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JUL 7 1964

10/13/98
x W. Layne
10/21/98
RB Craner
OK for Dpenn

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JUL 8 1964

TCG-NNT-1

CENTRAL TECH FILE

File No: S-16.000
T-10262
Test Completed: 5-1-64
RE 7331/250

CENTRAL TECH
BB
FILE
S-16 alpha

To: F. J. Maloney - 8124

Attn: M. R. Wells

From: J. E. Bear - 7331-1

Re: Shock Test of LRL Test Assembly No. 1183-A (U)

An LRL Test Assembly, containing a nuclear assembly simulated by lead, was internally pressured to 100 psia and tested by applying a 3600g shock pulse of 2 msec duration. The lead at the ambient temperature of the test simulated the mass and strength properties of its nuclear counterpost at a temperature of approximately 350°C.

There was no observed change of the internal lead bladder pressure or of the vacuum between bladder and test fixture. The unit was inspected radiographicly before and after the shock test and no structural changes were noted.

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A visual inspection of the lead bladder conducted after the radiographic inspection revealed that the pressure line leading to the bladder was torn loose. This damage is believed to have occurred during disassembly for inspection. New procedures for disassembly will be followed in the future. No further damage was observed.

Object of Test

The object of this test was to determine structural damage resulting from a high level acceleration pulse.

INVENTORIED

SEP 14 1965

B428-3

Carmela Dallizzo 10/27/98
PERSON CHANGING MARKING & DATE
W C Layne 10/28/98
PERSON VERIFYING MARKING & DATE

AUTHORITY: R.B Craner
RECORD ID: 99SN0099
DATED: 10/21/98

THIS DOCUMENT CONSISTS OF 14 PAGE(S)

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Procedure and Results

The impact setup shown in Figure 1 was used to produce the shock pulse shown in Table I. The 18 inch actuator located in Sandia Corporation Albuquerque Area III was used to launch a 78 pound ram projectile in free flight at a velocity of 270 ft/sec. The ram than impacted into the cushioning material (Ensolite) compressing the cushion and producing the acceleration pulse of Table I on the test assembly. After the impact, the test item, moving at 115 ft/sec and the ram moving at 85 ft/sec were stopped by a sawdust filled beam.

The acceleration level obtained in this test, recorded unfiltered using a tape system capable of 40 KC transient undistorted response, was 1400g lower than the requested value of 5000g.

A pretest calibration using a previously loaded cushion produced 4000g. The cause of this wide scatter is believed to be related to the loading history of the cushion. The cushioning material is unable to fully recover from its first loading producing unusually high acceleration when reused. In future testing and calibration new stock will be used and more repeatable tests are anticipated.

X-ray examination conducted before and after the shock test revealed no damage. The internal pressure within the bladder (100 psia) and the vacuum draws between the bladder and its holding fixture remained unchanged by the shock pulse.

A visual inspection of the bladder conducted after the radiograph inspection revealed that the pressure line leading to the bladder was torn loose. This damage is believed to have occurred during disassembly for inspection. New procedures for disassembly will be followed in the future. No further damage was observed.

Conclusion

Although the amplitude of the acceleration obtained in this test was below the value requested, more accurate control can be obtained in the future by using a new cushion for each test. A discription of the test capabilities using the 18-inch actuator as a velocity generator is given in Appendix I.

Single degree of freedom shock spectra for a test pulse of the type obtained in this experiment are given in Figures 3 to 5 of Appendix II. These spectra, which are believed typical of shock pulses obtained using the setup of Figure 1 may be compared with spectra for the requested pulse also given in Appendix II, Figures 6 to 8.

