AD

AD E402-785

Technical Report ARFSD-TR-96016

KINETICS LTD LOCK VALVE FIRST ARTICLE TEST REPORT

William Zepp

November 1996

US ARMY
TANK AUTOMOTIVE AND
ARMAMENTS COMMAND
ARMAMENT RDE CENTER

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Fire Support Armaments Center

Picatinny Arsenal, New Jersey

The views, opinions, and/or findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

The citation in this report of the names of commercial firms or commercially available products or services does not constitute official endorsement by or approval of the U.S. Government.

Destroy this report when no longer needed by any method that will prevent disclosure of its contents or reconstruction of the document. Do not return to the originator.

REPORT DOCUMENT PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 1996	

4. TITLE AND SUBTITLE

KINETICS LTD LOCK VALVE FIRST ARTICLE TEST REPORT

5. FUNDING NUMBERS

6. AUTHOR(S)

William Zepp

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

ARDEC, FSAC
Artillery and Indirect Fire Division (AMSTA-AR-FSA-W)
Picatinny Arsenal, NJ 07806-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

ARDEC, LSED
Information Research Center (AMSTA-AR-LSL)
Picatinny Arsenal, NJ 07806-5000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

Technical Report
ARFSD-TR-96016

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This report is a summary of the first article test conducted on the sample lock valves provided by Kinetics LTD in response to contract DAAE20-96-R-0034. The test procedures and their results for the three sample valves are provided.

14. SUBJECT TERMS

Lock Valve

15. NUMBER OF PAGES 82

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

CONTENTS

INTRODUCTION

To reduce procurement costs of the M109 Lock Valve (part no. 11784023) a competitive procurement solicitation, DAAE20-96-R-0034, was issued for a quantity of valves. To evaluate the samples submitted for consideration under the solicitation, a hydraulic test stand to verify compliance of drawing requirements is used. The sample valves delivered by the bidder, Kinetics LTD, under the procurement solicitation was tested using the procedure below during the period of 17 April through 10 May 1996.

TEST PROCEDURE

The procedure followed while conducting the first article test called out in the quality assurance provisions of drawing 11784023 is provided in appendeix A.

As required by the first article test requirments stated in the quality assurance provisions of drawing 11784023 and the valve cleanliness requirement stated on said drawing, a procedural plan was developed to insure compliance. This plan is provided in appendix B. Functional, hot climatic, and endurance testing was conducted under aspects of this plan within the clean room located in building 3150. The on-weapon tests could not be conducted within a similar environment due to the size and location of required environmental test cells. During these tests, precautions were taken to prevent exposure to contaminants while valves were changed and lines broken. On-weapon test data plots are provided in appendix C. Oil samples were taken throughout testing to verify compliance.

The cold climate test specified on the drawing 11784023 to be conducted at -50°F was waived from the test plan due to the lack of facilities and time constraints. This lack of verification of requirements was in now way held against the sample valves in evaluation of passing the test.

RECEIVING INSPECTION

Upon receiving the three sample valves submitted by Kinetics LTD., in accordance with the solicitation from Rock Island Arsenal, an initial inspection was conducted of the valves. The three valves were received in the original packaging provided by Kinetics LTD. The three valves had been packed individually with each valve wrapped in bubble wrap, placed in its own cardboard box, and sealed with tape. All three valves had protective back plates to protect the A and B ports. All three valves had o-ring sealed plugs installed in all ports. There was no evidence of any contamination by foreign particles or debris. All three valves were found to contain yellow oil which was MIL-H-46170 oil, not the required MIL-H-6083 oil. All ports were flushed by injecting clean MIL-H-6083 oil into the port until there was no visible trace of yellow oil in the effluence. Then each valve was flushed by passing fluid through all four possible pathways until there was no visible trace of yellow oil

in the effluence. No evidence of foreign matter or debris was found in the effluence. The yellow oil did not appear to adversely affect the valves performance.

TEST RESULTS

Results of the subtests are presented in table 1. To aid in test summary, passing a requirement was scored as 1. Failing a requirement, but within the value within measurement accuracy uncertainty, was scored 0.9 to 0.8. All other failures were scored as 0.

During the on-weapon testing and on all test stand tests, a "growl" sound was observed. On the test stand, this "growl" was first noticeable at a flow of 2 gal./min with its volume increasing with flow rate through the valve. During the on-weapon testing, the "growl" was first noticeable at a gunner's control handle rotation angle of 16 to 17 deg and increases as the flow rate increases with increasing handle angle up to the maximum rotation of 30 deg. At no time did the "growl" prevent normal verbal communications inside or outside the Paladin vehicle. Evaluation under the normal combat environment with the required double hearing protection could not be performed due to the lack of the required issue equipment. There is no noise/auditory requirement for the valve and the observed "growl" is just noted. There is no evidence that the flow noise "growl" had any effect on valve performance.

CONCLUSIONS

During the functional test, the Kinetics LTD valves failed. All valves failed requirement 7 at 250°F and valve SN KJ004 failed subtest 2 port M1 exhibiting excessive leakage. All valves passed the endurance test. All valves passed the on-weapon test except for rate inflection point that does not exist.

Based on the performance of the Kinetics LTD valve design derived from this test and compared to the Kemp valve performance with the recommended changes to requirements as documented in Technical Report ARFSD-TR-95013, Paladin Lock Valve Hydraulic Test Stand Upgrade and Baseline Validation, the Kinetics LTD valves outperformed the Kemp valves and would have passed all requirements.

RECOMMENDATIONS

1. The current Kinetics LTD design should be considered a valid source of supply for any procurement and the engineering change proposal to adjust the drawing requirements be amended to add Kinetics LTD to the list of approved sources. The following drawing corrections must be incorporated into any procurement.

Zone B4 sheet 1:

The counterbore depth is listed as .188 for .468 + .010/-.005 dia Cbore Depth .188. This should be changed to 1.88. Failure to incorporate this correction will result in procurement of valves that cannot be installed and may not be correctable.

2. The previously recommended adjustments to the requirements should be incorporated into any procurement so certification of conformance can be issued. These requirement adjustments are listed below.

Change note 11.B.6 to read:

"6. Operating Temperature: -50 Deg F to 250 Deg F. Table 1 requirements 3A (125 - 190 psi at -50 Deg F), 3c (on pressure - 140 psi at 250 Deg F), 4A (125 - 190 psi at -50 Deg F), 4c (on pressure - 140 psi at 250 Deg F), 5A (125 - 190 psi at -50 Deg F), 5c (on pressure - 140 psi at 250 Deg F), 6A (125 - 190 psi at -50 Deg F), 6c (on pressure - 140 psi at 250 Deg F)."

Change table 1, requirement no. 9 under "Apply Pressure Of" to read:

"125 to 200."

Delete note 11.B.3:

"A plot of the weapon speed vrses handle position (in degrees) shall show no inflection points."

Table 1
Test data

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		Start date			4/24/96		4/24/96		4/24/96	
		Start time			8:32		14:00		13:10	
	1									
		P A leakage	Y/N	N	N	1	N	1	N	1
		P B leakage	Y/N	N	N	1	N	1	N	1
	2									
		Port M1								
			Flow (cc)		12		17		38	
			Time (min)		5		5		5	
			Flow (cc/min)	1 < X < 6	2.4	1	3.4	1	7.6	0
		Port P1								
			Flow (cc)		17		15		19	
			Time (min)		5		5		5	
			Flow (cc/min)	1 < X < 6	3.4	1	3.0	1	3.8	1
		Port M2								
			Flow (cc)		14		29		31	
			Time (min)		5		5		5	
			Flow (cc/min)	1 < X < 6	2.8	1	5.8	1	6.2	0.9
		Port P2								
			Flow (cc)		18		21		24	
			Time (min)		5		5		5	
			Flow (cc/min)	1 < X < 6	3.6	1	4.2	1	4.8	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
	3									
		Oil temp (°F)			83		101.6		(NR)	
		On pres (psi)		125-170	157	1	157	1	170	1
		Flow (gpm)		2.9 min	3.65	1	3.3	1	3.5	1
		At ? pres (psi)		370 max	370	1	370	1	370	1
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	137	1	145	1	145	1
	4									
		Oil temp (°F)			(NR)		(NR)		(NR)	
		On pres (psi)		125-170	155	1	150	1	155	1
		Flow (gpm)		2.9 min	3.65	1	3.4	1	3.5	1
		At ? pres (psi)		370 max	370	1	370	1	370	1
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	135	1	145	1	140	1
	5									
		Oil temp (°F)			(NR)				(NR)	
		On pres (psi)		125-170	170	1	160	1	155	1
		Flow (gpm)		2.9 min	3.9	1	4+	1	3.7	1
		At ? pres (psi)		370 max	370	1	370	1	370	1
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	138	1	145	1	147	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
	6									
		Oil temp (°F)			(NR)		(NR)		(NR)	
		On pres (psi)		125-170	158	1	160	1	162	1
		Flow (gpm)		2.9 min	3.75	1	4+	1	3.7	1
		At ? pres (psi)		370 max	370	1	370	1	370	1
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	130	1	140	1	147	1
	7									
		Port A (drops/4 min		3 max	1	1	2	1	1	1
		Port B (drops/4 min		3 max	0	1	0	1	0	1
	8									
		Port P1 on pres (psi)		325-370	330	1	340	1	300	0.9
		Port P2 on pres (psi)		325-370	330	1	335	1	300	0.9
	9									
		Port M1 on pres (psi)		125-170	175	1	175	1	175	1
		Port M2 on pres (psi)		125-170	180	0.9	170	1	180	0.9
	10									
		Port P1 on pres (psi)		325-370	340	1	340	1	290	0.9

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		Port P2 on pres (psi)		325-370	345	1	350	1	300	0.9
	11									
		Port M1 on pres (psi)		125-170	190	0.9	185	0.9	170	1
		Port M2 on pres (psi)		125-170	190	0.9	190	0.9	180	0.9
	12									
		Total leak (drops)			195		59		93	
		Time (min)			4		2		4	
		Rate (drops/ min)		4 min	48.75	1	29.5	1	23.25	1
Hot test										
		Test date			4/30/96		4/30/96		4/30/96	
		Start oil temp (°F)			250		248.6		252	
	3									
		Oil temp (°F)			250		248.6		252	
		On pres (psi)		125-170	150	1	145	1	160	1
		Flow (gpm)		NA	3.9		3.8		4+	
		At ? pres (psi)		NA	370		370		330	
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	130	1	130	1	135	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		Oil temp (°F)			(NR)		(NR)		(NR)	
	4									
		Oil temp (°F)			(NR)		(NR)		238	
		On pres (psi)		125-170	160	1	145	1	150	1
		Flow (gpm)		NA	3.9		3.7		4+	
		At ? pres (psi)		NA	370		370		370	
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	125	1	130	1	135	1
		Oil temp (°F)			(NR)		(NR)		249.2	
	5									
		Oil temp (°F)			(NR)		(NR)		(NR)	
		On pres (psi)		125-170	155	1	150	1	150	1
		Flow (gpm)		NA	3.0		4+		4+	
		At ? pres (psi)		NA	370		330		300	
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	110	1	130	1	130	1
	6									
		Oil temp (°F)			249.2		(NR)		252.1	
		On pres (psi)		125-170	147	1	155	1	155	1
		Flow (gpm)		NA	4+		4+		4+	
		At ? pres (psi)		NA	330		330		330	

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		950 psi Y/N		Y	Y	1	Y	1	Y	1
		Off pres (psi)		On P +/- 50	130	1	120	1	130	1
	7									
		Oil temp (°F)			(NR)		(NR)		(NR)	
		Port A (drops/ min)		3 max	67	0	57	0	73	0
		Port B (drops/ min)		3 max	38	0	41	0	44	0
		Test end date			4/30/96		4/30/96		4/30/96	
		Final oil temp (°F)			262		244.7		259.6	
Shock										
	X	30 g/11 msec			30/11	1	30/11	1	30/11	1
		55 g/2.5 msec			55/2.5	1	55/2.5	1	55/2.5	1
		70 g/0.5 msec			70/1	1	70/1	1	70/1	1
	Y									
		30 g/11 msec			30/11	1	30/11	1	30/11	1
		55 g/2.5 msec			55/2.5	1	55/2.5	1	55/2.5	1
		70 g/0.5 msec			70/1	1	70/1	1	70/1	1
	Z									
		30 g/11 msec			30/11	1	30/11	1	30/11	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		55 g/2.5 msec			55/2.5	1	55/2.5	1	55/2.5	1
		70 g/0.5 msec			70/1	1	70/1	1	70/1	1
Vibra-tion										
	X	5-25 Hz/ +/- 1.5 g			5-25/1.5	1	5-25/1.5	1	5/25/1.5	1
		25-50 Hz/ 0.03 in.			25-50/5	1	25-50/5	1	25-50/5	1
		50-500 Hz/ +/- 5 g			50-500/ 5	1	50-500/ 5	1	50-500/ 5	1
	Y									
		5-25 Hz/ +/- 1.5 g			5-25/1.5	1	5-25/1.5	1	5/25/1.5	1
		25-50 Hz/ 0.03 in.			25-50/5	1	25-50/5	1	25-50/5	1
		50-500 Hz/ +/- 5 g			50-500/ 5	1	50-500/ 5	1	50-500/ 5	1
	Z									
		5-25 Hz/ +/- 1.5 g			5-25/1.5	1	5-25/1.5	1	5/25/1.5	1
		25-50 Hz/ 0.03 in.			25-50/5	1	25-50/5	1	25-50/5	1
		50-500 Hz/ +/- 5 g			50-500/ 5	1	50-500/ 5	1	50-500/ 5	1
Endur-ance										
		Cycles success-ful			Y	1	Y	1	Y	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
On-weap										
	Gun	Droop								
		Change in el (mils)			+0.5		+0.2		+0.8	
		Time duration (hrs)			1.00		1.05		1.03	
		Droop rate (mil/hrs)		1.5 max	0.5	1	0.19	1	0.77	1
Gun cycle time										
		Time 0 - max el (sec)		11 sec	8.93	1	9.97	1	9.04	1
		Time max el - 0 (sec)		11 sec	9.50	1	9.94	1	9.34	1
		Time 0 - max el (sec)		11 sec	8.90	1	9.43	1	8.59	1
		Time max el - 0 (sec)		11 sec	9.30	1	9.94	1	9.69	1
		Time 0 - max el (sec)		11 sec	8.90	1	9.35	1	8.53	1
		Time max el - 0 (sec)		11 sec	9.40	1	9.88	1	9.72	1
Gun el at 533 mils										
		El rate oscilla-tion	(Y/N)	N	N	1	N	1	N	1

Table 1
(cont)

				Req	Sample					
Funct test	Test no.				Kinetic 1	Pass/ fail	Kinetic 3	Pass/ fail	Kinetic 4	Pass/ fail
		Rate inflection point	(Y/N)	N	Y	0	Y	0	Y	0
		Min el/dep rate		130 mil/sec	150.4	1	136.3	1	146.5	1
		Manual handle motion	(Y/N)	N	N	1	N	1	N	1
				Totals (81 max)		77.7		77.8		76.3
				Test → pass/fail		F		F		F
Sample ident		Kinetic 1								
		DAAE20-96-R-0034								
		SN: KF001								
		Kinetic 3								
		DAAE20-96-R-0034								
		SN: KJ003								
		Kinetic 4								
		DAAE20-96-R-0034								
		SN: KJ004								

Note: (NR) - data element not recorded.

APPENDIX A

TEST PLAN AND PROCEDURES

9 May, 1996

Qualification Test Plan
For Lock Valve, PN 11784023

1. Material for test:

   A. Provided by test agency:

      1 Valve Test Stand
      1 Climatic Chamber
      1 Oil Chiller System
      Oil, Hydraulic, MIL-H-6083
      Filter Element,
      Filter Element,
      Wipes, Lint-free
      Jars, Sample, Lint-free
      Cylinder, Graduated

   B. Provided by contractor:

      3 Sample Valves (each vendor)

   C. Calibration hardware to support this TP.

2. Objective of Test:: Demonstrate vendor's capability of meeting the design requirements called out on drawing No. 11784023.

3. Safety Precautions in Handling and Testing: TBD

4. Recommended Test Program

   A. Each of the required valve samples supplied by a potential vendor shall be subjected to the following sequence of subtests to satisfy the Qualification Test requirement of paragraph 4.3 of QAP. Valves can be tested individually or as a batch(s) through subtest sequence.

   B. Subtest 1 - Shock/Vibration Test

      1) Test verifies compliance to Note 11.A on drawing 11784023.

      2) Test procedure as depicted in Appendix A shall be followed to perform the test.

3) The test data form depicted in Appendix A shall be filled out for each execution to test procedure.

C. Subtest 2 - Functional Test

1) Test verifies compliance to requirements 1 through 12 of Table I and Note 14 on drawing 11784023.

2) Test procedure as depicted in Appendix B shall be followed to perform the test.

3) The test data form depicted in Appendix B shall be filled out for each execution of test procedure.

D. Subtest 3 - Climatic Test

1) Test verifies compliance to requirements 3.a, b, and c, 4.a, b, and c, 5.a and c, 6.a and c, 7 of Table and note 11.B.6, at 250 degrees Fahrenheit only (cold phase waived), on drawing 11784023.

2) Test procedure as depicted in Appendix C shall be followed to perform the test.

3) The test data form depicted in Appendix C shall be filled out for each execution of test procedure.

E. Subtest 4 - Weapon Elevation Rate/Hold Test

1) Test verifies compliance to Notes 11.B.1, 11.B.1.1, 11.B.2, 11.B.3, and 11.B.4 on drawing 11784023.

2) Test procedure as depicted in Appendix D shall be followed to perform the test.

3) The test data form depicted in Appendix D shall be filled out for each execution of test procedure.

F. Subtest 5 - Endurance Test

1) Test verifies compliance to note 11.B.7 on drawing 11784023.

2) Test procedure as depicted in Appendix E shall be followed to perform the test.

3) The test data form depicted in Appendix E shall be filled out for each execution of test procedure.

5. References:

Valve Assembly, Lock	Drawing No.	11784023
Quality Assurance Provisions	QAP	11784023

6. Disposition

Sample valves shall be returned to submitted upon completion of test.

7. Type of Report and Security Classification

A. Letter report with copies of all test data forms generated as attachments.

B. Security Classification - Unclassified

8. Report Distribution

A. A copy of this test plan shall be included in the test report.

B. Statement C. Distribution authorized to U.S. Government Agencies and their contractors: Test and Evaluation, June 2, 1993. Other request for this document shall be referred to OPM PALADIN, ATTN: SFAE-FAS-PAL, Picatinny Arsenal, NJ 07806-5000.

C. Copies to:

Office	No. of Copies
AMSTA-AR-FSA-W	1
AMSTA-AR-QAA-R	1
SFAE-FAS-PAL	1
AMSTA-AC-TP	1

APPENDIX A - SHOCK/VIBRATION TEST

1. Shock and vibration testing shall be conducted in accordance with MIL-STD-810E which in entitled "Environmental Test Methods and Engineering Guidelines".

2. The shock shall be conducted in accordance with method 516.4, procedure 1. The vibration shall be conducted in accordance with method 514.4, category 8.

3. All the requirements of MIL-STD-810E apply with the exception that the tolerance on time in paragraph 5.1.1. be changed from +/- 1% to +/- 10%.

