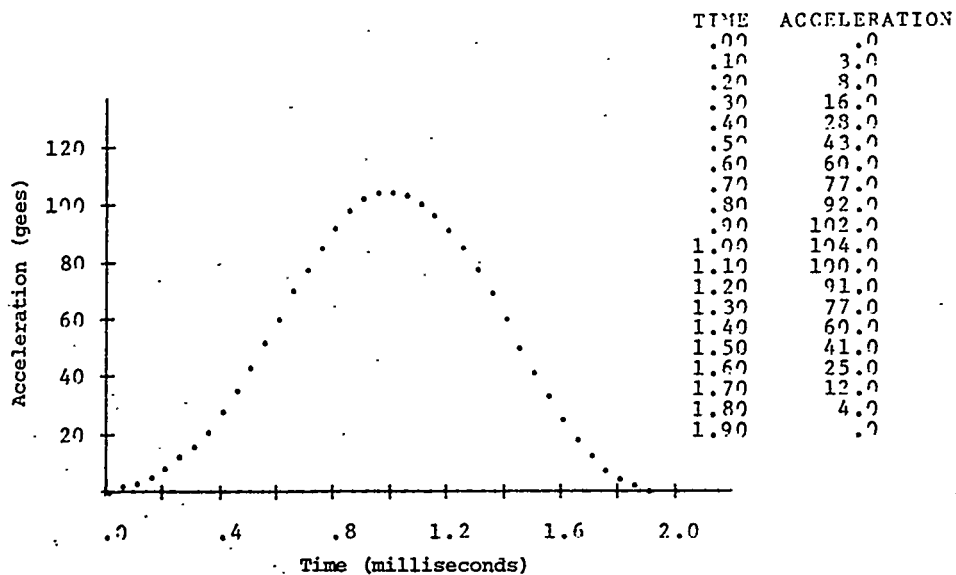


Fig. 29. RX-04-EA
14°, 0.88'
Normal Acceleration

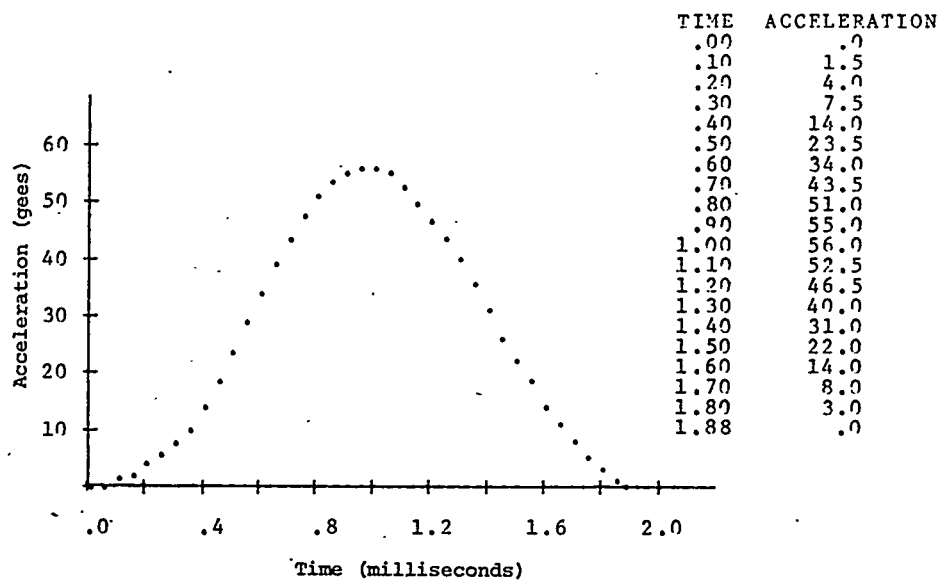


Fig. 30. RX-04-EA
14°, 0.88'
Rotational Acceleration

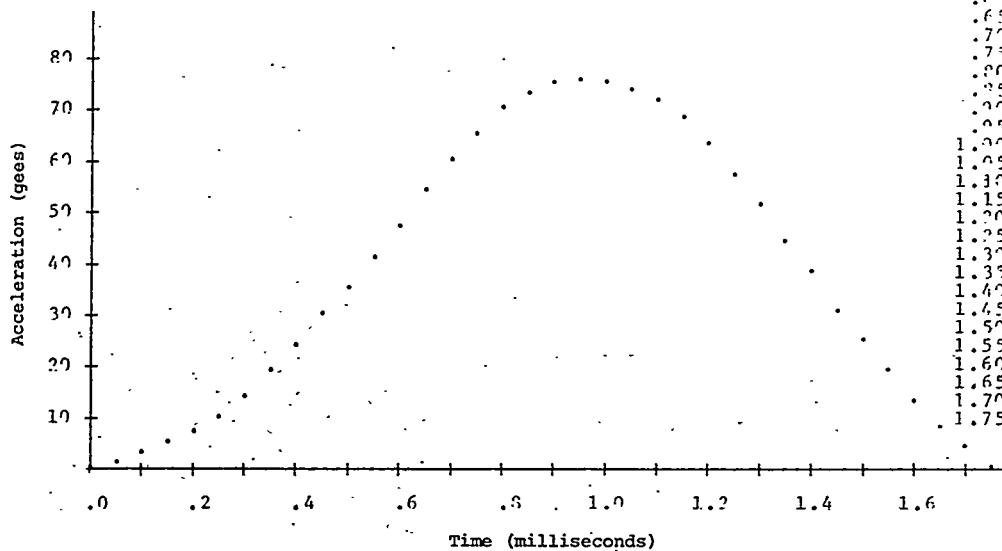


Fig. 31. RX-04-EB
14°, 0.88'
Normal Acceleration

TIME	ACCELERATION
.00	0.0
.05	1.0
.10	3.0
.15	5.0
.20	7.0
.25	10.0
.30	14.0
.35	17.0
.40	24.0
.45	30.0
.50	35.0
.55	41.0
.60	47.0
.65	54.0
.70	60.0
.75	65.0
.80	70.0
.85	72.0
.90	75.0
.95	75.5
1.00	75.0
1.05	73.5
1.10	71.5
1.15	68.0
1.20	63.0
1.25	57.0
1.30	51.0
1.35	44.0
1.40	38.0
1.45	30.5
1.50	25.0
1.55	18.0
1.60	13.0
1.65	8.0
1.70	4.0
1.75	0.0

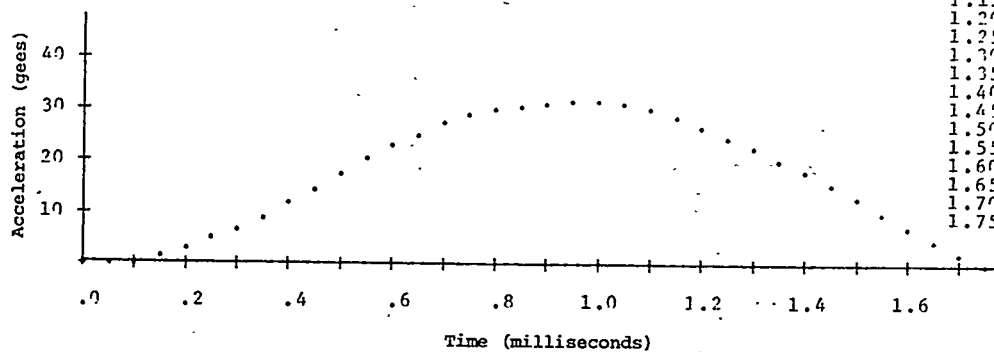


Fig. 32. RX-04-EB
14°, 0.88'
Rotational Acceleration

TIME	ACCELERATION
.00	0.0
.05	0.0
.10	0.0
.15	1.5
.20	3.0
.25	5.0
.30	6.5
.35	8.0
.40	12.0
.45	14.5
.50	17.5
.55	20.5
.60	23.0
.65	25.0
.70	27.5
.75	29.0
.80	30.0
.85	30.5
.90	31.0
.95	31.5
1.00	31.5
1.05	31.0
1.10	30.0
1.15	28.5
1.20	26.5
1.25	24.5
1.30	22.5
1.35	20.0
1.40	18.0
1.45	15.5
1.50	13.0
1.55	10.0
1.60	7.0
1.65	4.5
1.70	2.0
1.75	0.0