4. The following tables are provided for easy reference for the magnitude, frequency, time duration, and tolerances.

Shock

Each valve shall be subjected to 3 half-sine wave impulses for each combination in table 1.

Axis	Magnitude (g's)	Duration (millisec.)
X	30 +/- 3	11 +/- 1.1
Y	30 +/- 3	11 +/- 1.1
Z	30 +/- 3	11 +/- 1.1
X	55 +/- 5.5	2.5 +/- 0.25
Y	55 +/- 5.5	2.5 +/- 0.25
Z	55 +/- 5.5	2.5 +/- 0.25
X	70 +/- 7	0.5 +/- 0.05
Y	70 +/- 7	0.5 +/- 0.05
Z	70 +/- 7	0.5 +/- 0.05

TABLE 1

Vibration

Each valve shall be subjected to each combination in table 2.

Axis	Frequency (Hz)	Frequency Tolerance	Magnitude	Magnitude Tolerance
X	5 - 25	+/- 2%	+/- 1.5 G	+/- 0.15 G
Y	5 - 25	+/- 2%	+/- 1.5 G	+/- 0.15 G
Z	5 - 25	+/- 2%	+/- 1.5 G	+/- 0.15 G
X	25 - 50	+/- 2%	0.030 IN.	+/- 0.0003 IN.
Y	25 - 50	+/- 2%	0.030 IN.	+/- 0.0003 IN.
Z	25 - 50	+/- 2%	0.030 IN.	+/- 0.0003 IN.
X	50 -500	+/- 2%	+/- 5.0 G	+/- 0.5 G
Y	50 -500	+/- 2%	+/- 5.0 G	+/- 0.5 G
Z	50 -500	+/- 2%	+/- 5.0 G	+/- 0.5 G

TABLE 2

Shock and Vibration
Test Document Sheet

Manufacturer:_____
Sample #:_____ Test date:_____

Shock

Axis	Magnitude	Duration

Vibration

Axis	Frequency	Magnitude

APPENDIX B - FUNCTIONAL TEST

GENERAL PREPARATION

- Connect pressure and return lines (large and small lines) from test stand to reservoir.

- Fill reservoir with hydraulic fluid conforming to MIL-H-6083 so that fluid is seen in the level gage.

- Plug the power cord #1 into a 120 volt AC grounded wall outlet. The outlet should be capable of supplying 15 amps.

- Plug the power cord #2 into a 220 volt three phase AC grounded wall outlet. The outlet should be capable of supplying 30 amps.

- Turn switches M1, M3, V1, V2, and V3 to OFF position.

- Verify STOP switch is in ON position (out/released).

- Set cyclic controller switch to "By Passed".

- Press START button to energize stand.

- Make sure the O-rings at the A and B ports of the lock valve are properly installed. Mount the lock valve assembly to the hydraulic manifold so that the port identification markings are up-side-down.

Performance Requirement Number 1

1. Install plugs in ports M1, M2, P1, and P2.

2. Connect the line from the hand pump to the High Pressure Y Adapter. Connect Y Adapter to Port A and Port B.

3. Close valve at the base of the hand pump by rotating fully clockwise until seated. The hand pump extension handle is notched for this purpose.

4. Operate hand pump until a pressure of 8,000 to 10,000 PSI is achieved.

5. After standing for 2 minutes at 8,000 to 10,000 PSI, check valve for external leakage. Record any leakage observed. No external leakage is permitted.

6. Relieve pressure by rotating valve at the base of the hand pump counter-clockwise.

7. Performance Requirement Number 1 is complete.

Performance Requirement Number 2

1. Remove Y-Adapter from A and B ports. (Quick disconnects should already be installed in M and P ports from Performance Requirement Number 1.)

2. Connect line 1 to M1 port. Connect line 2 to M2 port.

3. Place switches V1 and V3 in the ON position (V2 OFF).

4. Rotate the knob at the base of the 200 PSI pressure gage fully counter-clockwise. Also rotate the knob on Throttle Valve 1 fully counter-clockwise.

5. Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) to indicate 75 +5 PSI on the 200 PSI pressure gage. Allow the system to run for 2 to 3 minutes to purge the air from the system.

6. Connect line 1 to P1 port. Connect line 2 to P2 port.

7. Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) to indicate 75 +5 PSI on the 200 PSI pressure gage. Allow the system to run for 2 to 3 minutes to purge the air from the system.

8. Turn the pump off and remove line 2. Attach the loose drain line to port M2 placing the open end in a graduated cylinder. First configuration in table below.

9. Run the pump for a predetermined period of time. (Suggest 5 minutes).

10. At the end of the predetermined time, turn the pump off and measure the volume of fluid collected. Divide the volume by the time and record the flow rate. Flow in excess of 6 cc per minute or less then 1 cc per minute will not be permitted. No leakage shall be evidenced at either port A or B.

11. Repeat step 2 through 8 with line connections and switches according to the following table.

Pressure Line	Drain Line	Switches ON	Switches OFF
1 on M1	M2	V1	V2 & V3
1 on P1	P2	V1	V2 & V3
2 on M2	M1	V1 & V3	V2
2 on P2	P1	V1 & V3	V2

12. Performance Requirement Number 2 is complete. Turn switch M3 to OFF position to stop primary pump.

Performance Requirement Number 3

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2, A, and B to their respective ports P1, P2, A, and B. No lines are to be connected to M1 and M2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switch V1 ON position and switched V2 and V3 in the OFF position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Turn Throttle Valve 1 clockwise until full flow through the lock valve is achieved. Do not exceed 370 PSI. Record maximum flow. Close valve to 600 PSI gage by turning clockwise fully.

8. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI or has seated, if pressure not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

9. Turn Throttle Valve 1 counter-clockwise until flow ceases.

10. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

11. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

12. Performance Requirement Number 3 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Pressure Requirement Number 4

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports P1, P2, A, and B. No lines are to be connected to M1 and M2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1, V2, and V3 in the ON position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Turn Throttle Valve 1 clockwise until full flow through the lock valve is achieved. Do not exceed 370 PSI. Record maximum flow. Close valve to 600 PSI gage by turning clockwise fully.

8. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI or has seated, if pressure not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

9. Turn Throttle Valve 1 counter-clockwise until flow ceases.

10. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

11. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

12. Performance Requirement Number 4 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 5

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports M1, M2, A, and B. No lines are to be connected to P1 and P2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1 in ON position and switches V2 and V3 in the OFF position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Turn Throttle Valve 1 clockwise until full flow through the lock valve is achieved. Do not exceed 370 PSI. Record maximum flow. Close valve to 600 PSI gage by turning clockwise fully.

8. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI or has seated, if pressure not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

9. Turn Throttle Valve 1 counter-clockwise until flow ceases.

10. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

11. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

12. Performance Requirement Number 5 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 6

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports M1, M2, A, and B. No lines are to be connected to P1 and P2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1, V2, and V3 in the ON position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Turn Throttle Valve 1 clockwise until full flow through the lock valve is achieved. Do not exceed 370 PSI. Record maximum flow. Close valve to 600 PSI gage by turning clockwise fully.

8. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI or has seated, if pressure not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

9. Turn Throttle Valve 1 counter-clockwise until flow ceases.

10. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

11. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

12. Performance Requirement Number 6 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 7

1. Remove all lines from ports M1, M2, P1 and P2. Connect line A to port A and line B to port B.

2. Orient valve so ports M1, M2, P1 and P2 are facing down.

3. Install appropriate adapters in ports M1, M2, P1 and P2. (Fill with fluid as necessary.)

4. Adjust throttle valves to full counter-clockwise position.

5. Rotate knob at the base of the 200 PSI gage full clockwise.

6. Start primary pump by setting switch M3 to ON. Place switch V2 in the ON position to test the A port.

7. Adjust throttle valve (TV1) to obtain pressure of 200 +/- 10 PSI. Maintain for a minimum of four minutes. Count total number of drops from all ports during time period.

8. Turn off pump by setting switch M3 to OFF and record the number of drops from M1, M2, P1, and P2 ports. Leakage to be three drops or less.

9. Repeat steps 6 though 8 with switch V2 in the OFF position to test B port.

10. Performance Requirement Number 7 is complete.

Performance Requirement Number 8

1. Remove adapters from ports M1, M2, P1, and P2 and install quick disconnects.

2. Connect Line A to port A and Line B to port B.

3. Connect line 1 to port P1.

4. Connect line E to any M or P line in bundle and bundle line to port P2.

5. Set switch V1 to ON position and switches V2 and V3 to OFF position.

6. Adjust throttle valves to full counter-clockwise position.

7. Rotate knob at base of 200 PSI gage fully clockwise.

8. Turn primary and secondary pump on by setting switch M3 and M1 to ON.

9. Adjust Throttle Valve 3 (TV3) to indicate 200 PSI on the 600 PSI pressure gage G2 and adjust Throttle Valve 1 (TV1) to indicate 200 PSI on the 600 PSI pressure gage G1. Alternating between the two during pressure increase.

10. Turn Throttle Valve 1 clockwise until flow is evident by drop in Line 1 pressure by a flow meter. Do not exceed 370 PSI. Record pressure when flow becomes evident. Flow evident at pressures below 325 PSI will not be permitted.

11. Rotate Throttle Valve 1 counter-clockwise until 200 PSI is indicated on the 600 PSI pressure gage G1.

12. Turn of pumps by setting switch M3 and M1 to OFF.

13. Disconnect lines 1 and bundle line connected to line E from ports P1 and P2.

14. Connect bundle line connected line E to port P1 and line 1 to port P2.

15. Repeat steps 8 through 13.

16. Performance Requirement Number 8 is complete.

Performance Requirement Number 9

1. Connect line G to bundle line B and line F to bundle line A.

2. Connect bundle line B to port B and bundle line A to port A.

3. Connect line 1 to port P1 and line 2 to port P2.

4. Set switch V1 to ON and switches V2 and V3 to OFF position.

5. Adjust Throttle Valves to full counter-clockwise position.

6. Rotate knob at base of 200 PSI gage fully counter-clockwise position.

7. Turn primary and secondary pumps on by setting switches M3 and M1 to ON.

8. Adjust Throttle Valve 3 (TV3) to indicate 500 PSI on the 600 PSI pressure gage G2.

9. Adjust Throttle Value 1 (TV1) to indicate 50 PSI on the 200 PSI pressure gage.

10. Turn Throttle Valve 1 clockwise until flow is evident buy drop in Line 1 pressure or by a flow meter. Do not exceed 170 PSI. Record pressure when flow becomes evident. Flow evident at pressures below 125 PSI will not be permitted.

11. Rotate Throttle Valve 1 counter-clockwise until 50 PSI in indicated on the 200 PSI pressure gage.

12. Turn off pumps by setting switches M3 and M1 to OFF.

13. Disconnect line 1 from port P1.

14. Disconnect line 2 from port P2.

15. Connect line 1 to port P2 and line 2 to port P1.

16. Repeat steps 7 though 12.

17. Performance Requirement Number 9 is complete.

Performance Requirement Number 10

1. Remove adapters from ports M1, M2, P1, and P2 and install quick disconnects.

2. Connect line A to port A and line B to port B.

3. Connect line 1 to port M1.

4. Connect line E to any M or P line in bundle and bundle line to port M2.

5. Set switch to ON position and switches V2 and V3 to OFF position.

6. Adjust Throttle Valves to full counter-clockwise position.

7. Rotate knob at base of 200 PSI gage fully clockwise.

8. Turn primary and secondary pumps on by setting switches M3 and M1 to ON.

9. Adjust Throttle Valve 3 (TV3) to indicate 200 PSI on the 600 PSI pressure gage G2 and adjust Throttle Valve 1 (TV1) to indicate 200 PSI on the 600 PSI pressure gage G1. Alternating between the two during pressure increase.

10. Turn throttle Valve 1 clockwise until flow is evident by drop in Line 1 pressure or by a flow meter. Do not exceed 370 PSI. Record pressure when flow becomes evident. Flow evident at pressures below 325 PSI will not be permitted.

11. Rotate Throttle Valve 1 counter-clockwise until 200 PSI is indicated on the 600 PSI pressure gage G1.

12. Turn off pumps by setting switches M3 and M1 to OFF.

13. Disconnect lines 1 and bundle line connected to line E from ports M1 and M2.

14. Connect bundle line connected to line E to port M2 and line 1 to port M1.

15 Repeat steps 8 through 13.

16. Performance Requirement Number 10 is complete.

Performance Requirement Number 11

1. Connent line G to bundle line B and line F to bundle line A.

2. Connect bundle line B to port B and bundle line A to port A.

3. Connect line 1 to port M1 and line 2 to port P2.

4. Set switch V1 to ON and switches V2 and V3 to OFF position.

5. Adjust Throttle Valves to full counter-clockwise position.

6. Rotate knob at base of 200 PSI gage fully counter-clockwise position.

7. Turn primary and secondary pump on by setting switches M3 and M1 to ON.

8. Adjust Throttle Valve 3 (TV3) to indicate 500 PSI on the 600 PSI pressure gage G2.

9. Adjust Throttle Valve 1 (TV1) to indicate 50 PSI on the 200 PSI pressure gage.

10. Turn Throttle Valve 1 clockwise until flow is evident by drop in Line 1 pressure or by a flow meter. Do not exceed 170 PSI. Record pressure when flow becomes evident. Flow evident at pressures below 125 PSI will not be permitted.

11. Rotate Throttle Valve 1 counter-clockwise until 50 PSI in indicated on the 200 PSI pressure gage.

12. Turn off pumps by setting switches M3 and M1 to OFF.

13. Disconnect line 1 from port M1.

14. Disconnect line 2 from port M2.

15. Connect line 1 to port M2 and line 2 to port M1.

16. Repeat steps 7 though 12.

17. Performance Requirement Number 11 is complete.

Performance Requirement Number 12

1. Connect line A to Y adapter and Y adapter to ports A and B.

2. Install male quick disconnects on ports M1, M2, P1, and P2 if not already installed.

3. Install quick disconnects with tubes of ports P1 and M1.

4. Place graduated receptacle under the two tubes to collect fluid.

5. Rotate the knob at the base of the 200 PSI pressure gage and the 600 PSI pressure gage G1 fully counter-clockwise. Also, rotate the knob on Throttle Valve 1 fully counter-clockwise.

6. Place switches V1 and V3 in the ON position and switch V2 to OFF position.

7. Turn primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) to indicate 2000 PSI an the 3000 PSI pressure gage or has seated, if pressure not within range turn Throttle Valve 2 clockwise until required pressure is achieved. Run pump for a predetermined time while counting total number of drops from all disconnects.

8. At the end of the predetermined time, turn the pump off by setting switch M3 to OFF and record total number of drops. Divide the volume number of drops by the time. Record rate. Flow less the 4 drops per minute will not be permitted.

9. Transfer quick disconnects with tubes from port M1 and P1 to M2 and P2.

10. Repeat steps 4 through 8.

11. Performance Requirement Number 12 is complete.

Test Documentation Sheet
for Lock Valve PN 11784023

FUNCTIONAL TEST

Contract:_____ Test Date:_____

Manufacturer:_____

Sample #:_____ Test Time:_____

Test 1:

PORT A:	Leakage	or	No Leakage
PORT B:	Leakage	or	No Leakage

Test 2:

Port	Flow(cc)	Duration(sec.)	Flow Rate(cc/sec)
M1	_____	_____	_____
P1	_____	_____	_____
M2	_____	_____	_____
P2	_____	_____	_____

Test 3: P1 to B

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 4: P2 to A

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 5: M1 to B

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 6: M2 to A

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 7:

At 200 psi

Port A _____ drops / 4 minutes

Port B _____ drops / 4 minutes

Test 8:

a. Port P1 On Pressure (psi)_____

b. Port P2 On Pressure (psi)_____

Test 9:

a. Port P1 On Pressure (psi)_____

b. Port P2 On Pressure (psi)_____

Test 10:

a. Port M1 On Pressure (psi)_____

b. Port M2 On Pressure (psi)_____

Test 11:

a. Port M1 On Pressure (psi)_____

b. Port M2 On Pressure (psi)_____

Test 12:

Total Leakage Volume (drops):_____

Duration: _____

Leakage Rate (drops/sec.):_____

16 June 95

APPENDIX C - CLIMATIC TEST

Climatic Test - Hot Phase 11 Aug 95

GENERAL PREPARATION

- Connect pressure and return lines (large and small lines) from test stand to reservoir.

- Fill reservoir with hydraulic fluid conforming to MIL-H-6083 so that fluid is seen in the circular "bulls eye" level gage.

- Plug the power cord into a 120 volt AC grounded wall outlet. The outlet should be capable of supplying 15 amps.

- Make sure the O-rings at the A and B ports of the lock valve are properly installed. Mount the lock valve assembly to the hydraulic manifold so that the port identification markings are up-side-down.

- Mount Valve Stand onto the test stand.

- Wire each Fluid Heater into a 220 volt single phase AC grounded Breaker box. The Breaker box should be capable of supplying 12 amps.

- Turn switches M1, M3, V1, V2, and V3 to OFF position.

- Ensure STOP switch is in on position (out/released).

- Set cyclic controller switch to "By Passed".

- Press START button to energize stand.

- Run Fluid Heater until fluid temperature stabilizes at 250 degrees Fahrenheit while circulating the fluid. Adjust Heater so that the fluid temperature as it enters the Valve Stand is at 250 degrees Fahrenheit.

- Install valve to be tested onto the test stand. Flow oil through valve at temperature alternated between P1 and P2 ports for five (5) minutes to temperature condition valve prior to any testing. Repeat with M1 and M2 port pair.

Performance Requirement Number 3

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports P1, P2, A, and B. No lines are to be connected to M1 and M2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1 in the ON position and switches V2 and V3 in the OFF position.

6. * Turn the primary pump on by setting switch M3 ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI, or has seated, if pressure is not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

8. Turn Throttle Valve 1 counter-clockwise until full flow ceases.

9. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

10. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

11. Performance Requirement Number 3 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 4

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports P1, P2, A, and B. No lines are to be connected to M1 and M2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1, V2, and V3 in the ON position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI, or has seated, if pressure is not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

8. Turn Throttle Valve 1 counter-clockwise until full flow ceases.

9. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

10. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

11. Performance Requirement Number 4 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 5

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports M1, M2, A, and B. No lines are to be connected to P1 and P2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1 in the ON position and switches V2 and V3 in the OFF position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI, or has seated, if pressure is not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

8. Turn Throttle Valve 1 counter-clockwise until full flow ceases.

9. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

10. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

11. Performance Requirement Number 5 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 6

1. Install quick disconnects in all valve ports.

2. Connect lines 1, 2 A, and B to their respective ports M1, M2, A, and B. No lines are to be connected to P1 and P2.

3. Rotate knobs on both Throttle Valves fully counter-clockwise.

4. Rotate knob at the base of the 200 PSI gage fully counter-clockwise.

5. Place switches V1, V2, and V3 in the ON position.

6. * Turn the primary pump on by setting switch M3 to ON and adjust Throttle Valve 1 (TV1) clockwise until flow is evident. (Note: Do not exceed 200 PSI. If flow is not evident by 200 PSI, rotate knob at the base of the 200 PSI gage fully clockwise and continue testing using the 600 PSI gage.) Record the pressure at which flow becomes evident.

7. Continue turning Throttle Valve 1 until the pressure indicated on the 3000 PSI pressure gage reads between 925 PSI and 950 PSI, or has seated, if pressure is not within range turn Throttle Valve 2 clockwise until required pressure is achieved.

8. Turn Throttle Valve 1 counter-clockwise until full flow ceases.

9. Record the pressure at which flow ceased. (Note: If the pressure is less then 200 PSI, turn the knob at the base of the 200 PSI gage fully counter-clockwise and read the pressure from the 200 PSI gage.) Pressure when the flow ceases shall be within 50 PSI of the pressure required to initiate flow.

10. Turn off pump by setting switch M3 to OFF and place all switches in the OFF position.

11. Performance Requirement Number 6 is complete.

* If additional pressure is desired on the lock valve, Throttle Valve 2 (TV2) can be rotated clockwise.

Performance Requirement Number 7

1. Remove all lines from ports M1, M2, P1, and P2. Connect line A to port A and line B to port B.

2. Orient valve so ports M1, M2, P1, and P2 are facing down.

3. Install appropriate adapters in ports M1, M2, P1, and P2. (Fill with fluid as necessary.)

4. Adjust throttle valves to full counter-clockwise position.

5. Rotate knob at the base of the 200 PSI gage full clockwise.

6. Start primary pump by setting switch M3 to ON. Place switch V2 on the ON position to test the A port.

7. Adjust throttle valve TV1 to obtain pressure of 200 +/- 10 PSI. Maintain for a minimum of four minutes. Count total number of drops from all ports during time period.

8. Turn off pump by setting switch M3 to OFF and record the number of drops M1, M2, P1, and P2 ports. Leakage to be three drops or less.

9. Repeat steps 6 though 8 with switch V2 in the OFF position to test the B port.

10. Performance Requirement Number 7 is complete.

Test Documentation Sheet
for Lock Valve PN 11784023

CLIMATIC TEST

HOT PHASE

Contract:_____ Test Date:_____

Manufacturer:_____

Sample #:_____

Chamber Temperature (At Start of Test):_____

Oil Temperature (At Start of Test):_____

Test 3: P1 to B

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 4: P2 to A

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 5: M1 to B

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 6: M2 to A

a. On Pressure (psi) _____

b. Flow (gpm)_____ at psi_____

c. Off Pressure (psi)_____

Test 7:

At 200 psi

Port A _____ drops / 4 minutes

Port B _____ drops / 4 minutes

Chamber Temperature (At End of Test):_____ Test End Date:_____

Oil Temperature (At End of Test):_____ Test End Time:_____

APPENDIX D - WEAPON ELEVATION RATE/HOLD TEST

GENERAL PREPARATION

1. An M109A6 will be used to test the lock valve's on-vehicle performance.

2. Prior to installing the valve, ensure that the gun is in travel lock and the hydraulic system is properly discharged (para. 18-1a from TM 9-2350-314-20-2-2).

3. Remove the presently installed lock valve, and replace it with the test lock valve (para. 10-8b and c from TM 9-2350-314-34-2). The removed lock valve should be properly plugged and placed into protective packaging to ensure the valve is not contaminated.

4. Prior to the initiation of testing, ensure that the equilibration/elevation system is properly charged (para. 28-10 of TM 9-2350-314-20-2-2), bled, and equilibrated (para. 18-1e and f of TM 9-2350-314-20-2-2).

5. The ability to retain a set elevation over a period of time shall be verified. Elevate the gun tube to 700 mils and verify using a gunner's quadrant. Record the time and elevation. Allow the vehicle to remain undisturbed for one hour. Then use the gunner's quadrant to determine the elevation. Record the time and elevation Determine the differences between the times and elevations. For a minimum time difference of one hour there is a maximum allowable elevation difference of 1.5 mils. The fluid temperature must remain at 75 +/- 5 degrees F during the test.

6. The gun tube cycle time between 0 mils and max. elevation shall be verified. Turn the hydraulics on and set the gun tube elevation at 0 mil. Use the COS control handle to raise the gun tube to max. elevation at full speed. Measure and record the amount of time expended to complete this operation. Starting with the gun tube at max. elevation, use the expended time shall not exceed 11 seconds. The ambient temperature must be 70 +/- 15 degrees F and the fluid temperature must be 980 +/- 30 degrees F. Repeat this procedure twice.

7. The gun elevation rate in mils per sec shall be measured for varying degrees of gun control handle actuation. Bring the gun tube to the lower stop and with the hydraulics off, pull the COS control handle 7.5 degrees off the centered position. Turn the hydraulic on and allow the gun to elevate to the upper stop. Use the vehicle's elevation tachometer to determine the elevation rate while simultaneously using the DRU to determine the elevation. This data will be used to create plots of elevation velocity verses time for the ranges of 0-300 mils, 500-800 mils, and 1000-3000 mils. This shall be repeated with the control handle at 10, 15, 20, 25, and 30 degrees off neutral position. For each curve, there

shall be no oscillation greater than +/- 5% about the curve's mean value (this requirement is not to held for the start and stop oscillation). The velocity at 533 mils for each control handle position shall be used to create a second plot of velocity verses handle position. This curve shall be no inflection points.

8. The gun elevation rate in mils per sec shall be measure for a constant manual elevation hand pump rotation. Remove the manual elevation pump handle assembly (para. 10-14a of TM 9-2350-314-34-2) and install a gear in its place. The gear should be mated with another gear that is mounted to an electric motor. The electric motor will be used to elevate the gun at a constant handle rotation. A plot of the elevation velocity verses time shall be created for motion between 400 and 700 mils. The curve shall fall within +/- 5% of the mean curve (this requirement is not to be held for the start and stop oscillations).

9. The elevation/depression rate shall be measured for the full range of gun elevations. Using the COS control handle, the gun shall be elevated from the lower gun stop to the upper gun stop while the elevation rate is recorded. This shall be repeated while going from max. elevation to max. depression. The minimum elevation/depression rate shall be no less than 130 mils/sec.

10. During conduct of the above test procedures, there is no allowable motion from the manual elevation hand crank during power elevation. (Motion would most likely occur when the gun is brought into either the upper or lower stop.)

11. This completes the on vehicle test for the valve. The above procedure should now be duplicated for any additional valve. If there are no additional valves the howitzer should be returned to the original configuration.

On Vehicle Testing
Test Document Sheet

Manufacturer:_____ Sample #:_____
Test date:_____

Gun Droop

Start Time_____ Elevation_____
Finish Time_____ Elevation_____
Time Duration_____ Elevation Delta_____

Gun Cycle Time

Elevation time_____ Depression Time_____
Elevation time_____ Depression Time_____
Elevation time_____ Depression Time_____

Gun Velocity at 533 Mils

Off Center Position of Control Handle_____ Velocity_____
Off Center Position of Control Handle_____ Velocity_____
Off Center Position of Control Handle_____ Velocity_____
Off Center Position of Control Handle_____ Velocity_____
Off Center Position of Control Handle_____ Velocity_____
Off Center Position of Control Handle_____ Velocity_____

APPENDIX E - ENDURANCE TEST

GENERAL PREPARATION

- Connect pressure and return lines (large and small lines) from test strand to reservoir.

- Fill reservoir with hydraulic fluid conforming to MIL-H-6083 so that fluid is seen in the circular "bulls eye" level gage.

- Plug the power cord #1 into a 120 volt AC grounded wall outlet. The outlet should be capable of supplying 15 amps.

- Plug the power cord #2 into a 220 volt three phase AC grounded outlet. The outlet should be capable of supplying 30 amps.

- Plug the power cord from refrigeration unit into 220 volt single pase connector. Install refrigeration unit coil into reservoir and adjust system to maintain 150 degrees Fahrenheit or less.

- Turn switches M1 and M3 to OFF and V1, V2, and V3 to ON.

- Insure STOP switch is in ON position (out/released).

- Set cyclic controller switch to NORMAL.

- Press START button to energize the stand.

- Make sure the O-rings at the A and B ports of the lock valve are properly installed. Mount the lock valve assembly to the hydraulic manifold so that the port identification markings are up-side-down.

- Requires approximately 6.5 hours to perform 18000 cycles on each pair of ports.

Test Procedure

1) Rotate knobs at base of 200 and 600 PSI gages fully clockwise.

2) Connect line 1 to port P1, line 2 to port P2, line A to port A, and line B to port B.

3) Set cyclic controller switch to STANDBY. Turn on primary pump by setting switch M3 to ON and adjust throttle valve VT1 to obtain pressure of 1250 PSI. Adjust throttle valve VT2 if required to obtain required pressure. Turn off switch M3.

4) Set cyclic controller switch from STANDBY to NORMAL. Set switch M3 to ON. Set cyclic controller power switch to ON. Reset counter.

5) Set cyclic controller to start test. After controller stops, record results and reset controller if counter reads 18000 or HP1 or HP2 status light are on. If L{P status light is on, do not reset counter and correct servo valve failure and continue test.

6) Turn off pump by setting switch M3 to OFF.

7) Connect line 1 to port M1 and line 2 to port M2 and repeat steps 3 to 5.

8) Test completed.

NOTE: HP1 and HP2 indicator light ON indicate Lock Valve failure to shift spool. LP indicator light ON indicates stand servo valve failure.

ENDURANCE TEST DATA SHEET

MANUFACTURER:_____

SN:_____

P1 - P2

DATE TEST STARTED:_____

TIME TEST STARTED:_____

DATE TEST ENDED:_____

TIME TEST ENDED:_____

CYCLE COUNTER READING AT START:_____

CYCLE COUNTER READING AT END:_____

INDICATOR STATUS AT END OF TEST

INDICATOR	LIGHT ON?	
LP	Y	N
HP1	Y	N
HP2	Y	N

M1 - M2

DATE TEST STARTED:_____

TIME TEST STARTED:_____

DATE TEST ENDED:_____

TIME TEST ENDED:_____

CYCLE COUNTER READING AT START:_____

CYCLE COUNTER READING AT END:_____

INDICATOR STATUS AT END OF TEST

INDICATOR	LIGHT ON?	
LP	Y	N
HP1	Y	N
HP2	Y	N

APPENDIX B

HYDRAULIC CONTAMINATION CONTROL PLAN

2 Mar 95

Hydraulic Contamination Control Plan

AMSTA-AR-FSA-W

MEMORANDUM FOR RECORD

SUBJECT: Hydraulic Contamination Control

1. The purpose of this memo is to provide guidance material to be followed during the hydraulic testing of M109 lock valves. Adherence to the following instructions will assure that the requisite cleanliness level 200 of MIL-STD-1246 is met.

2. Instructions for lock valve testing include:

- Gross cleaning as specified in MIL-STD-1246B will be employed.
- The test area will be maintained in a visually clean state.
- Only clean lint free rags will be used on the test stand and components.
- The lock valve protective packaging will not be opened until the valve is required for testing. The packaging will be cleaned before movement to the test stand to remove dust and dirt. This will apply to any other hydraulic components needed for the test stand.
- All open ports and fittings will be plugged or capped immediately when not in use. Plugs or caps will only be removed immediately prior to connecting that particular port or fitting.
- Hydraulic components will not remain unattended or unprotected.
- Any components removed from the test stand will be properly capped or plugged and stored in protective packaging.
- Compressed air will not at any time be permitted to clean hydraulic components.
- Dry sweep will not be used in the hydraulic areas.
- All hand tools and equipment used will be kept clean through the testing process.

3. Prior to testing, the test stand shall have new filters installed and will be flushed using a dummy lock valve. A hydraulic fluid sample will be taken and analyzed to ensure compliance with level 200 of MIL-STD-1246. Only certified clean sample bottles will be allowed.

4. All testing will be performed using the facilities located at Picatinny Arsenal. Picatinny does not have access to a hydraulic fluid particle counter to analyze fluid samples during the qualification testing. For this reason, it is deemed necessary to document that adherence to the above guidelines while performing the actual test sequence will produce acceptable oil contamination levels. A control set of Kemp locking valves will be run through the full set of tests and a fluid sample will be taken during each distinct phase. The samples will be analyzed and favorable results will be considered basis for qualifying the stand and the above guidelines.

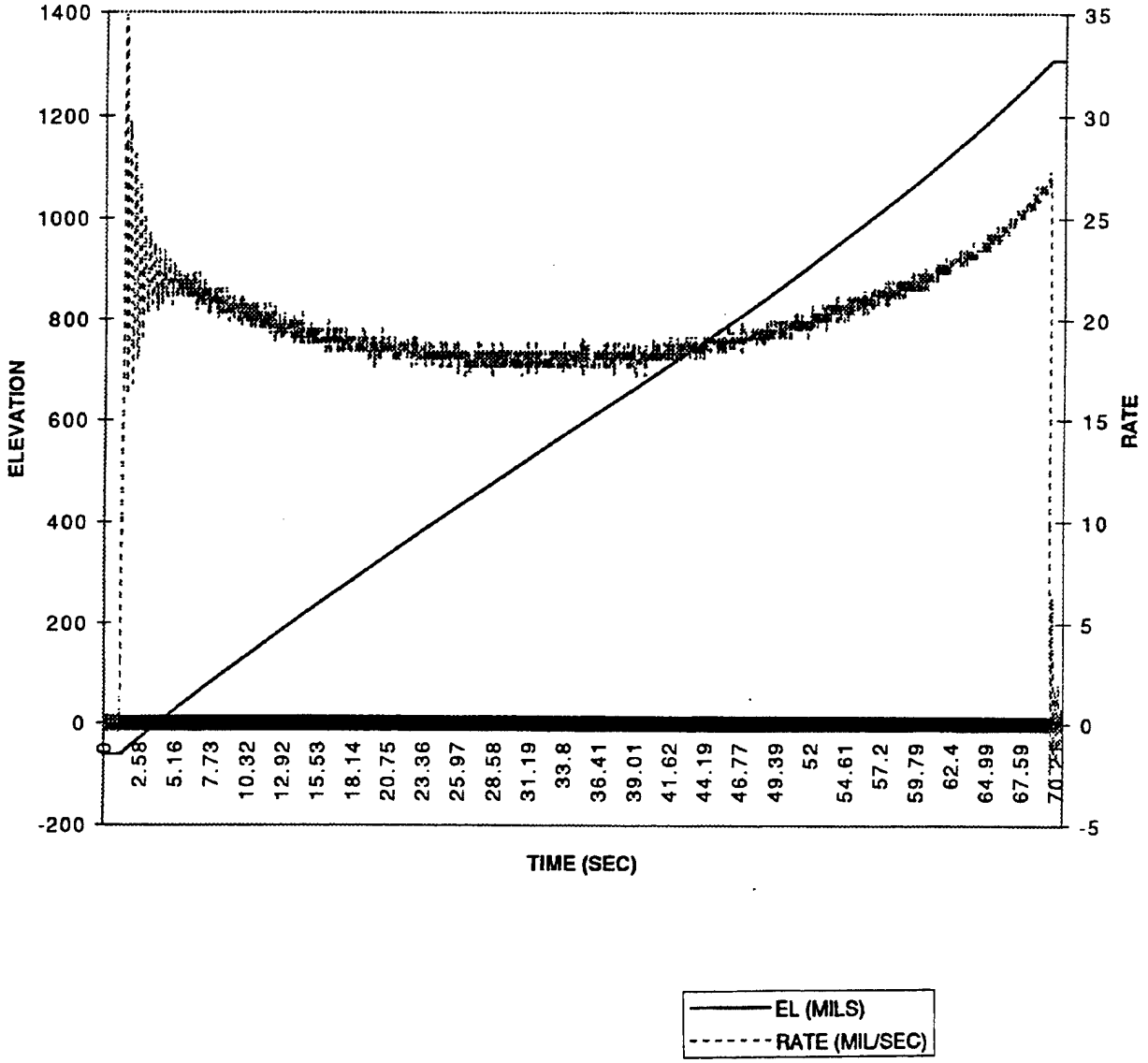
5. Oil samples will only be taken during the qualification testing if there is a valve failure. The sample will be taken as soon as possible after the failure, but under no circumstances will the hydraulic system be opened before a sample is taken.