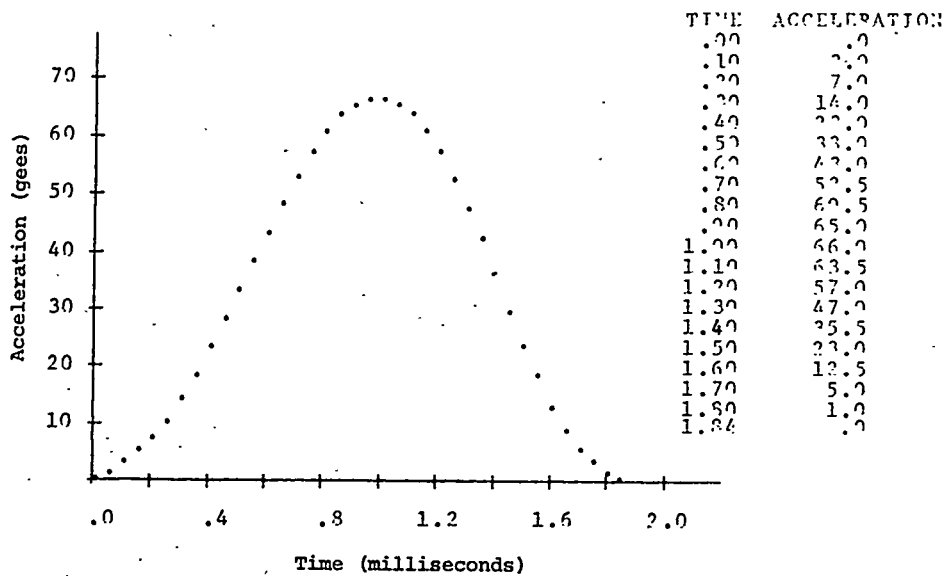


Fig. 33. RX-04-EB
14°, 0.88'
Normal Acceleration

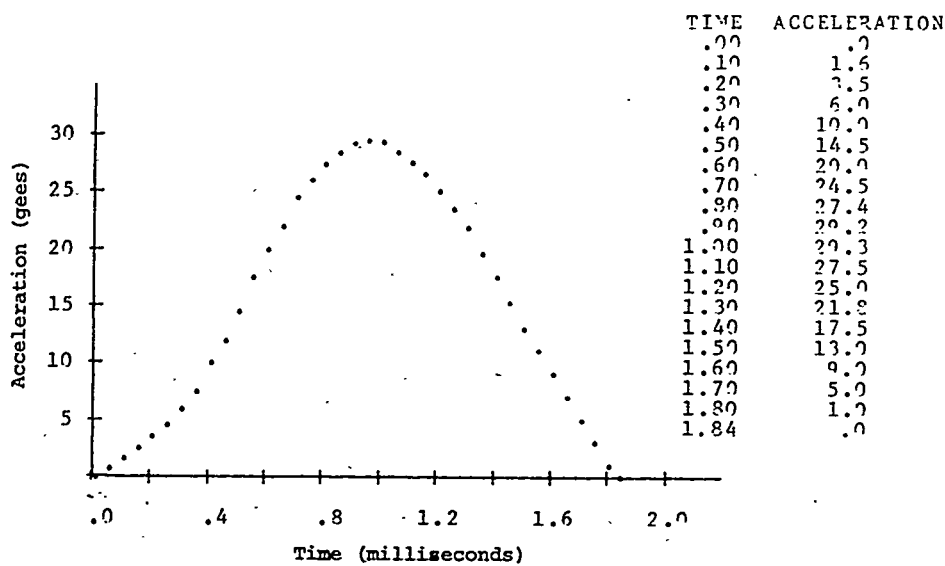


Fig. 34. RX-04-EB
14°, 0.88'
Rotational Acceleration

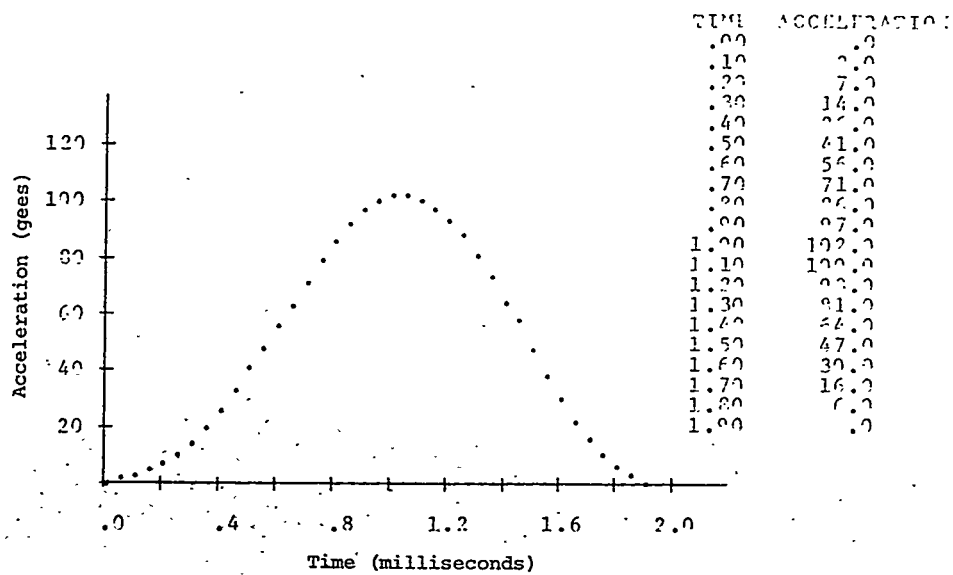


Fig. 35. RX-04-EB
14°, 0.88'
Normal Acceleration

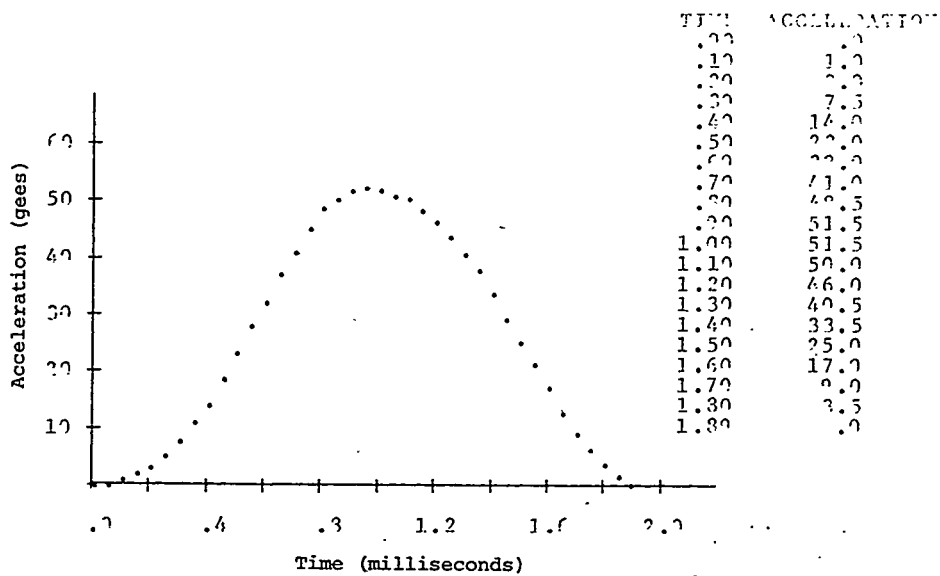


Fig. 36. RX-04-EB
14°, 0.88'