6. POC for this matter is Paul Kida, x2733.

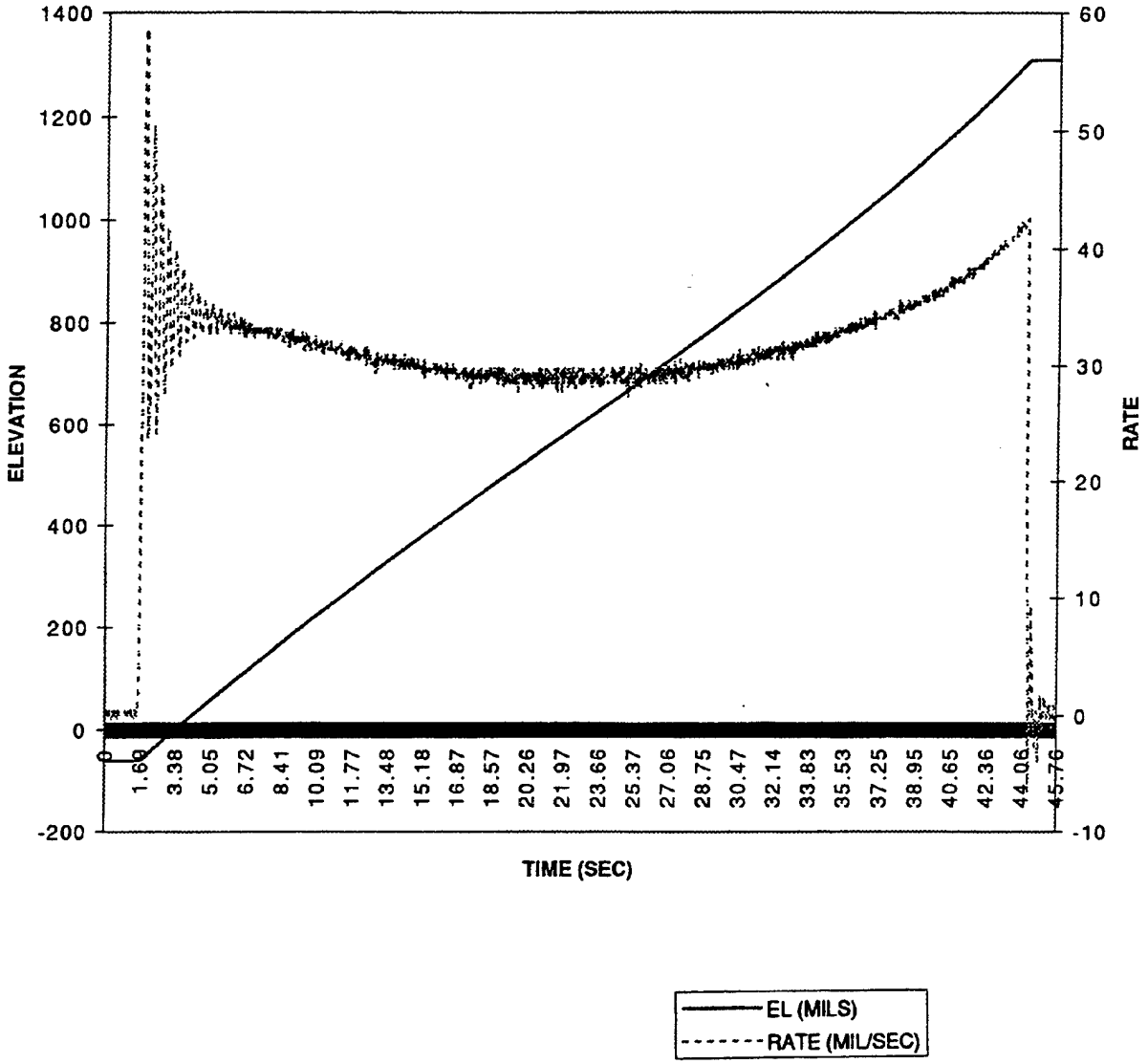
Paul R. Kida
GS-12 Mechanical Engineer

APPENDIX C
ON-WEAPON TEST DATA PLOTS

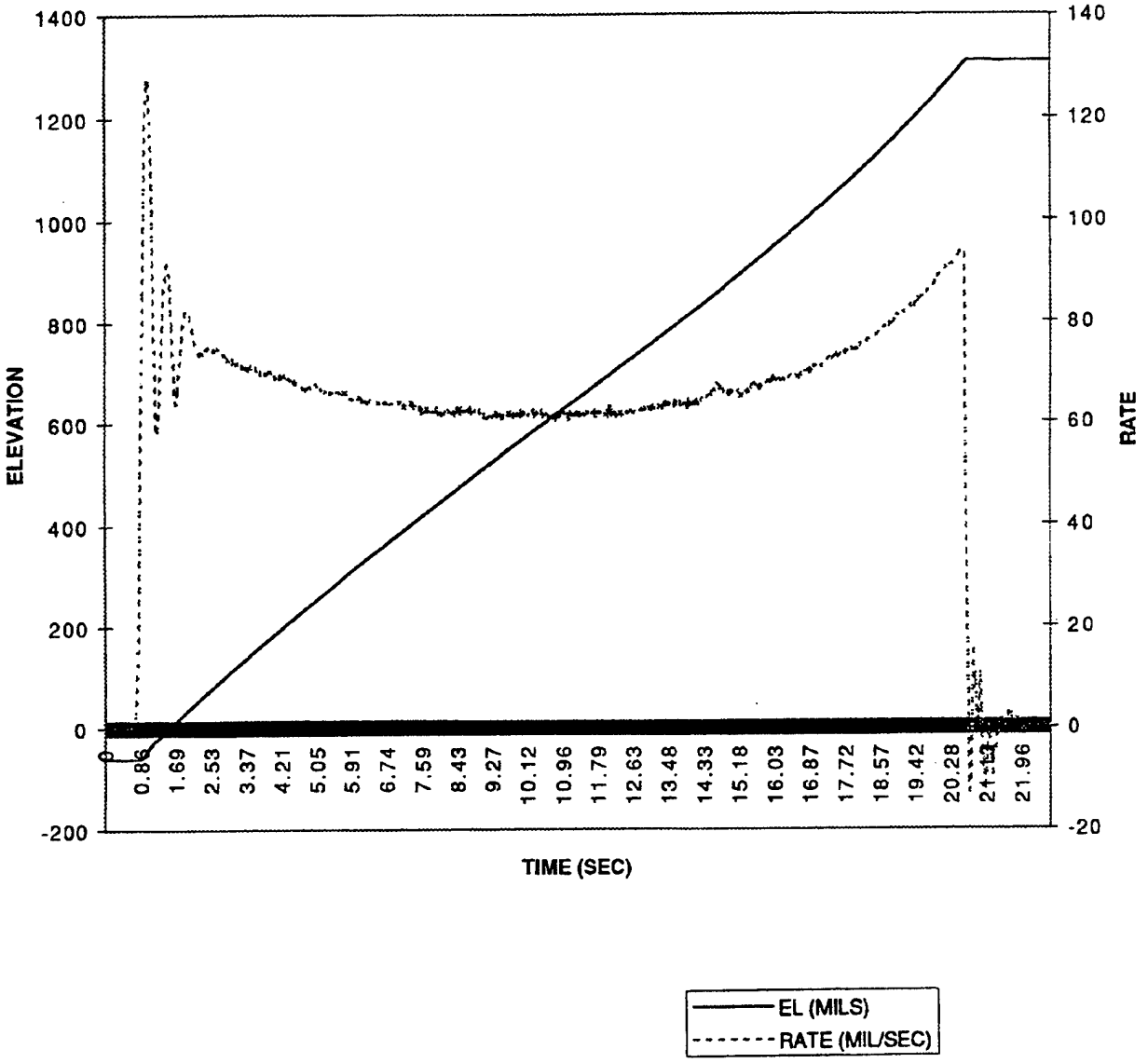
7.5 DEG HANDLE JK001



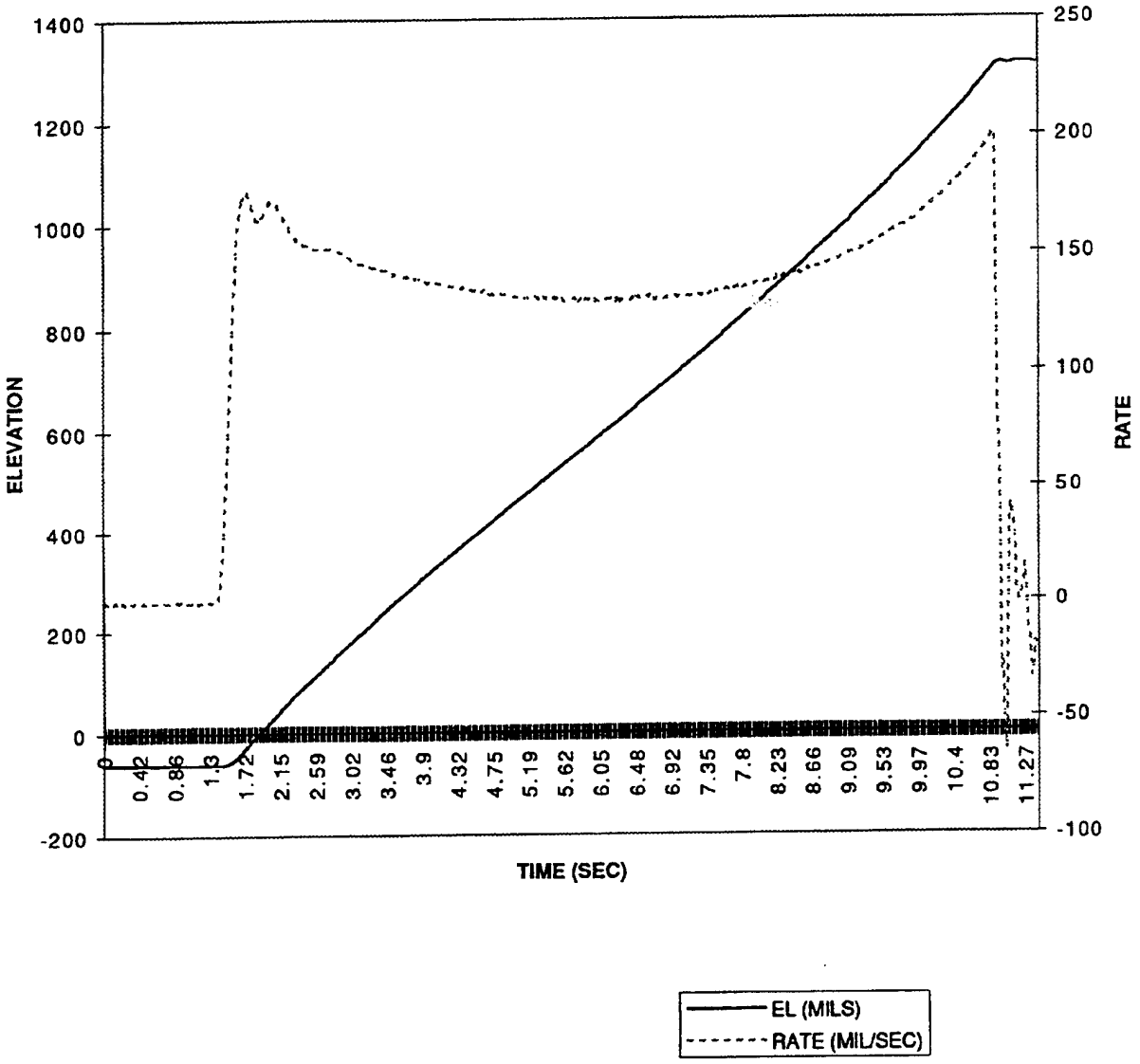
10 DEG HANDLE KJ001



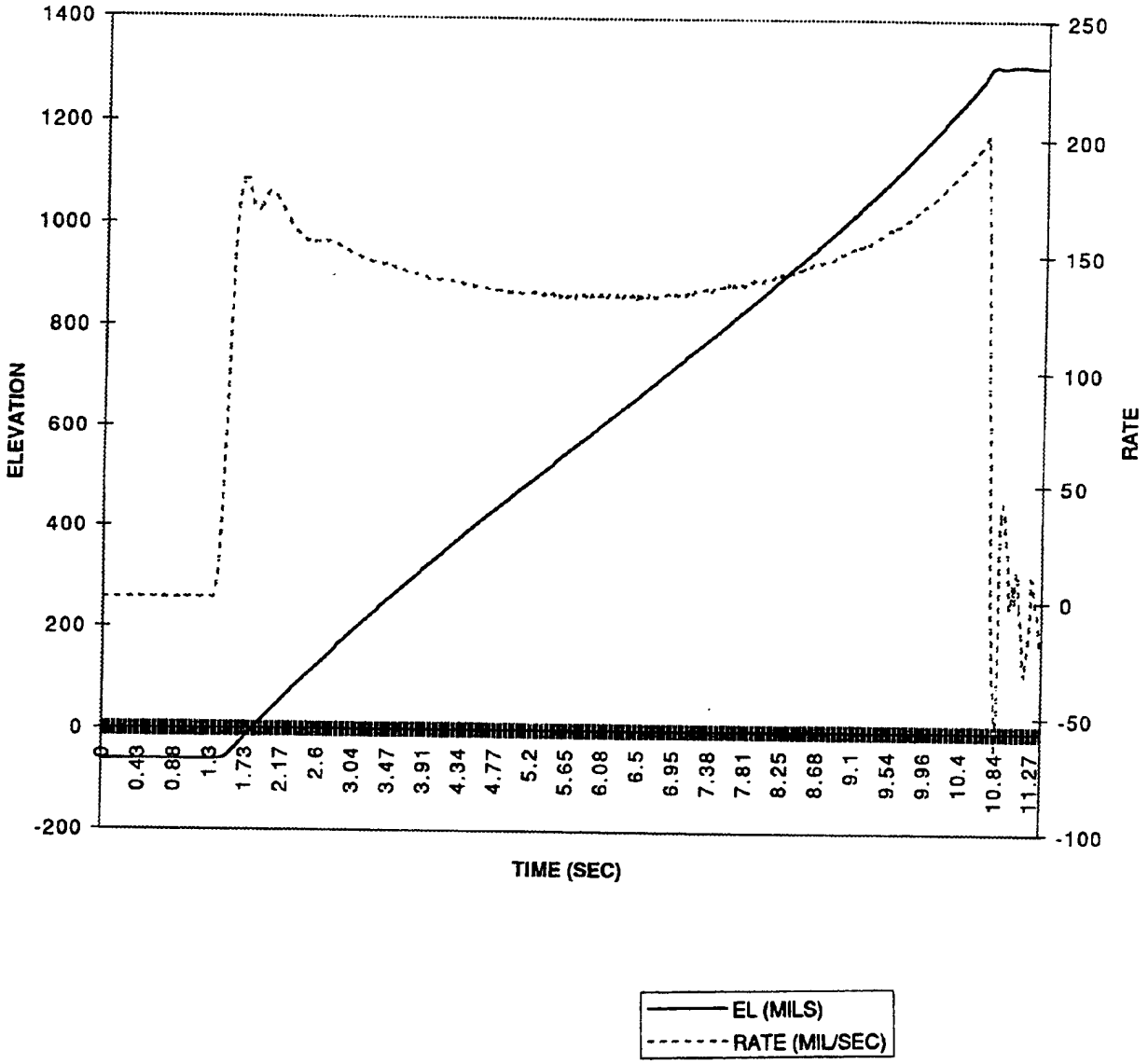
15 DEG HANDLE KJ001



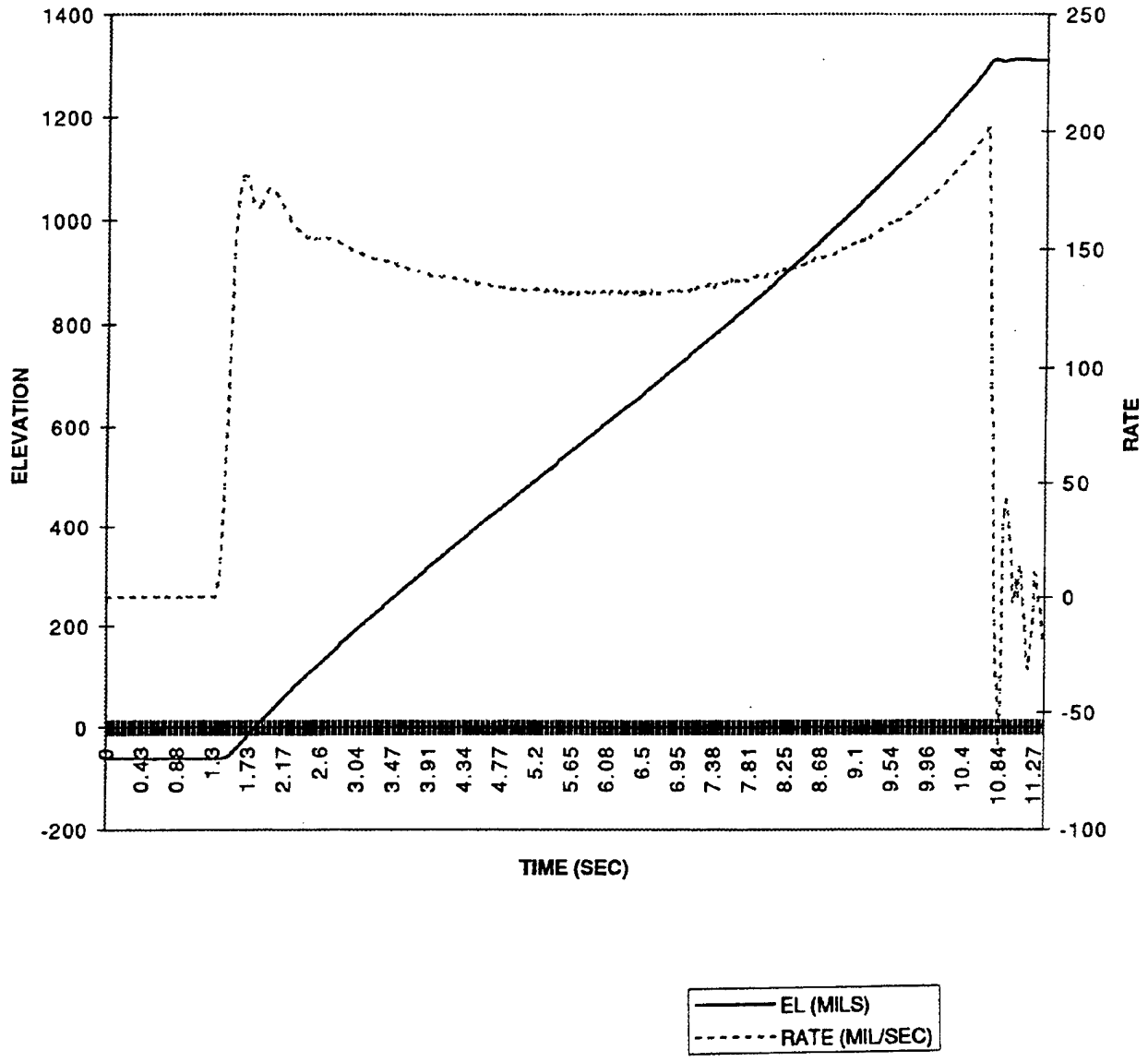
20 DEG HANDLE KJ001



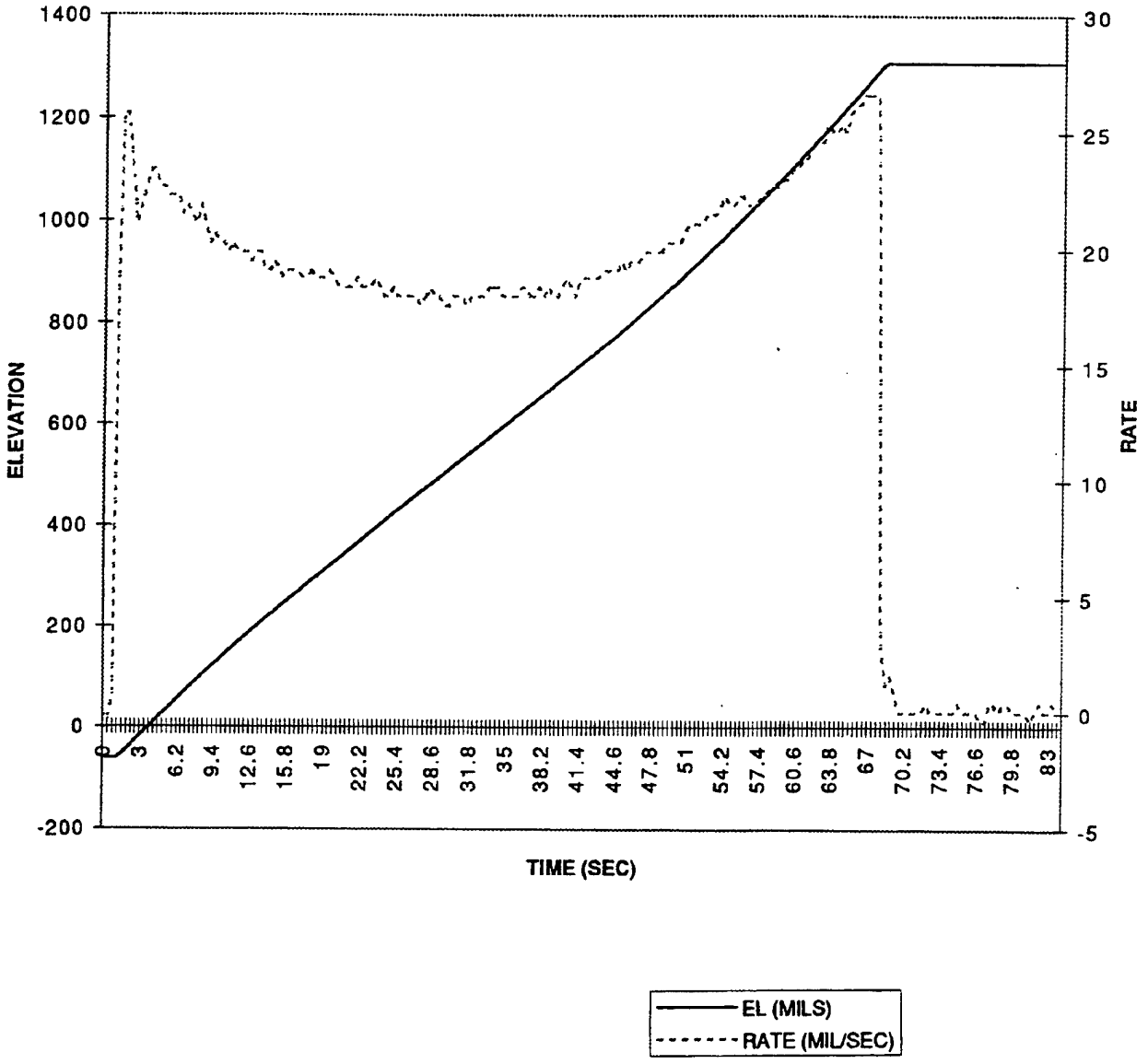
25 DEG HANDLE KJ001



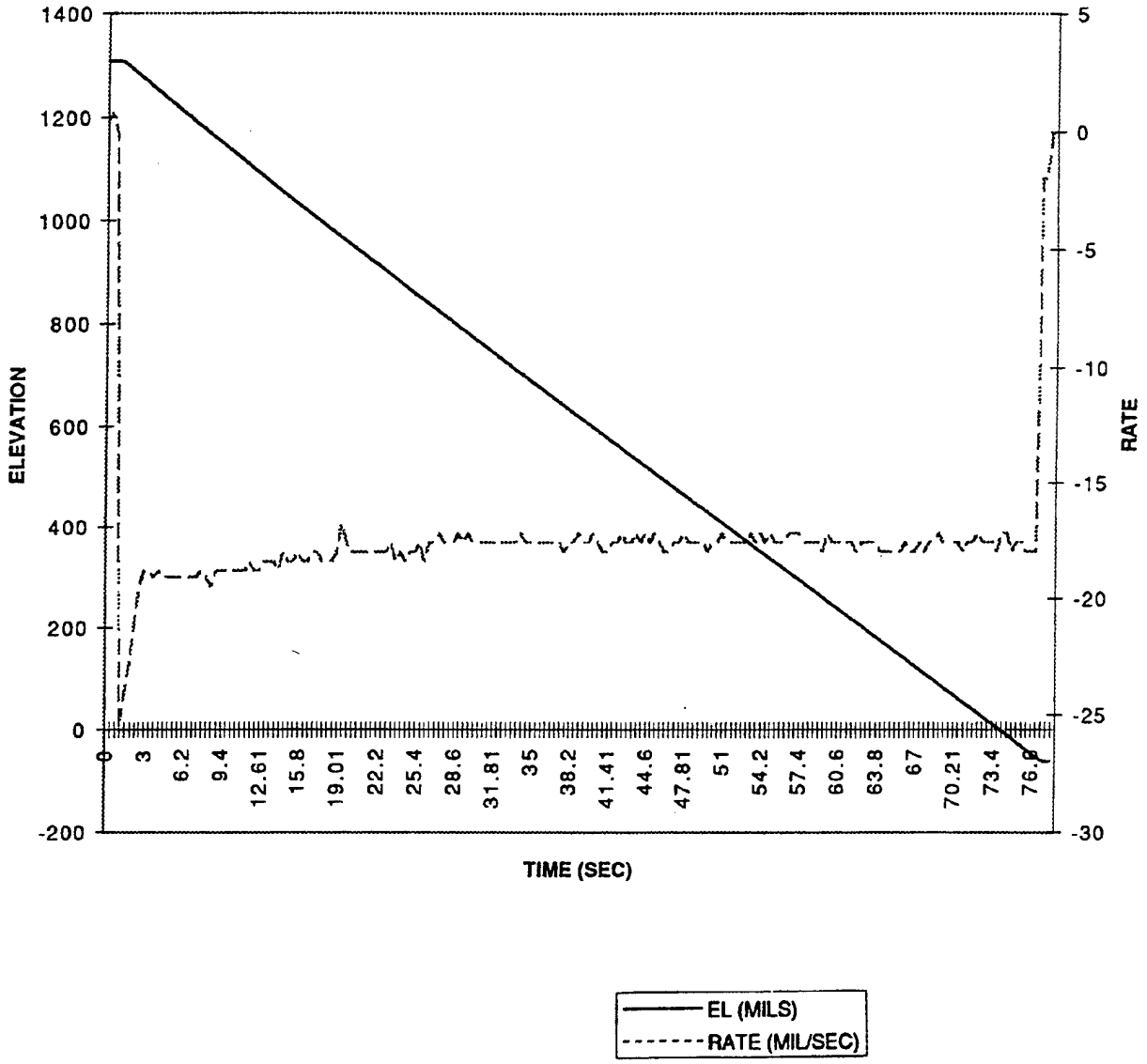
25 DEG HANDLE KJ001



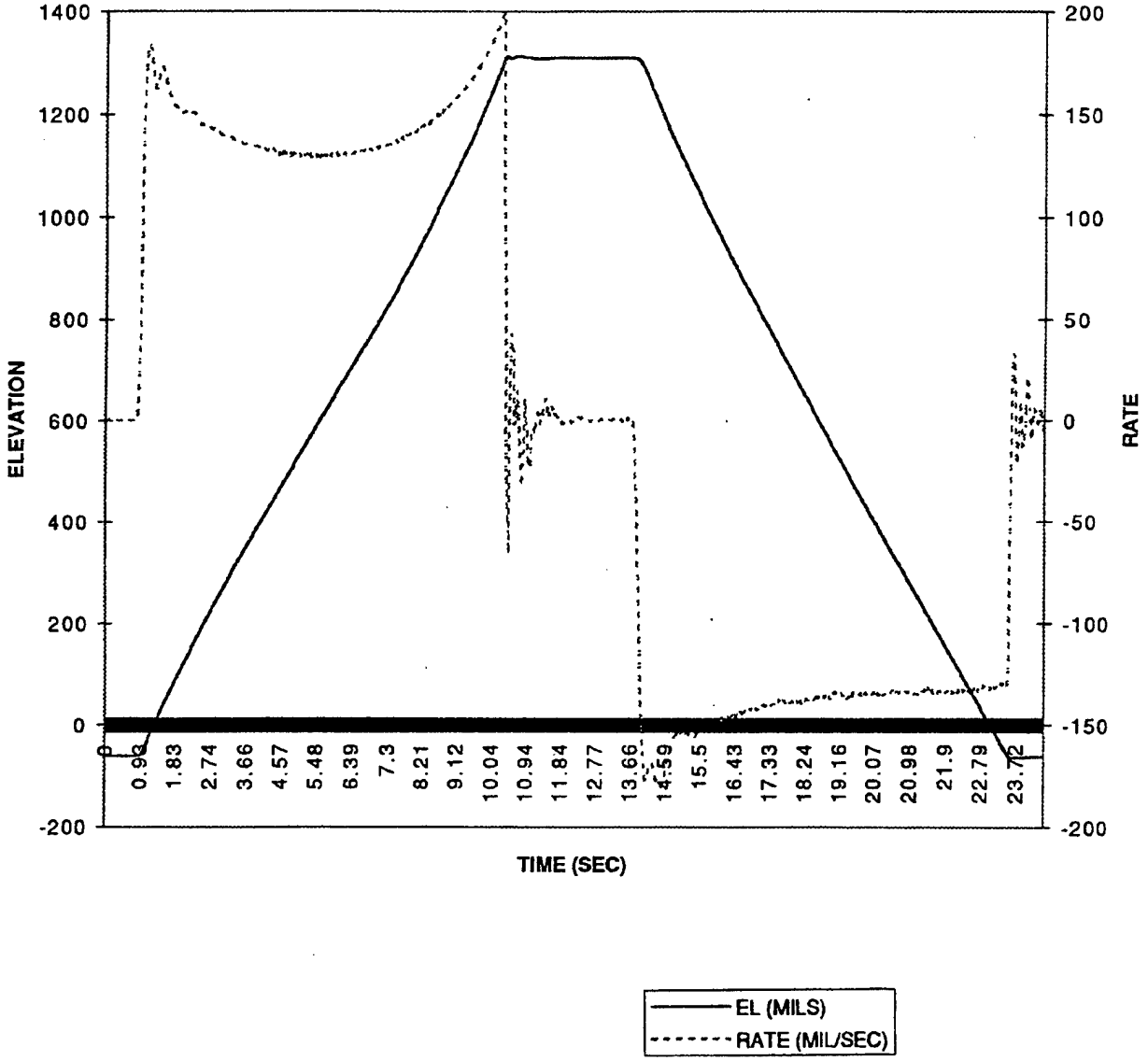
CONSTANT MANUAL ELEVATION KJ001



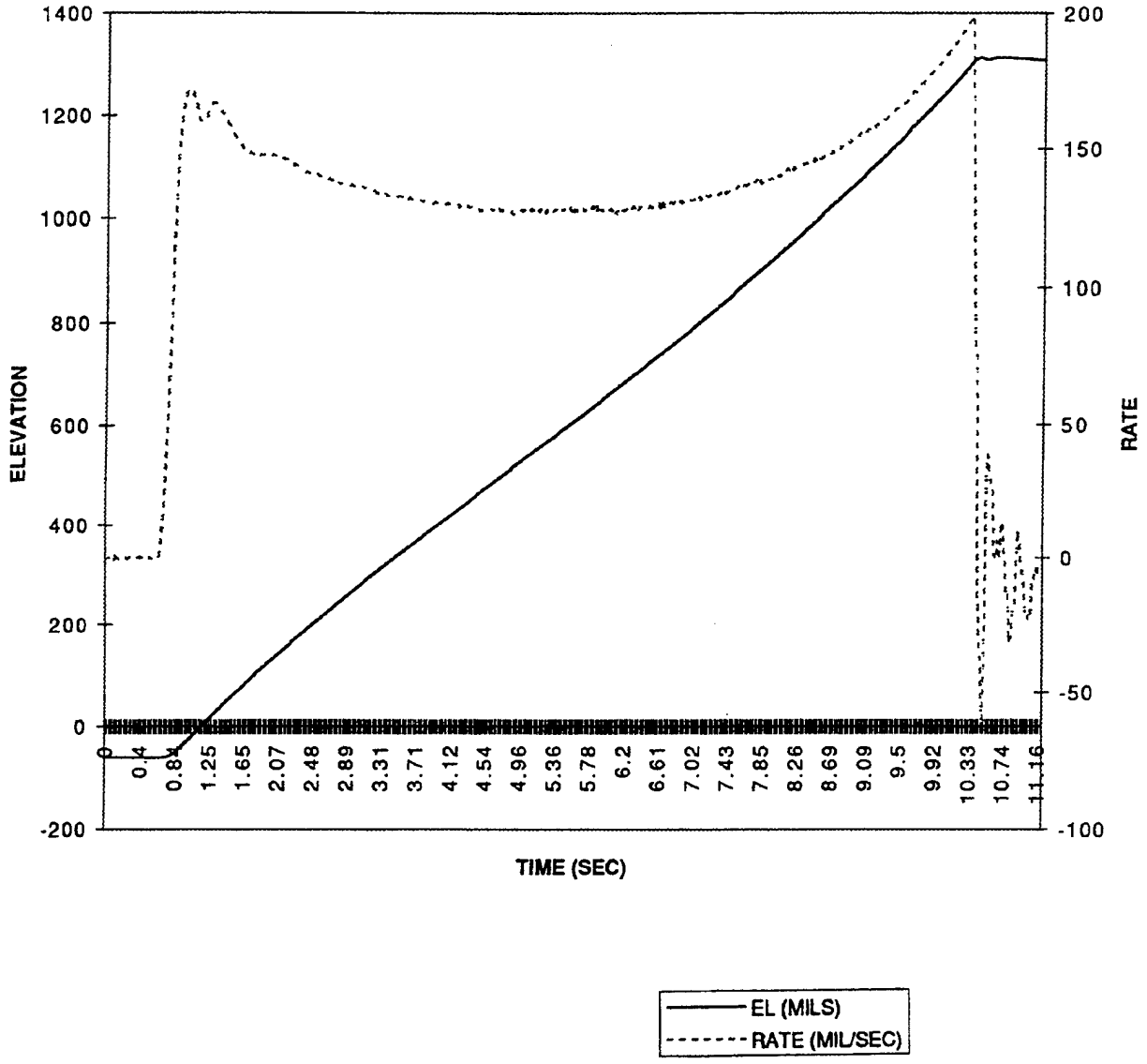
CONSTANT MANUAL DEPRESSION JK001



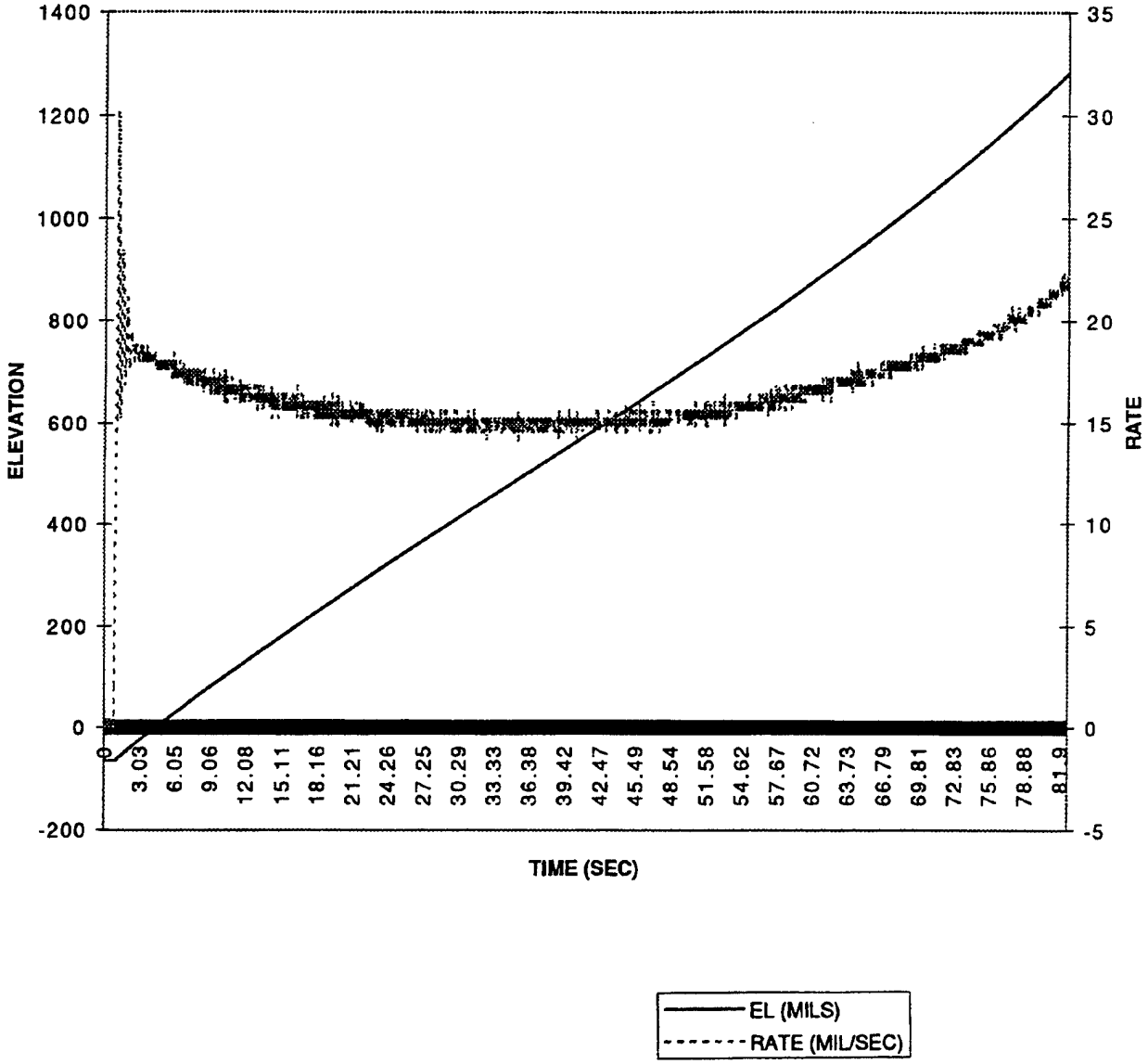
MAX ELEVATION/DEPRESSION KJ001



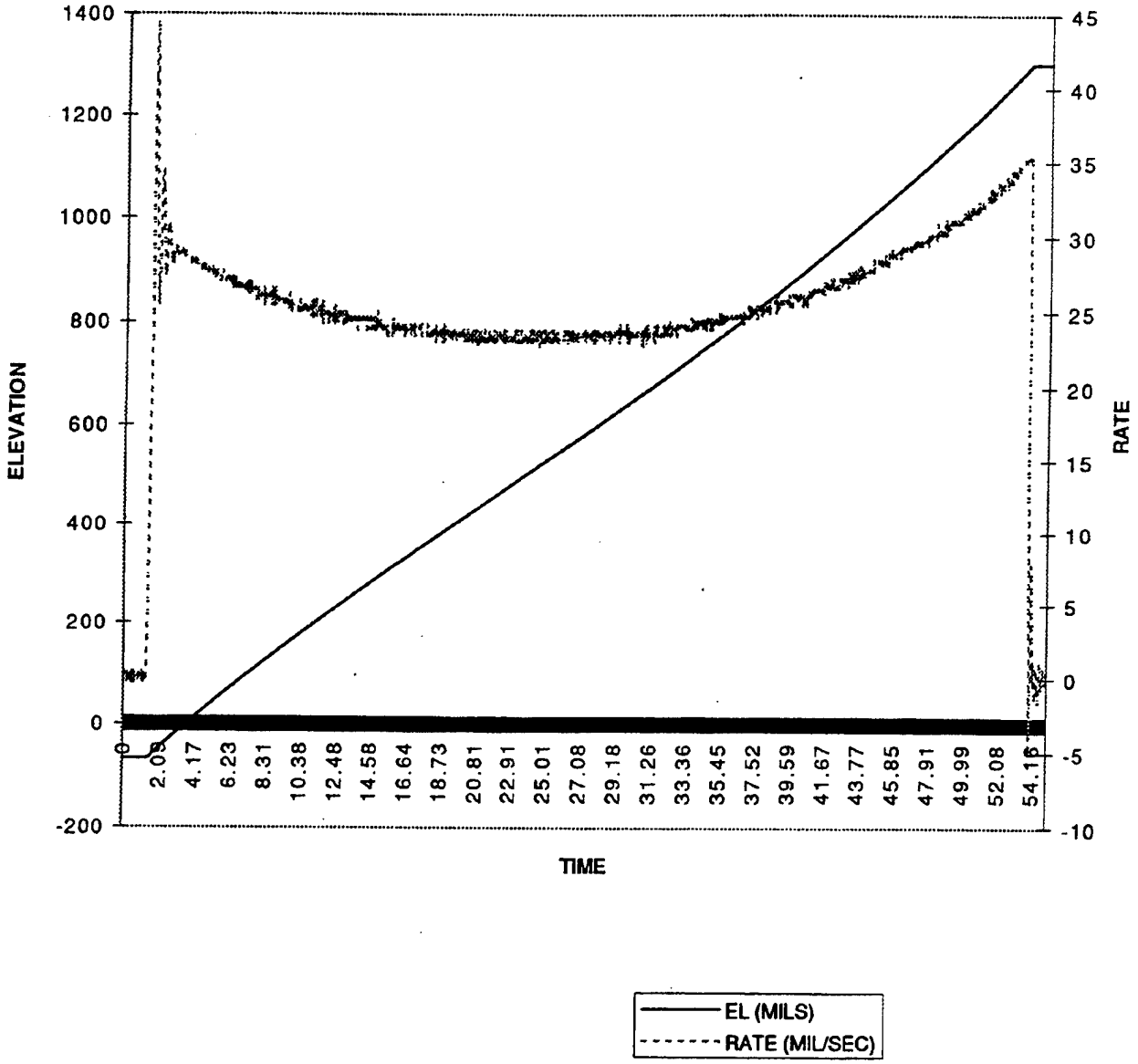
MAXIMUM DEG HANDLE KJ001



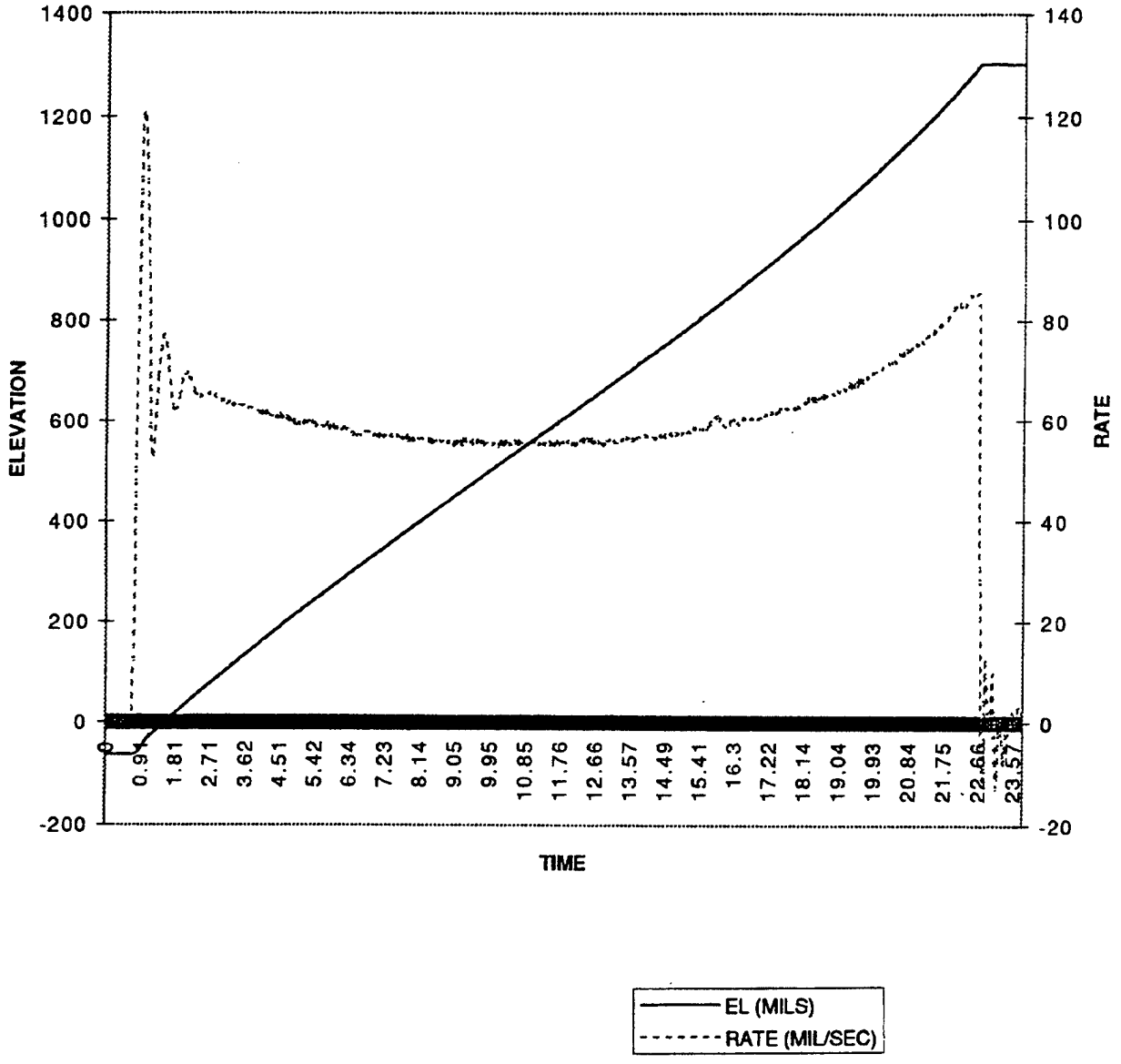
7.5 DEGREE HANDLE JK003



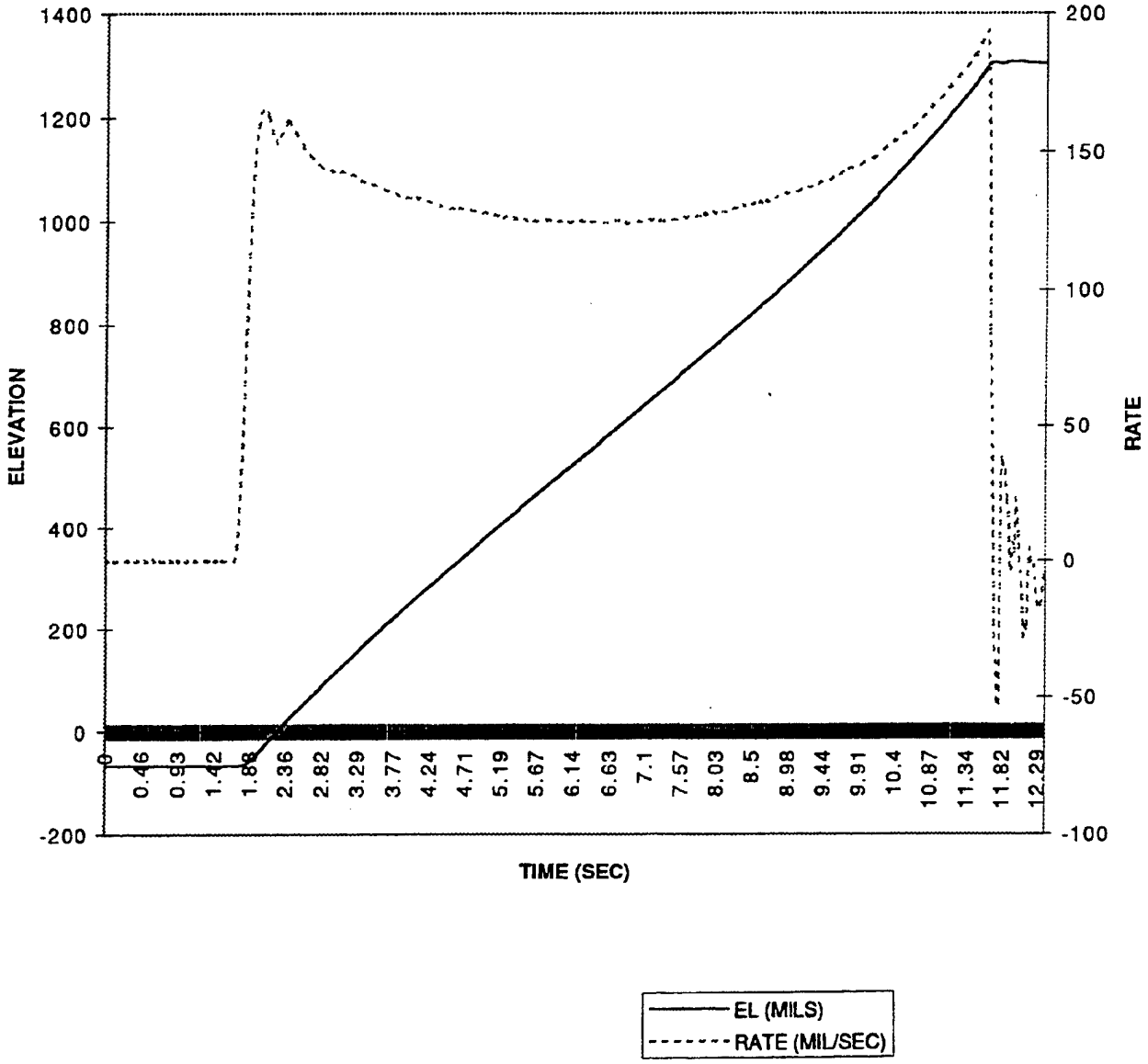
KINETIC KJ003 10 DEGREE HANDLE



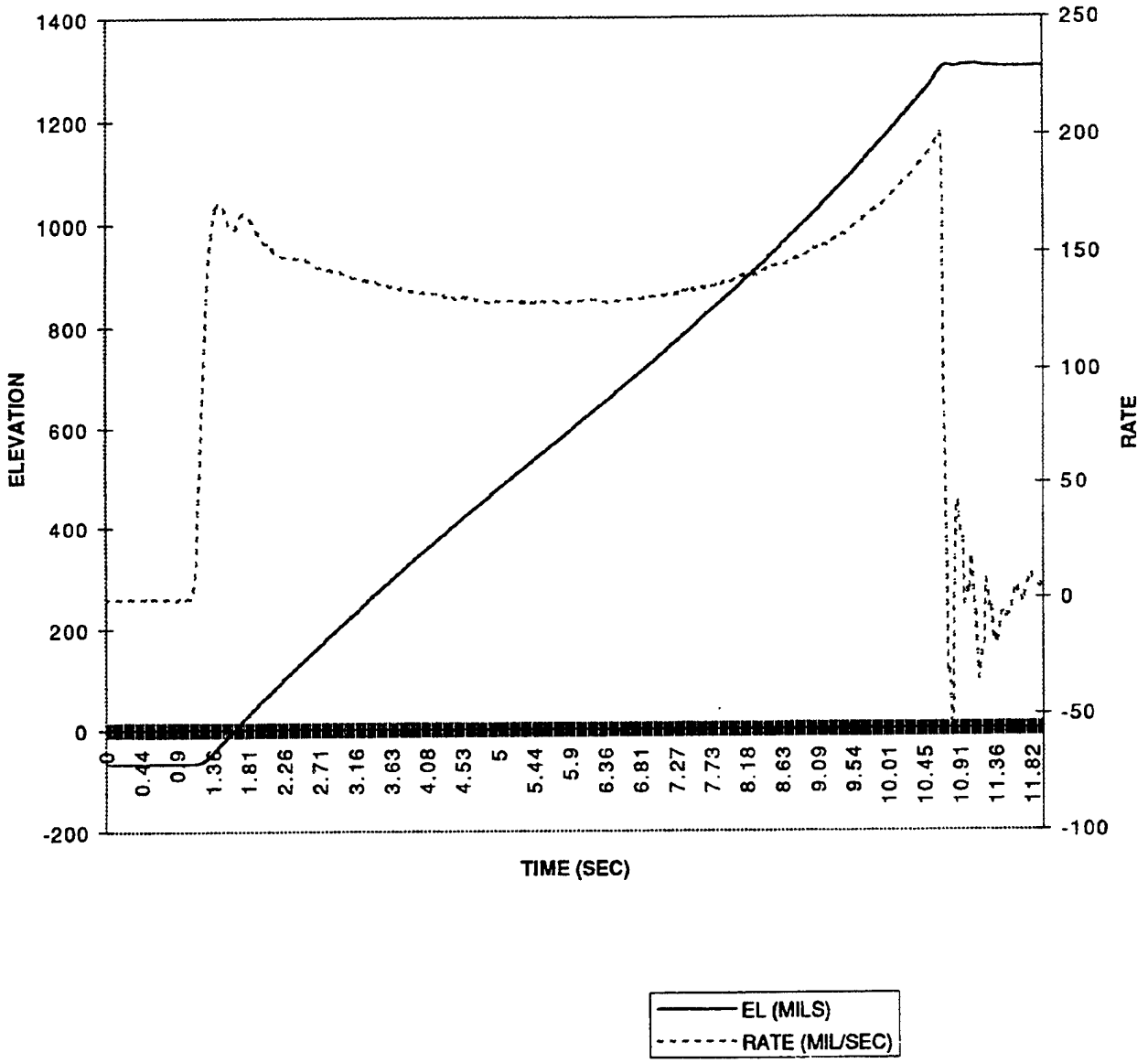
15 DEGREE HANDLE KINETIC KJ003



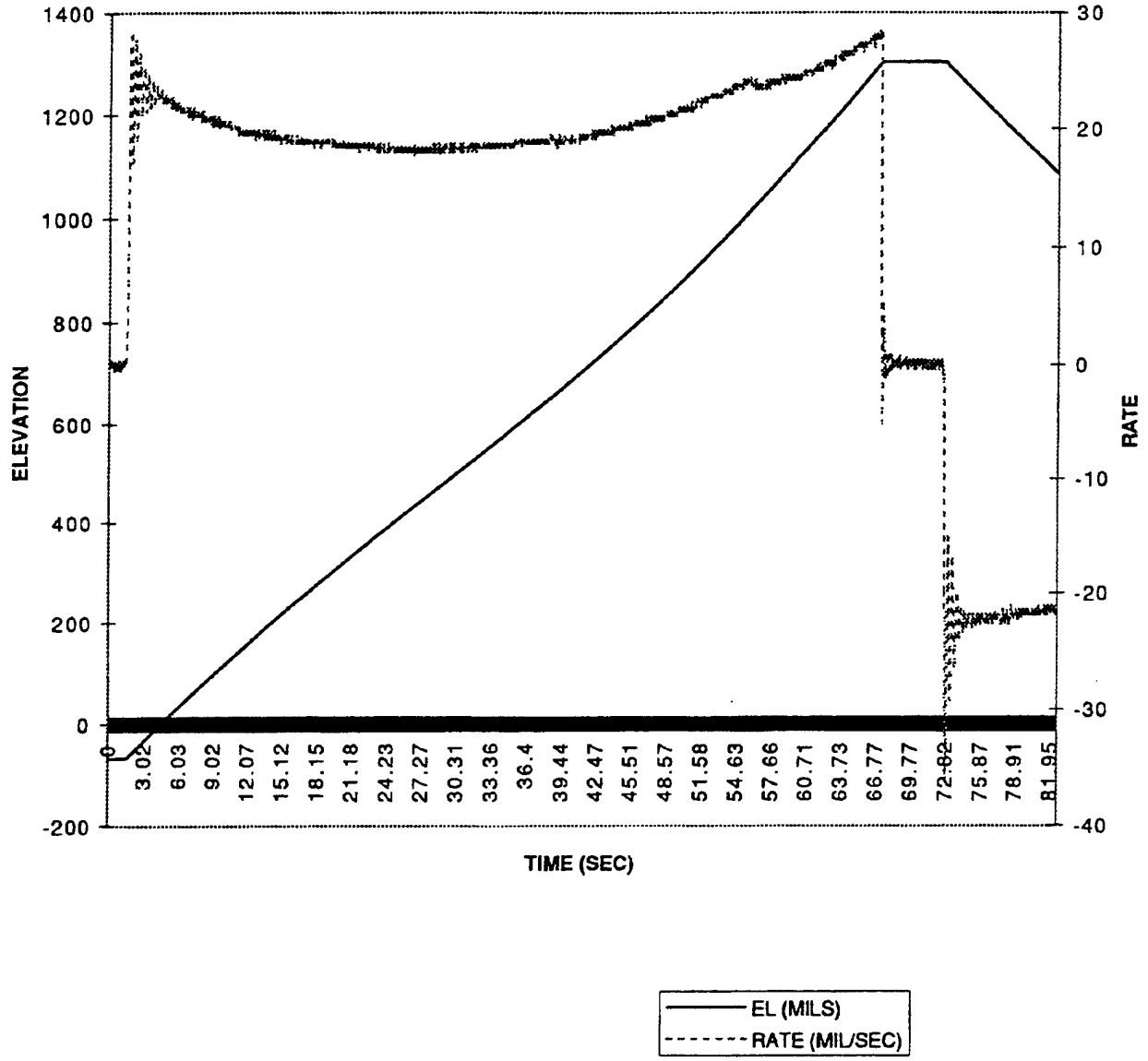
20 DEGREE HANDLE JK003



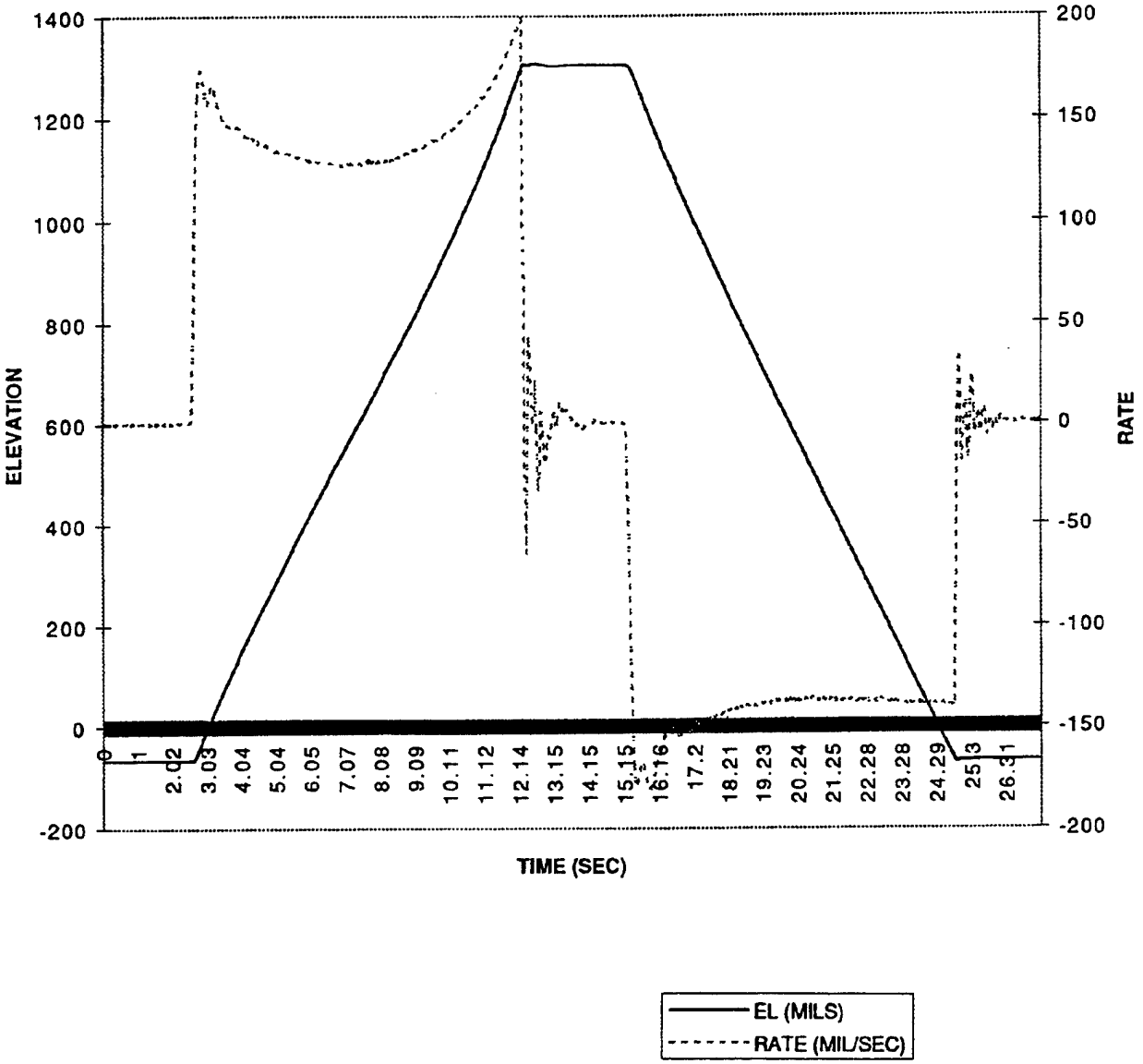
25 DEGREE HANDLE JK003



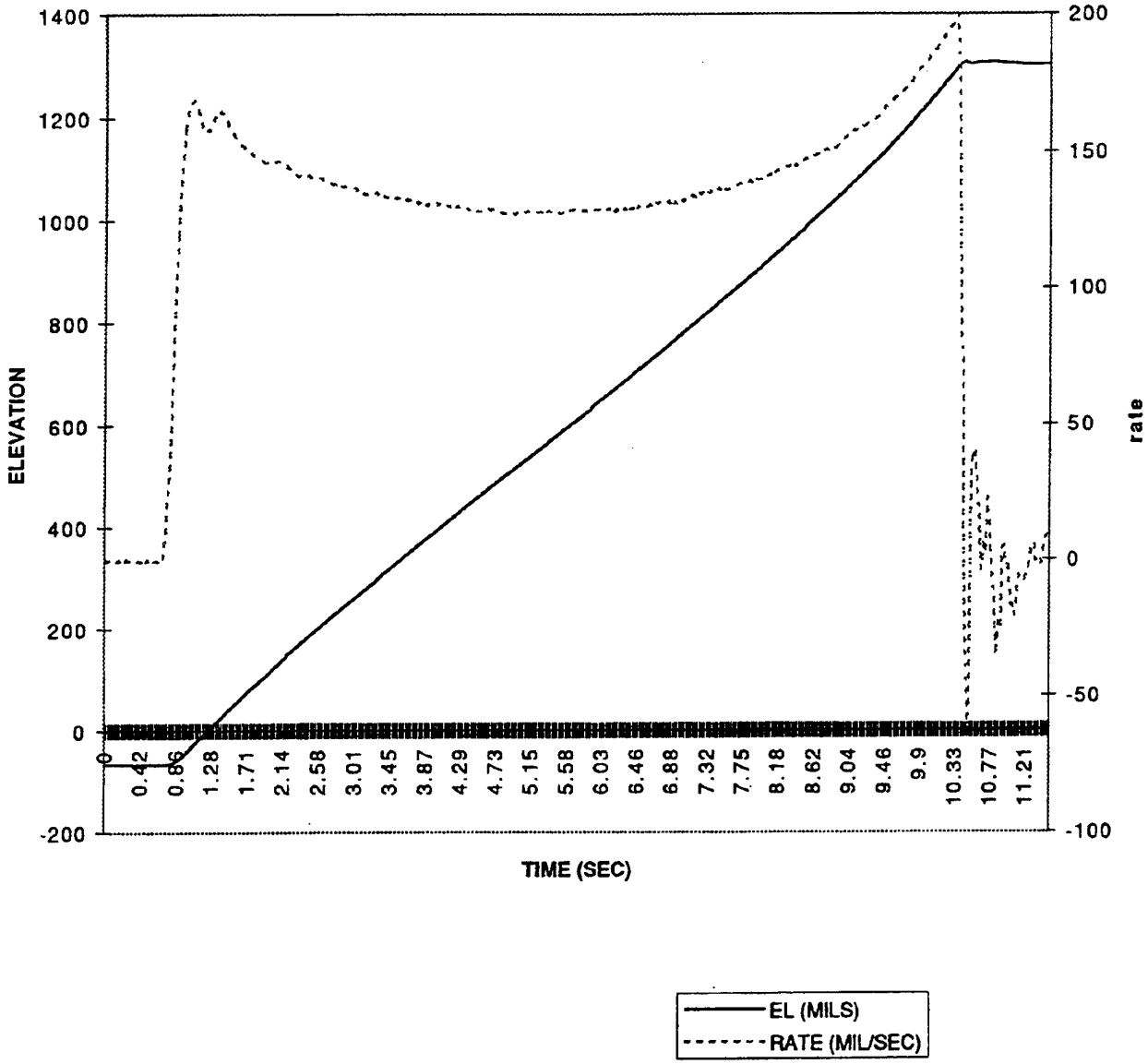
CONSTANT MANUAL ELEVATION JK003



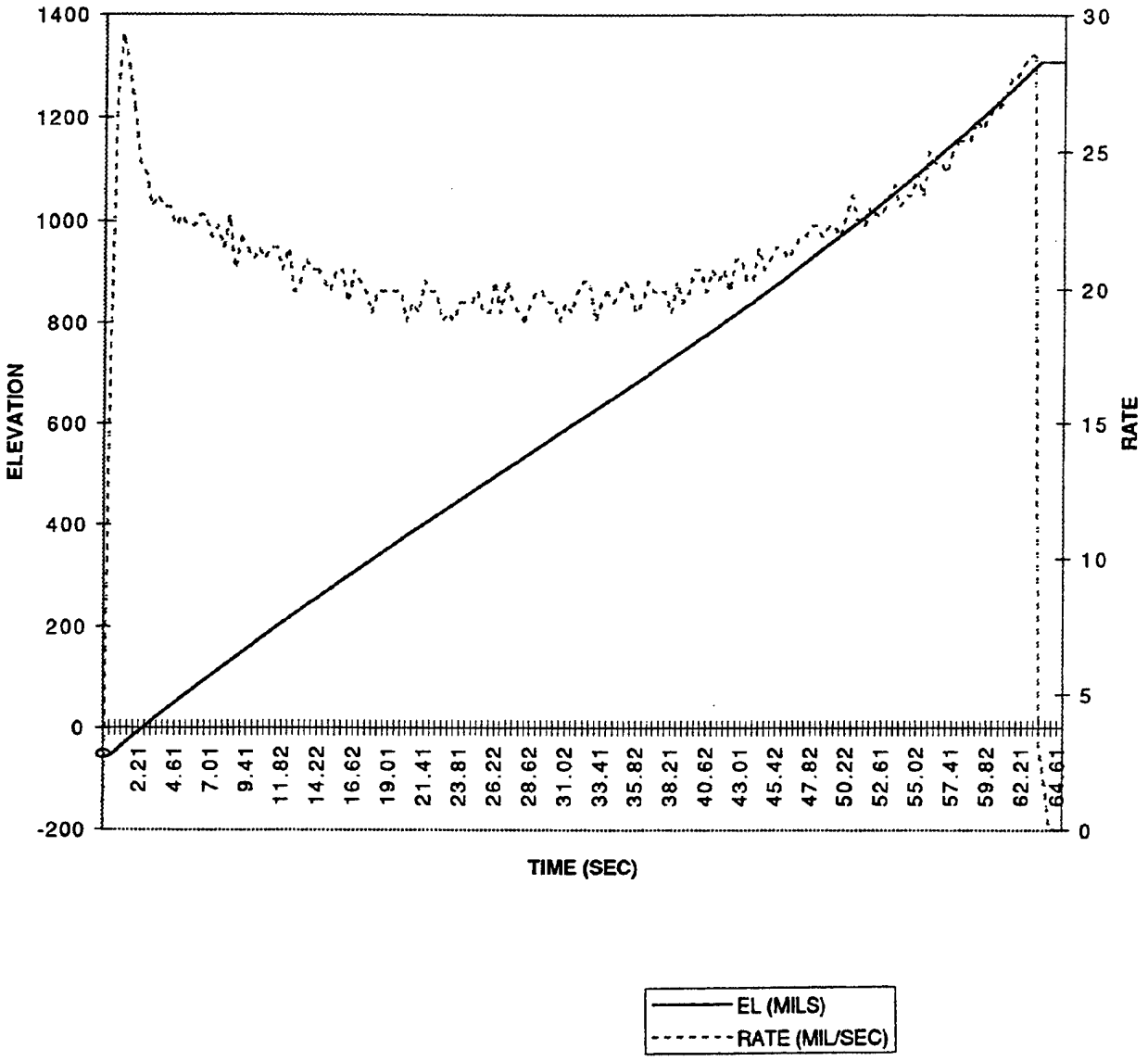
MAXIMUM ELEVATION/DEPRESSION KJ003



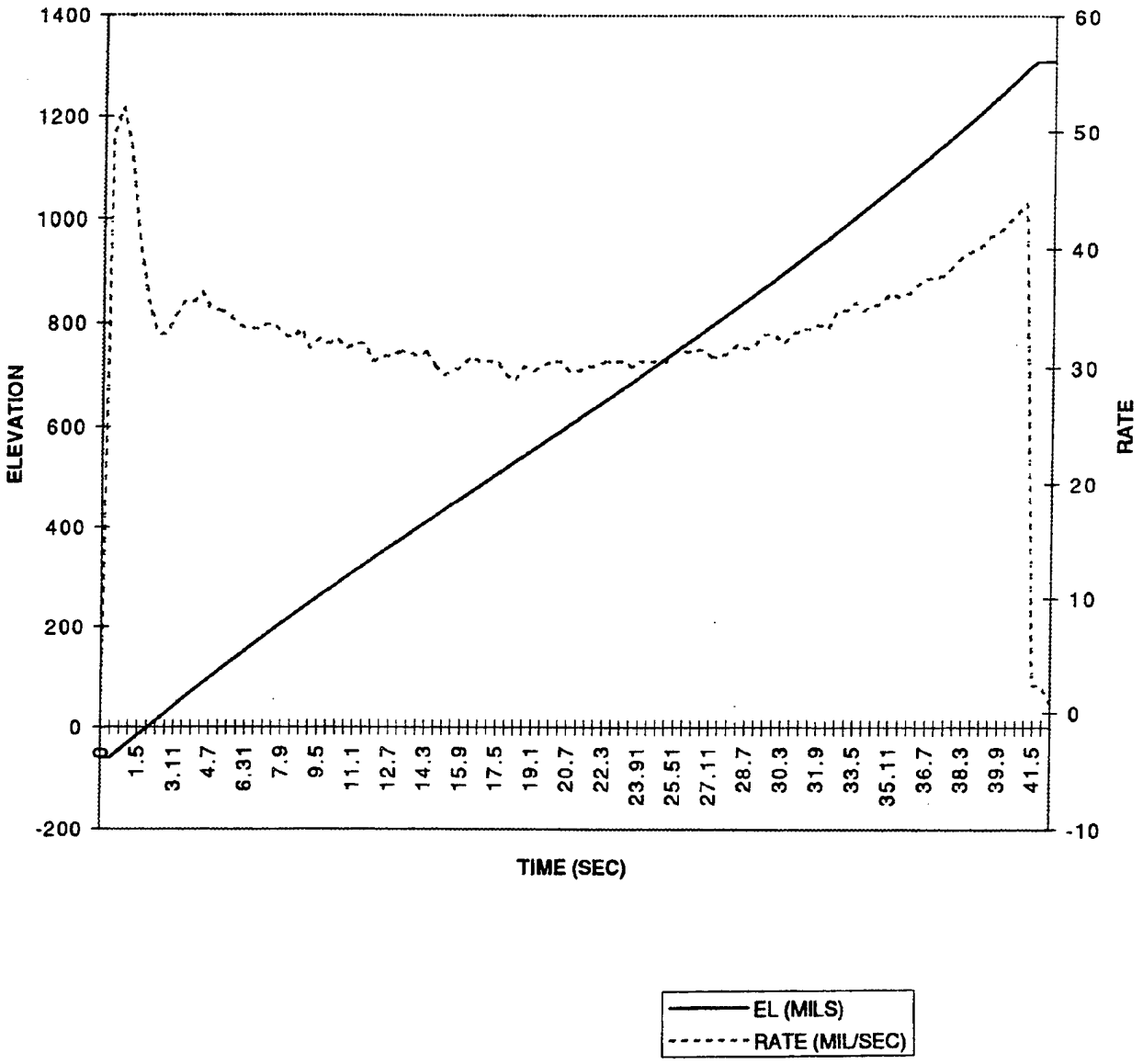
MAXIMUM ELEVATION RATE KJ003



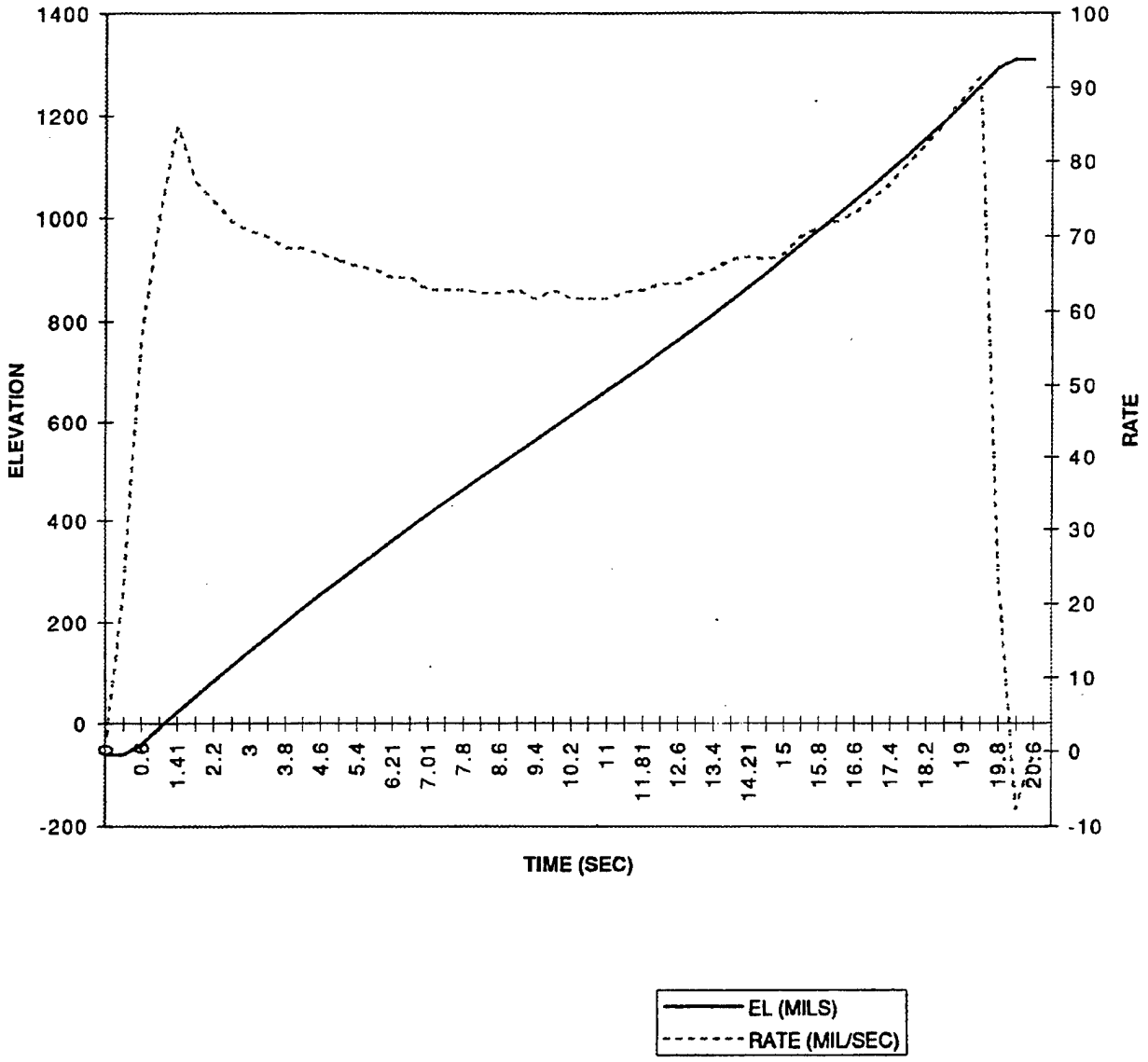
7.5 DEG HANDLE KJ004



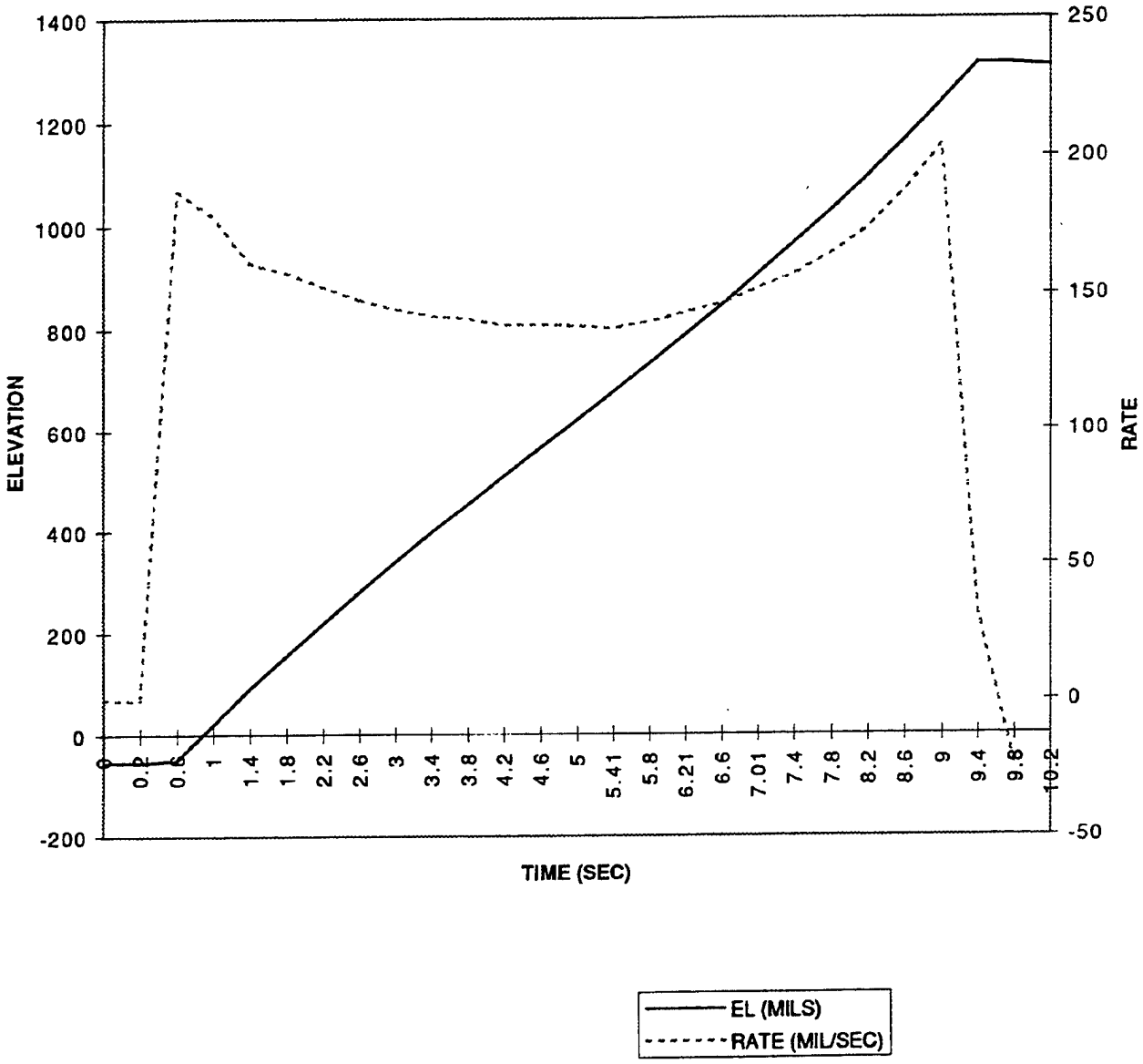
10 DEG HANDLE KJ004



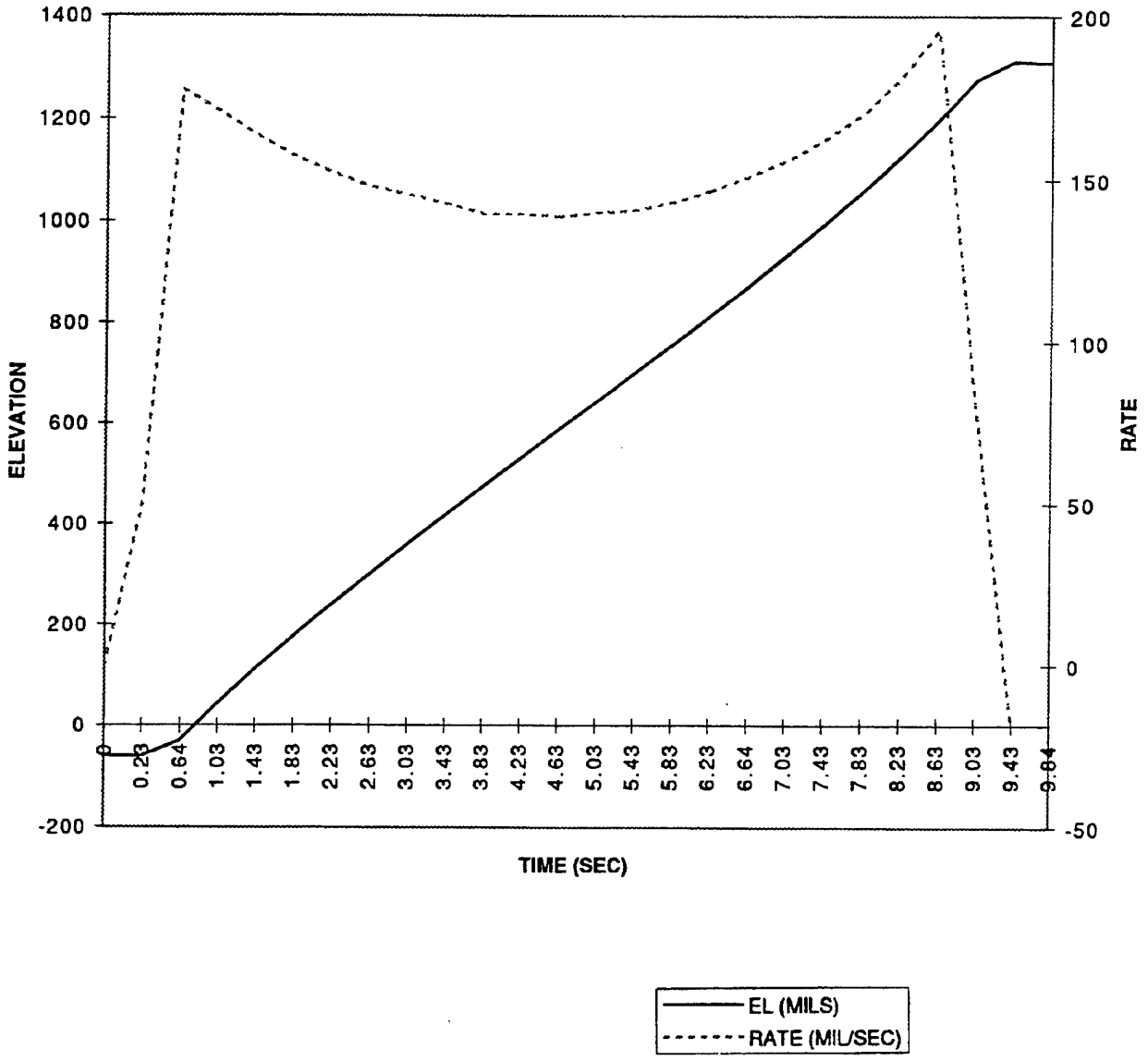