Rotational Acceleration

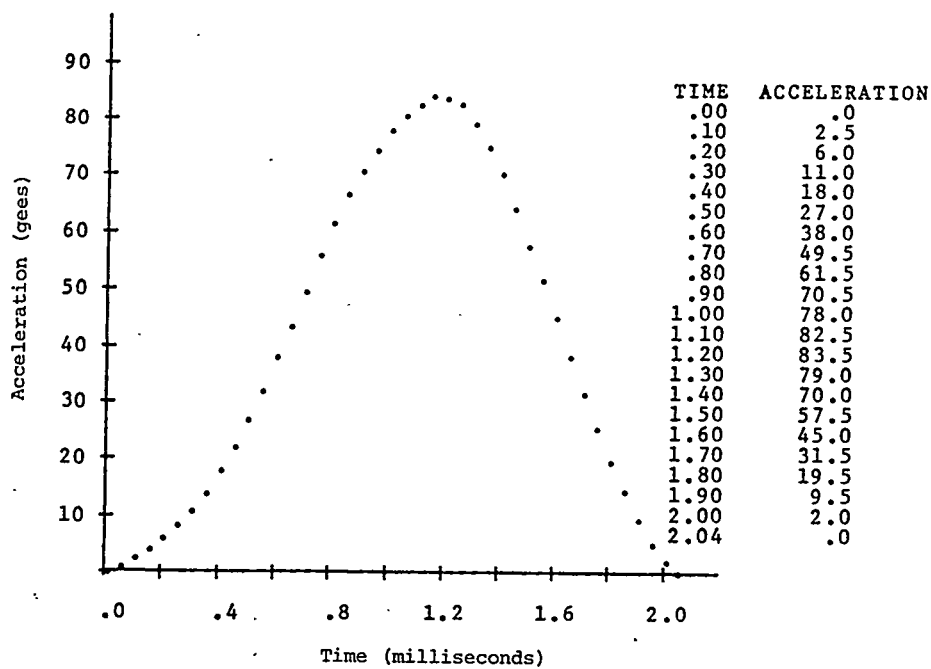


Fig. 37. RX-04-DW
14°, 0.88'
Normal Acceleration

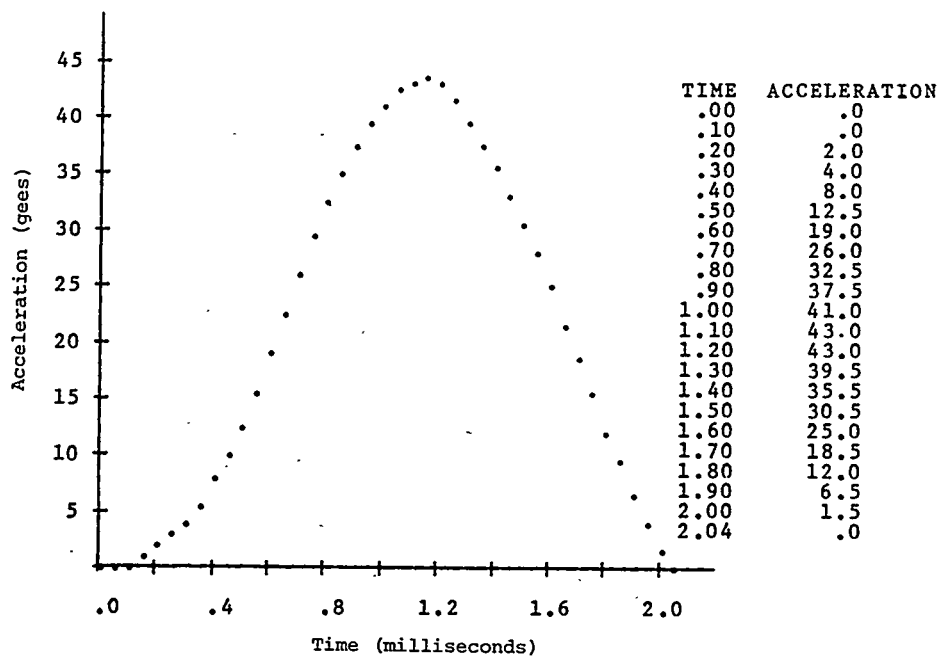


Fig. 38. RX-04-DW
14°, 0.88'
Rotational Acceleration

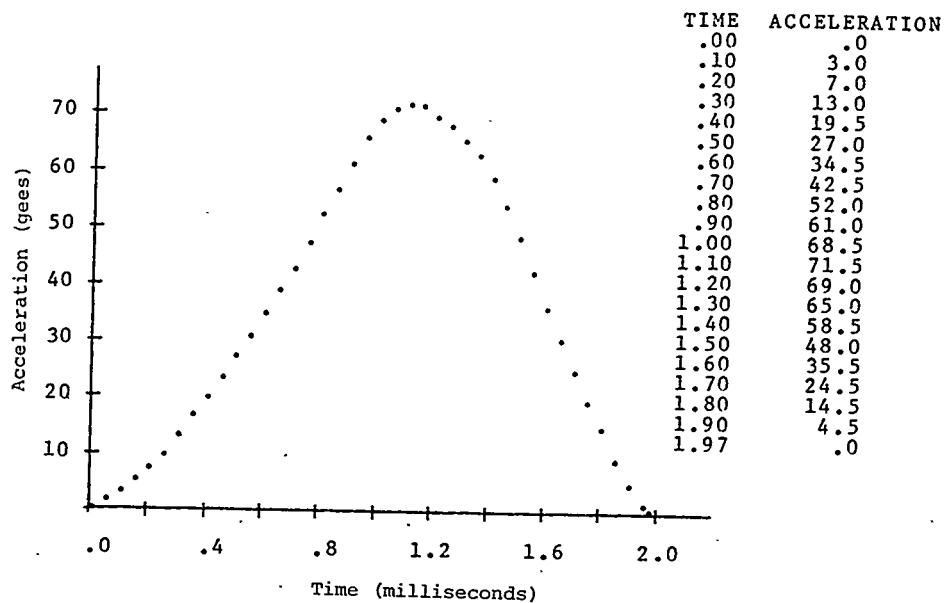


Fig. 39. RX-04-DW
14°, 0.88'
Normal Acceleration

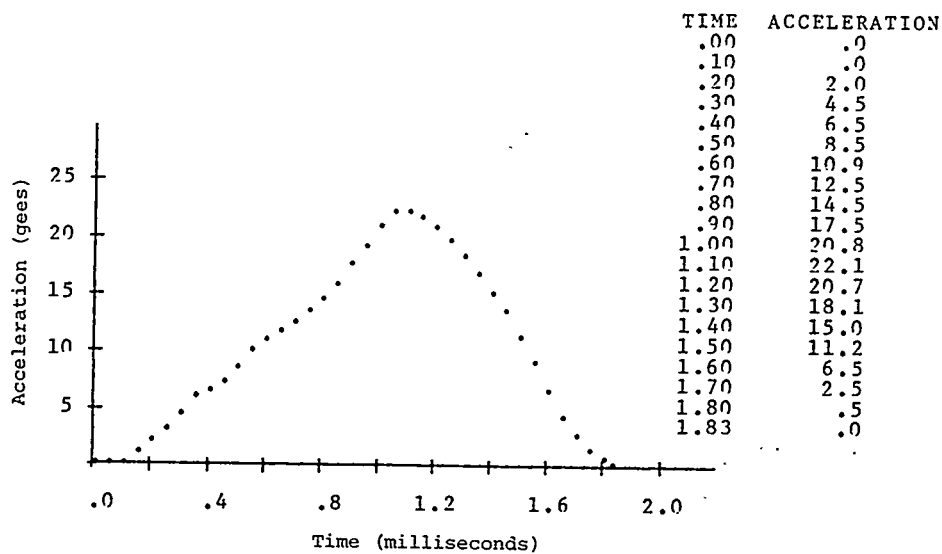


Fig. 40. RX-04-DW