15 DEG HANDLE KJ004

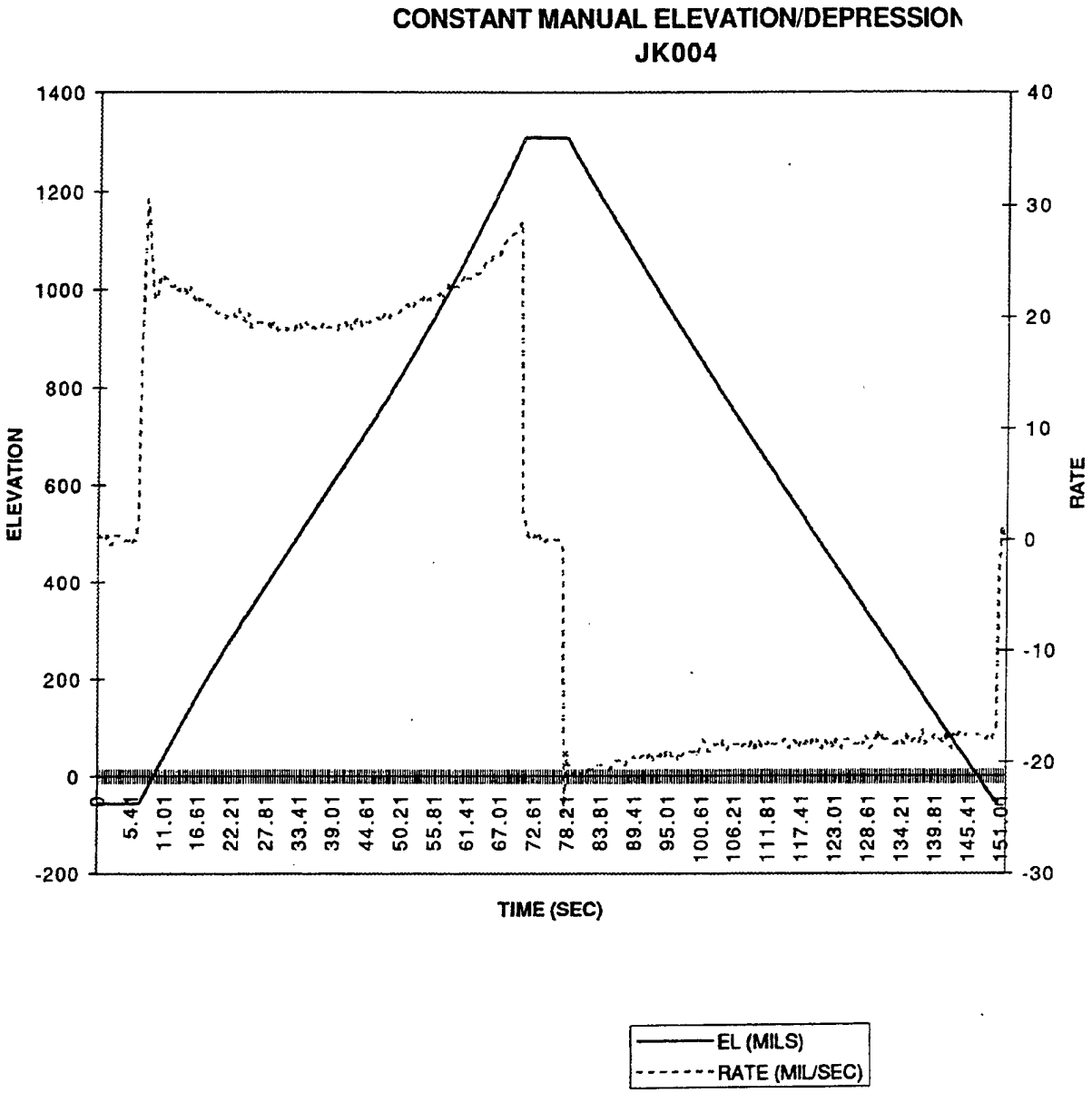


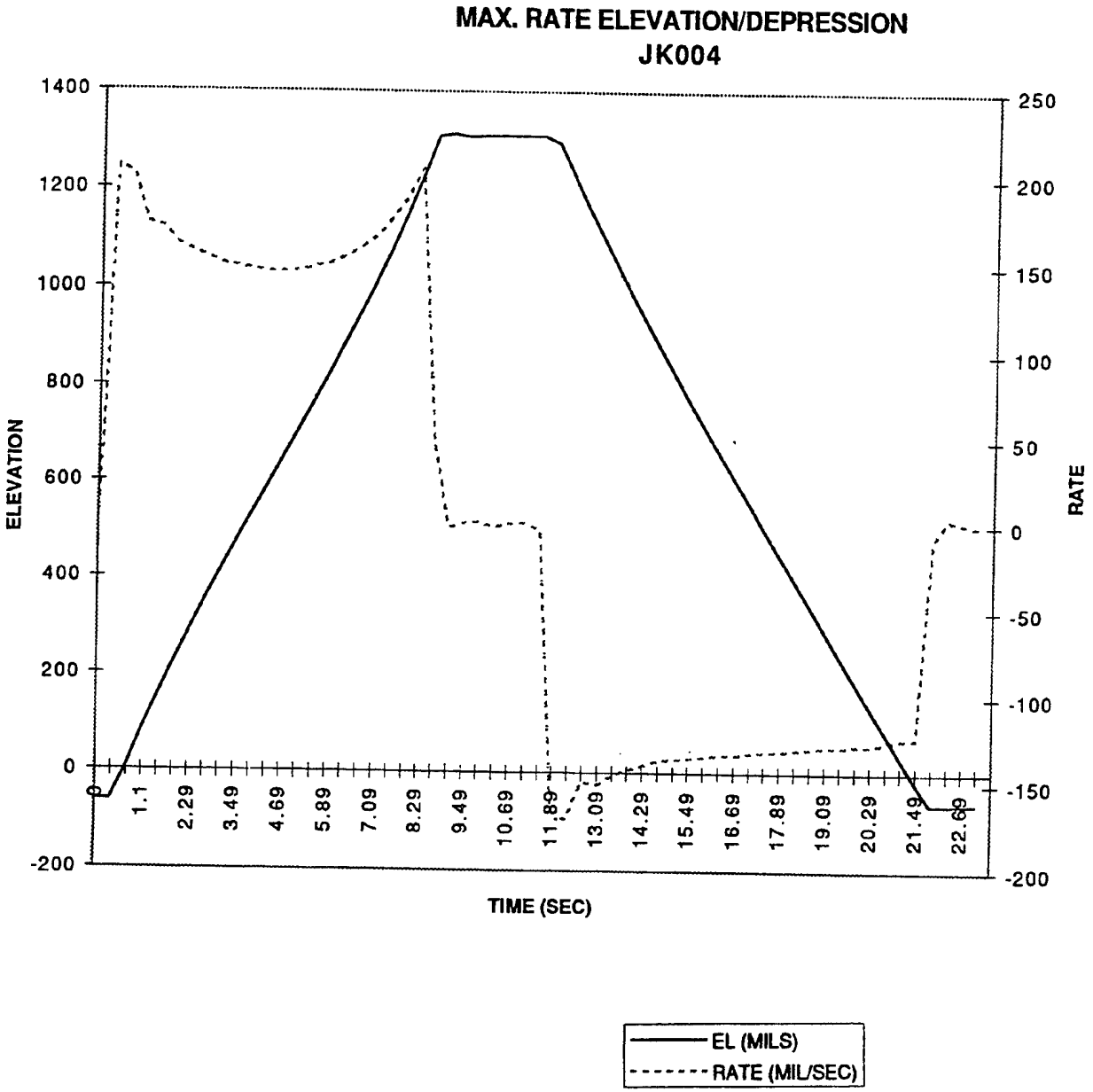
20 DEG HANDLE KJ004



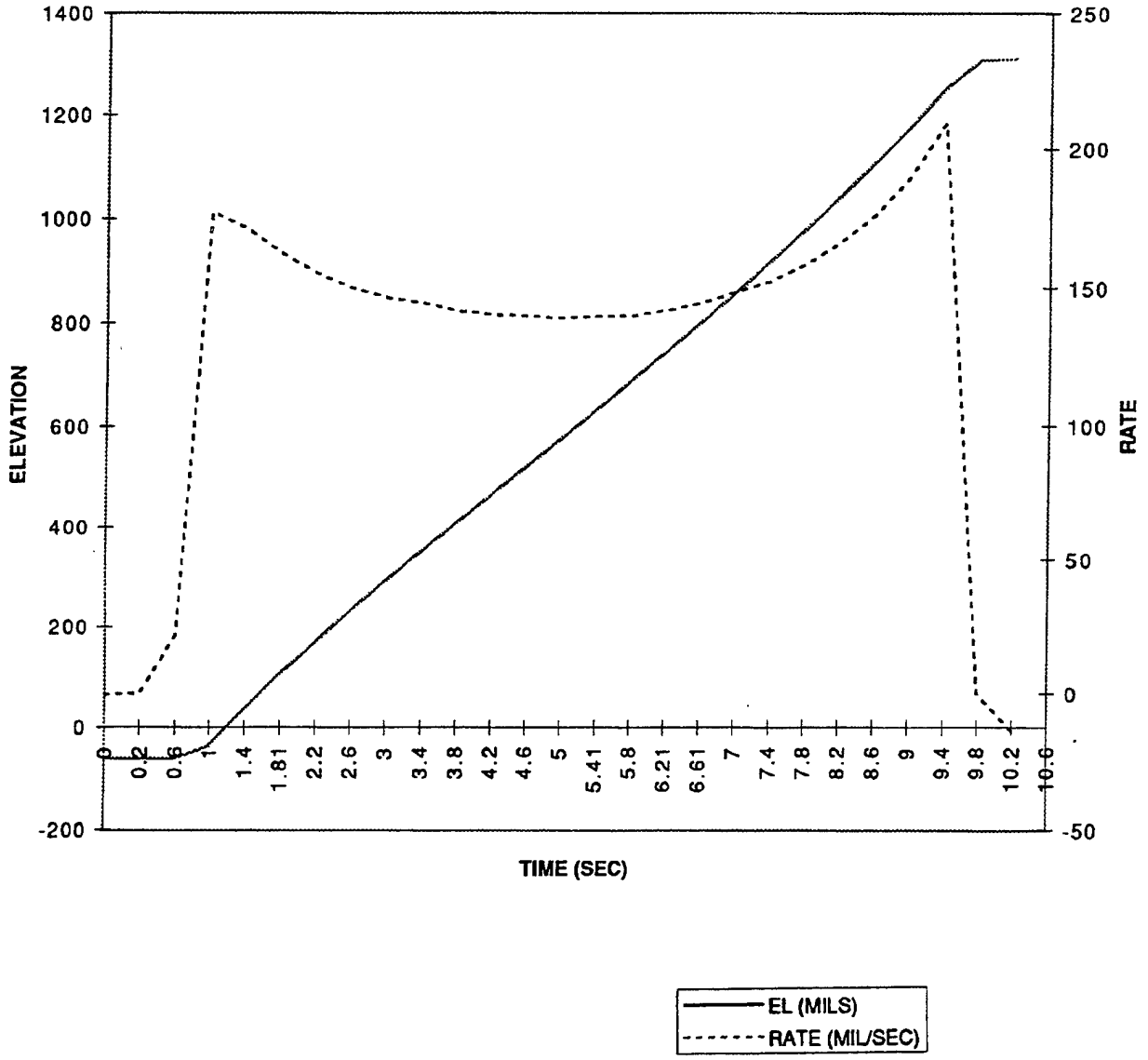
25 DEG HANDLE KJ004




CONSTANT MANUAL ELEVATION/DEPRESSION
JK004
ELEVATION
RATE
TIME (SEC)
1400
1200
1000
800
600
400
200
0
-200
40
30
20
10
0
-10
-20
-30
0
5.41
11.01
16.61
22.21
27.81
33.41
39.01
44.61
50.21
55.81
61.41
67.01
72.61
78.21
83.81
89.41
95.01
100.61
106.21
111.81
117.41
123.01
128.61
134.21
139.81
145.41
151.01
EL (MILS)
RATE (MIL/SEC)


MAX. RATE ELEVATION/DEPRESSION
JK004
ELEVATION
RATE
TIME (SEC)
1400
1200
1000
800
600
400
200
0
-200
250
200
150
100
50
0
-50
-100
-150
-200
0
1.1
2.29
3.49
4.69
5.89
7.09
8.29
9.49
10.69
11.89
13.09
14.29
15.49
16.69
17.89
19.09
20.29
21.49
22.69
EL (MILS)
RATE (MIL/SEC)

MAXIMUM HANDLE DEGREE - JK004



DISTRIBUTION LIST

Commander
Armament Research, Development and Engineering Center
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-AR-LSL (2)
AMSTA-AR-GCL
AMSTA-AR-FSA-W (5)
AMSTA-AR-QAA-R
SFAE-FAS-PAL (2)
Picatinny Arsenal, NJ 07806-5000

Defense Technical Information Center (DTIC)
ATTN: Accessions Division (12)
8725 John J. Kingman Road, Ste 0944
Fort Belvoir, VA 22060-6218

Director
U.S. Army Materiel Systems Analysis Activity
ATTN: AMXSY-EI
392 Hopkins Road
Aberdeen Proving Ground, MD 21005-5071

Commander
Chemical/Biological Defense Agency
U.S. Army Armament, Munitions and Chemical Command
ATTN: AMSCB-CII, Library
Aberdeen Proving Ground, MD 21010-5423

Director
U.S. Army Edgewood Research, Development and Engineering Center
ATTN: SCBRD-RTB (Aerodynamics Technology Team)
Aberdeen Proving Ground, MD 21010-5423

Director
U.S. Army Research Laboratory
ATTN: AMSRL-OP-CI-B, Technical Library
Aberdeen Proving Ground, MD 21005-5066

Chief
Benet Weapons Laboratory, CCAC
Armament Research, Development and Engineering Center
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-AR-CCB-TL
Watervliet, NY 12189-5000

Director
U.S. Army TRADOC Analysis Command-WSMR
ATTN: ATRC-WSS-R
White Sands Missile Range, NM 88002

Commander
Naval Air Warfare Center Weapons Division
1 Adinistration Circle
ATTN: Code 473C1D, Carolyn Dettling (2)
China Lake, CA 93555-6001

GIDEP Operations Center
P.O. Box 8000
Corona, CA 91718-8000

Commander
Armament and Chemical Acquisition and Logistics Activity
ATTN: AMSTA-PCF-C (2)
AMSTA-AC-TO (2)
AMSTA-AR-ESM (2)
Rock Island, IL 61299-7630