14°, 0.88'
Rotational Acceleration

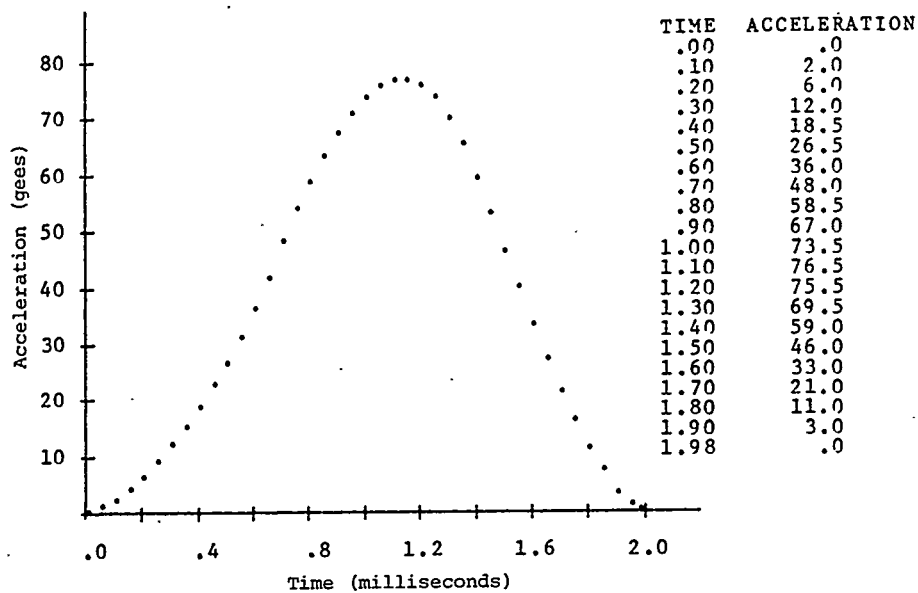


Fig. 41. RX-04-DW
14°, 0.88'
Normal Acceleration

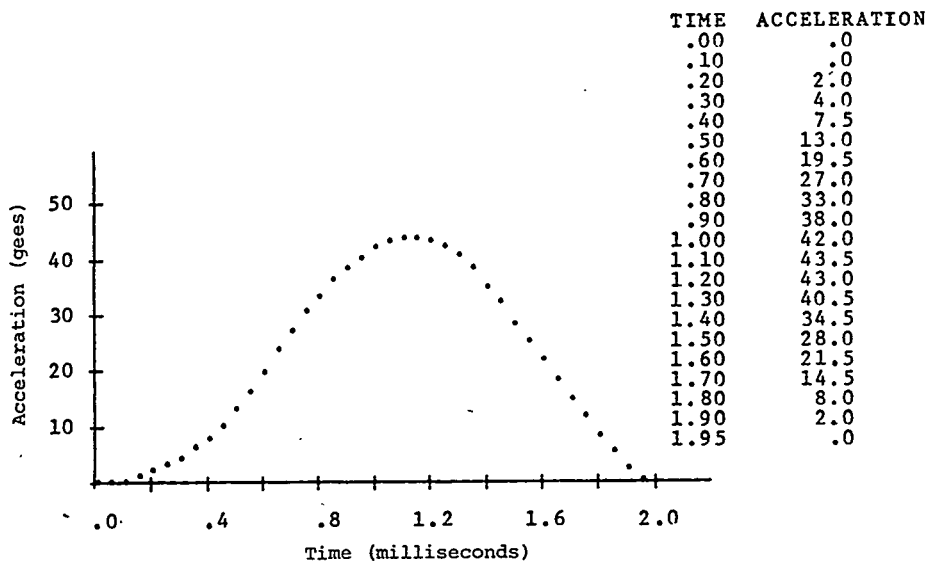


Fig. 42. RX-04-DW
14°, 0.88'
Rotational Acceleration

— LX-10-0 Lot 710-2
 - - - Standard LX-10-0 Composition

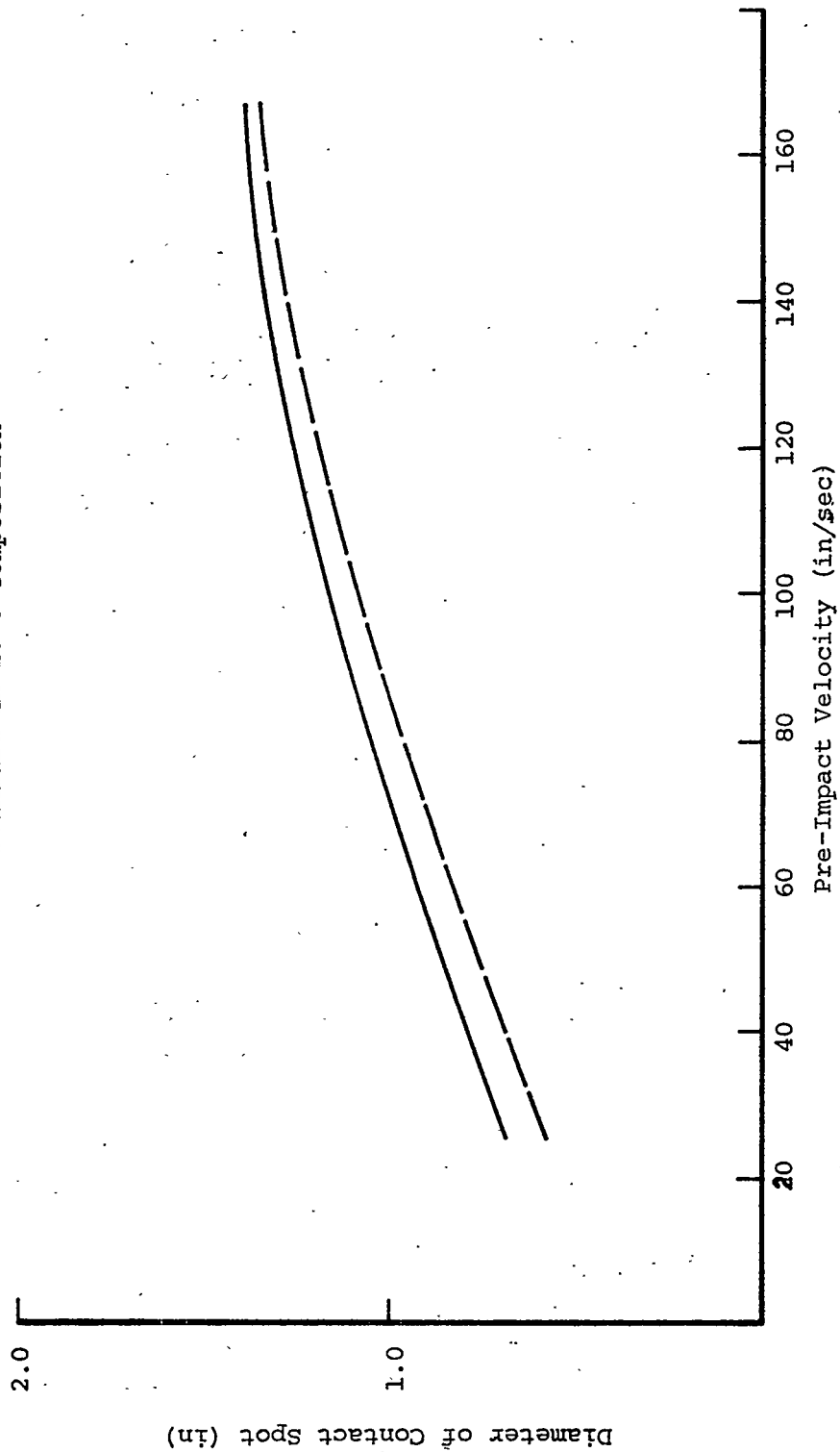


Fig. 43. Maximum Contact Spot Diameter Versus Pre-Impact Velocity

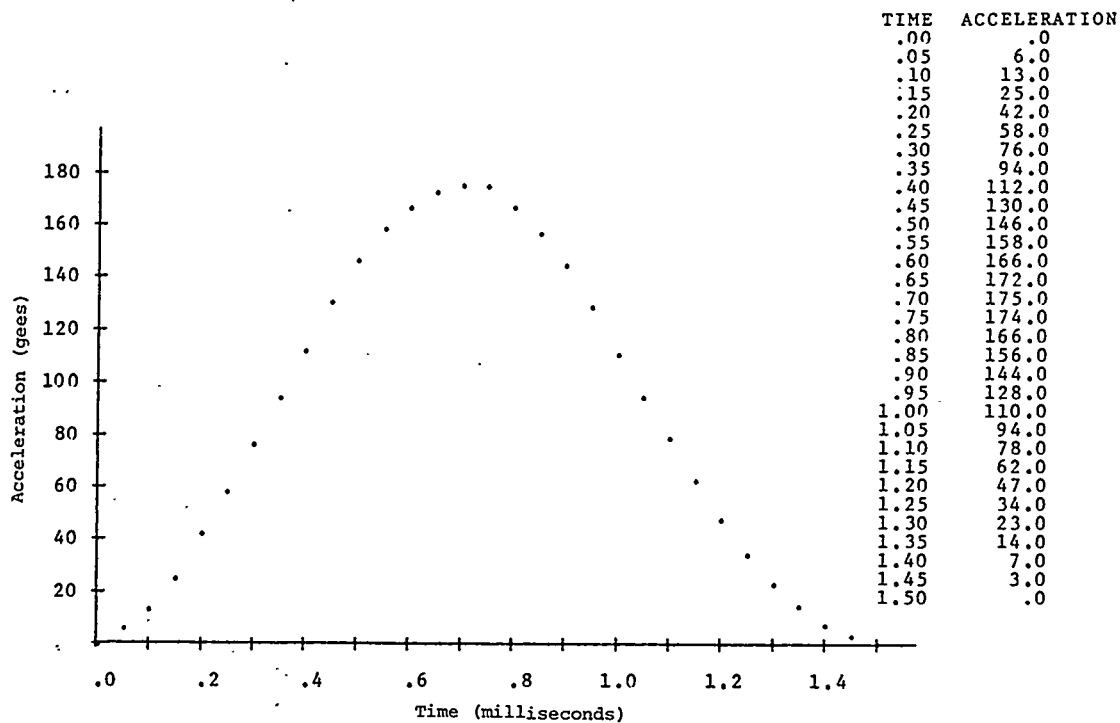


Fig. 44. LX-10-0
Lot 710-2
1.5" Vertical Drop

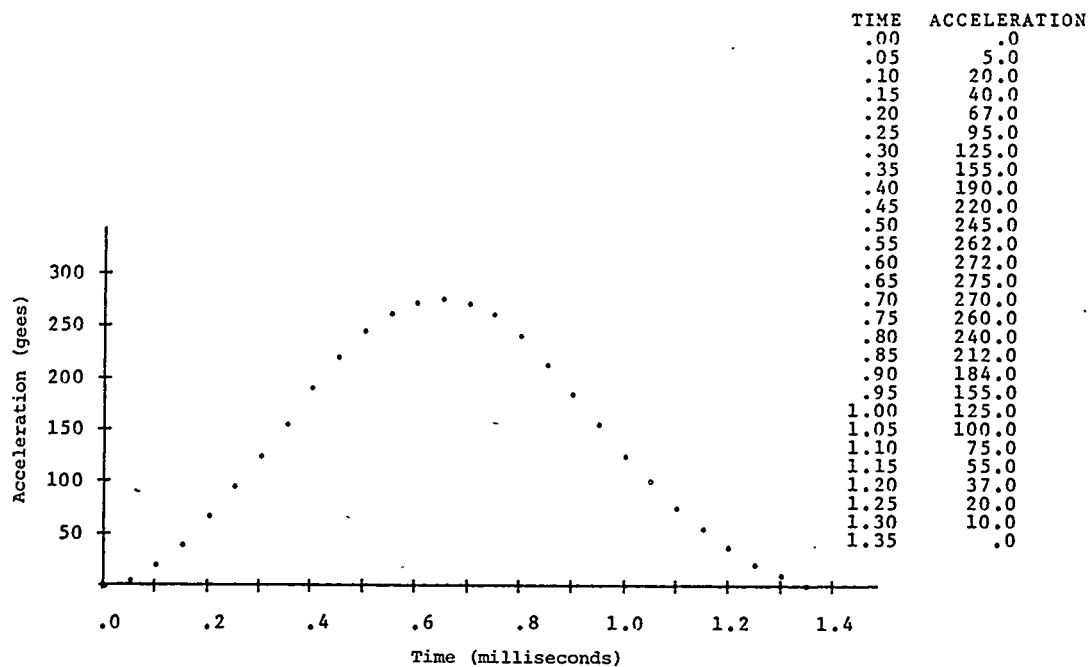


Fig. 45. LX-10-0
Lot 710-2
3.0" Vertical Drop

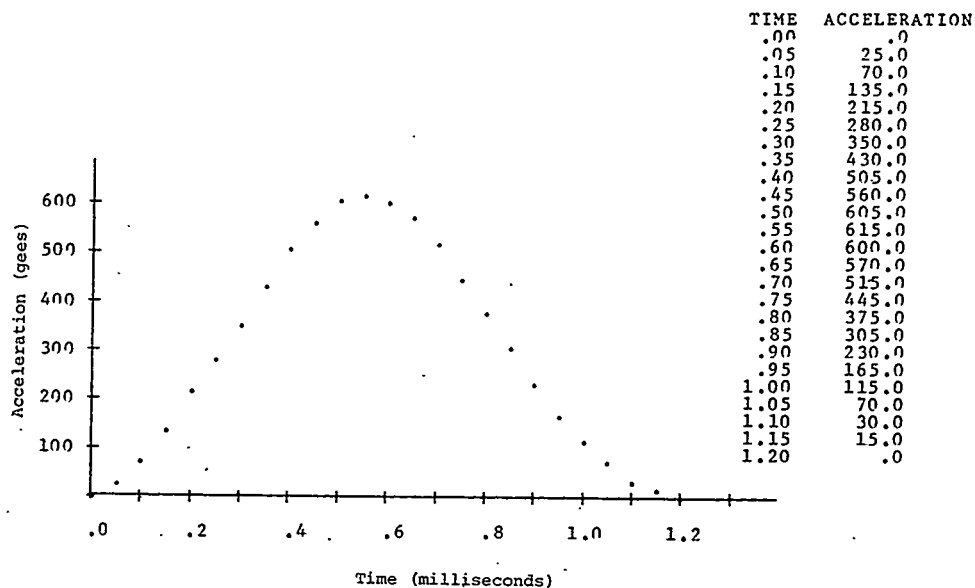


Fig. 46. LX-10-0
Lot 710-2
12.0" Vertical Drop

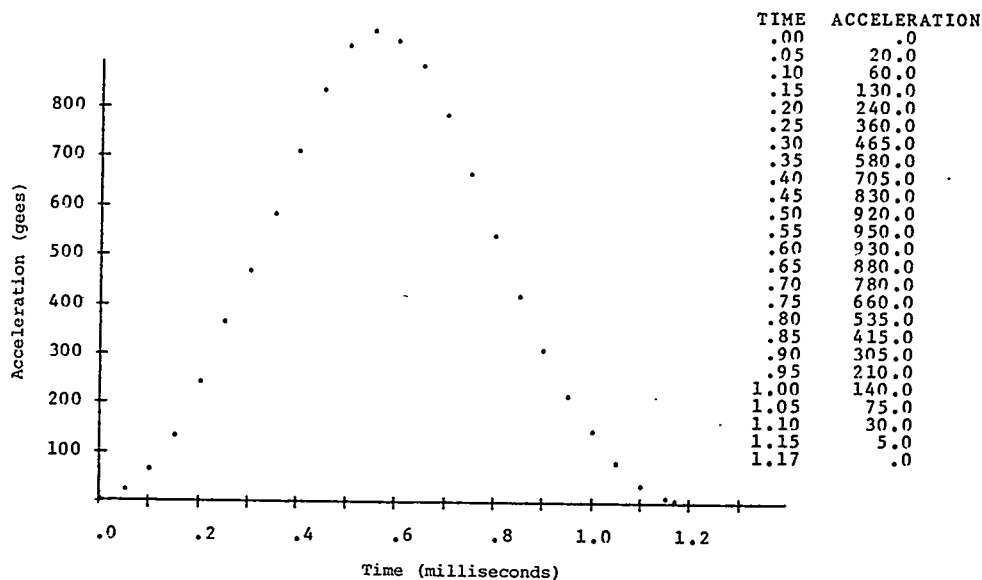


Fig. 47. LX-10-0
Lot 710-2
24.0" Vertical Drop

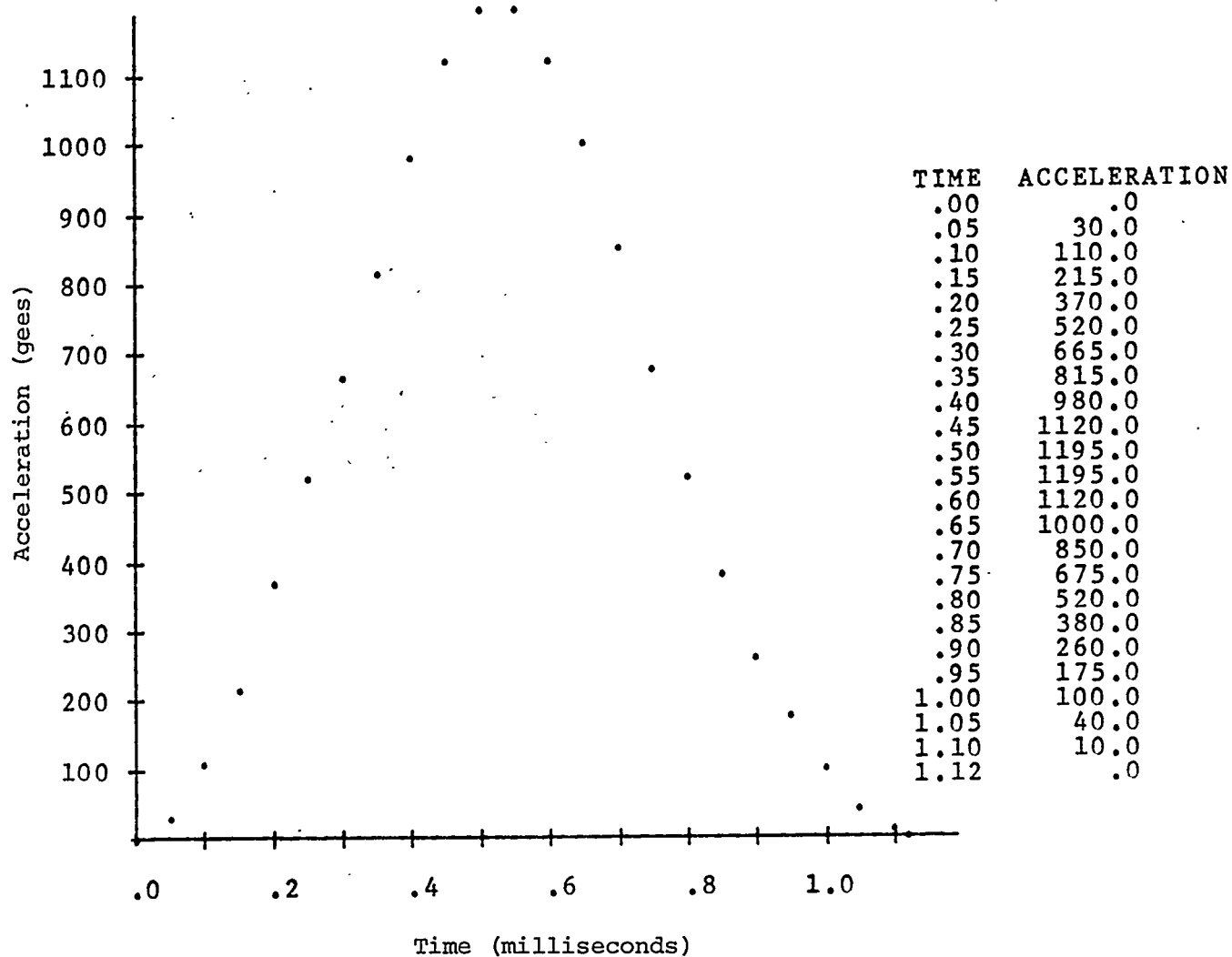


Fig. 48. LX-10-0
Lot 710-2
36.0" Vertical Drop

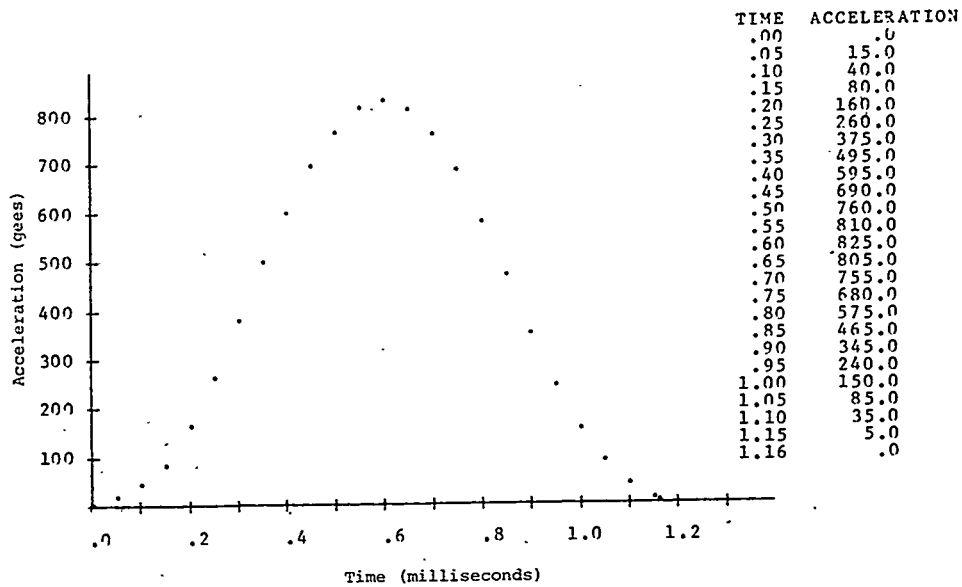


Fig. 49. LX-10-0
Lot 710-2
45°, 3.5'
Normal Acceleration

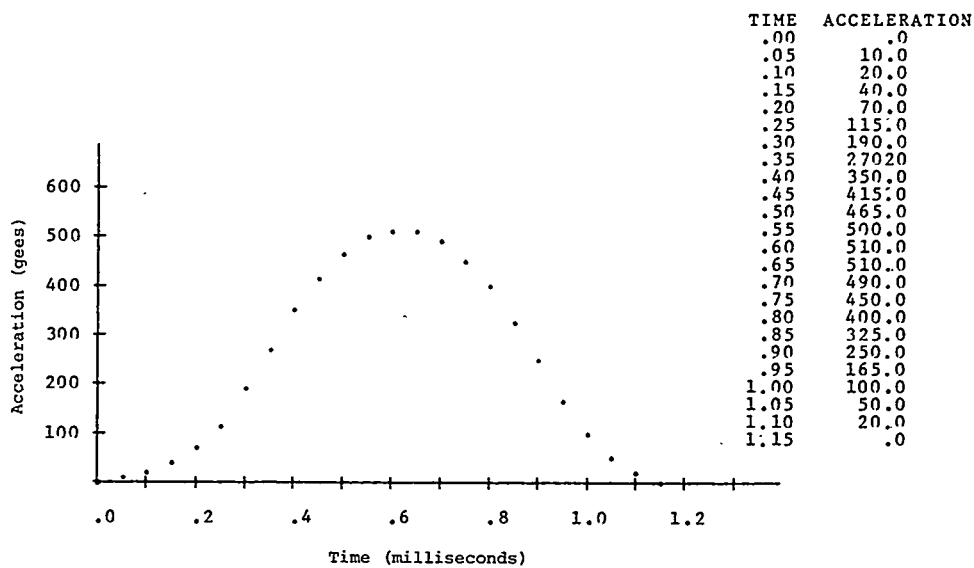


Fig. 50. LX-10-0
Lot 710-2
45°, 3.5'
Rotational Acceleration

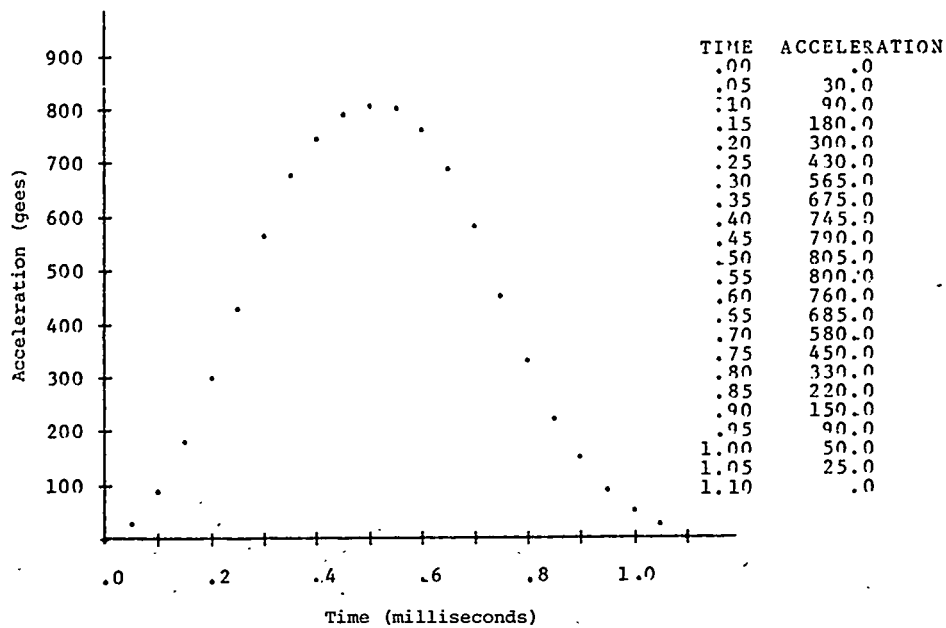


Fig. 51. LX-10-0
Lot 710-2
45°, 3.5'
Normal Acceleration

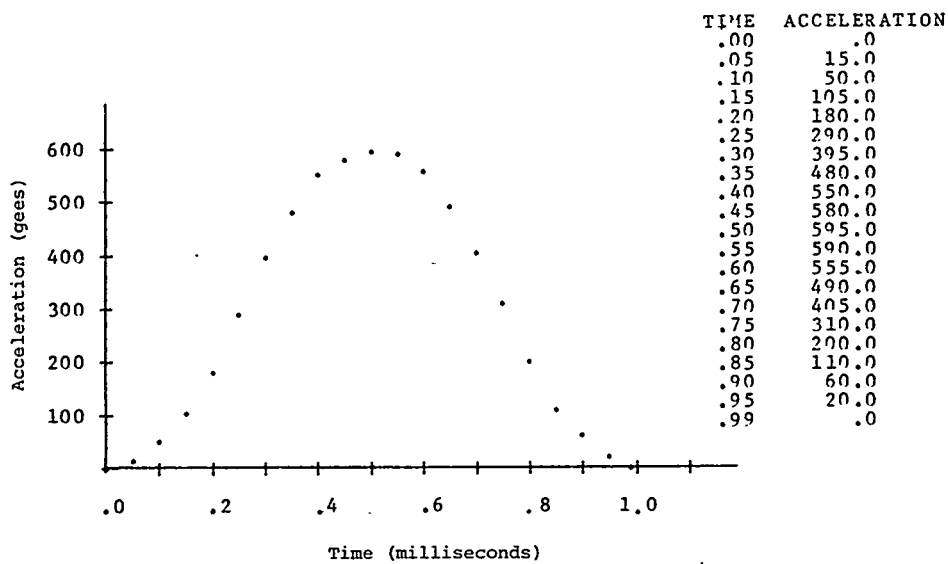


Fig. 52. LX-10-0
Lot 710-2
45°, 3.5'
Rotational Acceleration

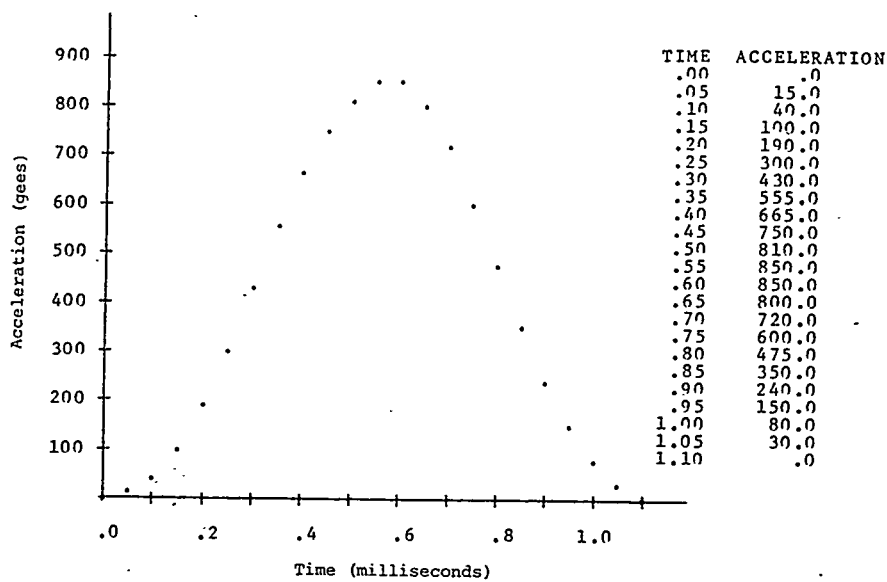


Fig. 53. LX-10-0
Lot 710-2
45°, 3.5'
Normal Acceleration

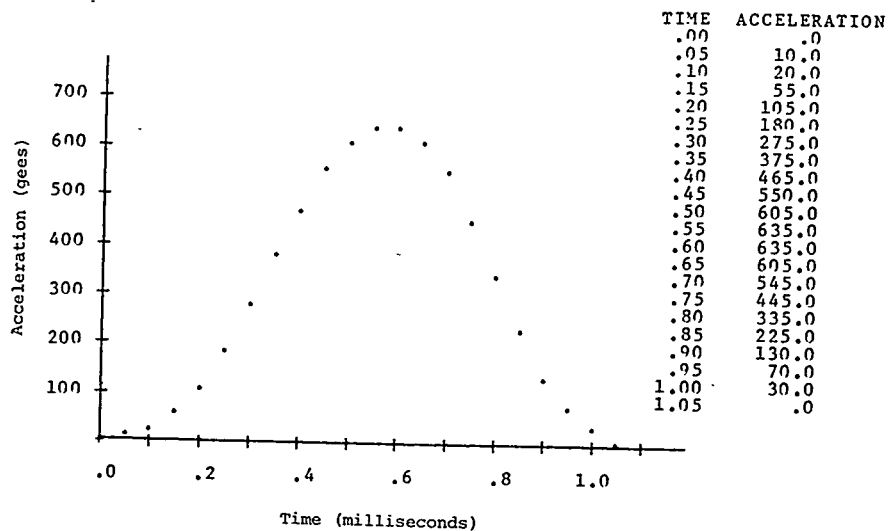


Fig. 54. LX-10-0
Lot 710-2
45°, 3.5'
Rotational Acceleration