FHMathews:7325-2:mw

Approved by E. White
E. White - 7331-1

Distribution:
1-3/6A - F. J. Maloney, 8124
4/6A - E. H. Copeland, 7331
5/6A - Central Technical File, 8232-2
6/6A - Central Technical File, 3428-1

APPENDIX I

Range of Acceleration Pulses Attainable Using the 18-Inch Actuator and Free Projectile Impact Into Ensolite

The maximum level of acceleration attainable using the 18-inch actuator and a free projectile impact into Ensolite is bounded by the maximum energy performance of the 18-inch actuator, the minimum dimension of the working space between the twin rails, and the maximum stress permitted in the Ensolite. The maximum energy capability of the actuator is sensitive to the weight of the driver item and is 160,000 ft. lbs. upon a 100 lb. projectile (320 ft/sec) and 600,000 ft. lbs. on an 840 lb. projectile (210 ft/sec). These performance factors could be increased by altering the internal configuration of the actuator. The maximum dimension betwen the actuator rails is 21 inches limiting the test item to a width of about 16 inches which provides adequate clearance between the catcher and test item. Test item height and length could be considerably greater than 16 inches, dimensions of 25 inches height and 30 inches length being acceptable. The minimum width could be increased by moving the actuator to a more favorable location where rail dimension would not be a problem. The upper limit of stress permitted in the Ensolite has not been determined. However, a maximum stress (value averaged over the loaded surface) of 12,000 psi has been obtained.

The following table describes the maximum acceleration and velocity change attainable using the actuator as a velocity generator.

Maximum Attainable Acceleration and Velocity

Dimensions of Loaded Surface	Test Item Weight 100 lbs.	150 lbs.	200 lbs.
10" diamter	9400g 120 ft/sec*	6300g 120 ft/sec*	4700g 120 ft/sec*
14" diamter	15,400g 190 ft/sec*	10,400g 190 ft/sec*	7200g 190 ft/sec
16" diameter	20,000g 240 ft/sec*	13,000g 240 ft/sec*	10,000g 230 ft/sec
16" x 20"	38,000g 280 ft/sec	25,000g 250 ft/sec	19,000 230 ft/sec

* These velocities are limited by the maximum height of cushioning material which will remain stable under impact landing.

Samples of typical acceleration pulses produced upon a 130 lb. test item having a loaded surface of 10 inch diameter are given in Figure 2. The 7200g acceleration represents the highest acceleration currently obtained.

APPENDIX II

A Comparison of the Acceleration Response Spectra of the Requested Acceleration Pulse and an Acceleration Pulse Obtained Using Free Projectile Impact

Acceleration response spectra is defined as the maximum acceleration occurring on the mass of a single degree of freedom spring mass system subjected to a ground acceleration pulse. The natural frequency of the spring mass system is varied and a value of maximum acceleration response obtained for each frequency. This establishes a curve of acceleration response as a function of natural frequency for any given shock pulse acting as ground displacement and for any amount of damping.

Response spectra were computed numerically using a CDC 1604 computer for two shock pulses and three cases of damping. The first pulse was of the time profile requested and is based upon rigid body response to a countermeasure blast. This pulse had a linear rise to 4000g in 0.4 ms. The pulse then dropped to 0 following an exponential decay. The pulse duration at the 10% level was 2 ms. The second pulse was obtained experimentally using the method of free projectile impact into a cushion of Ensolite. This pulse exibited the general shapes of shock pulses obtained with a 4000g peak amplitude and a 1.95 ms duration at the 10% level.

The maximum undamped response to the requested pulse occurs at 1000 cps at a level of 6400g while the test pulse produces 5300g response at this frequency. Therefore, for an undamaged system of approximately 1000 cps natural frequency the test pulse would produce a 20% under test. In the response region above 2000 cps the requested pulse produce accelerations ranging from 3800g to 4800g while the test pulse produces response ranging from 4800g to 5800g. In this region an undamped system would be overtested.

In future testing shock spectra comparison between desired pulses and test pulses of the type obtained in the actuator could be used to determine changes in test pulse amplitude and duration required to provide exact simulation in some interesting range of frequency. The desired pulse could be obtained either theoretically or from acceleration records obtained in full scale testing.

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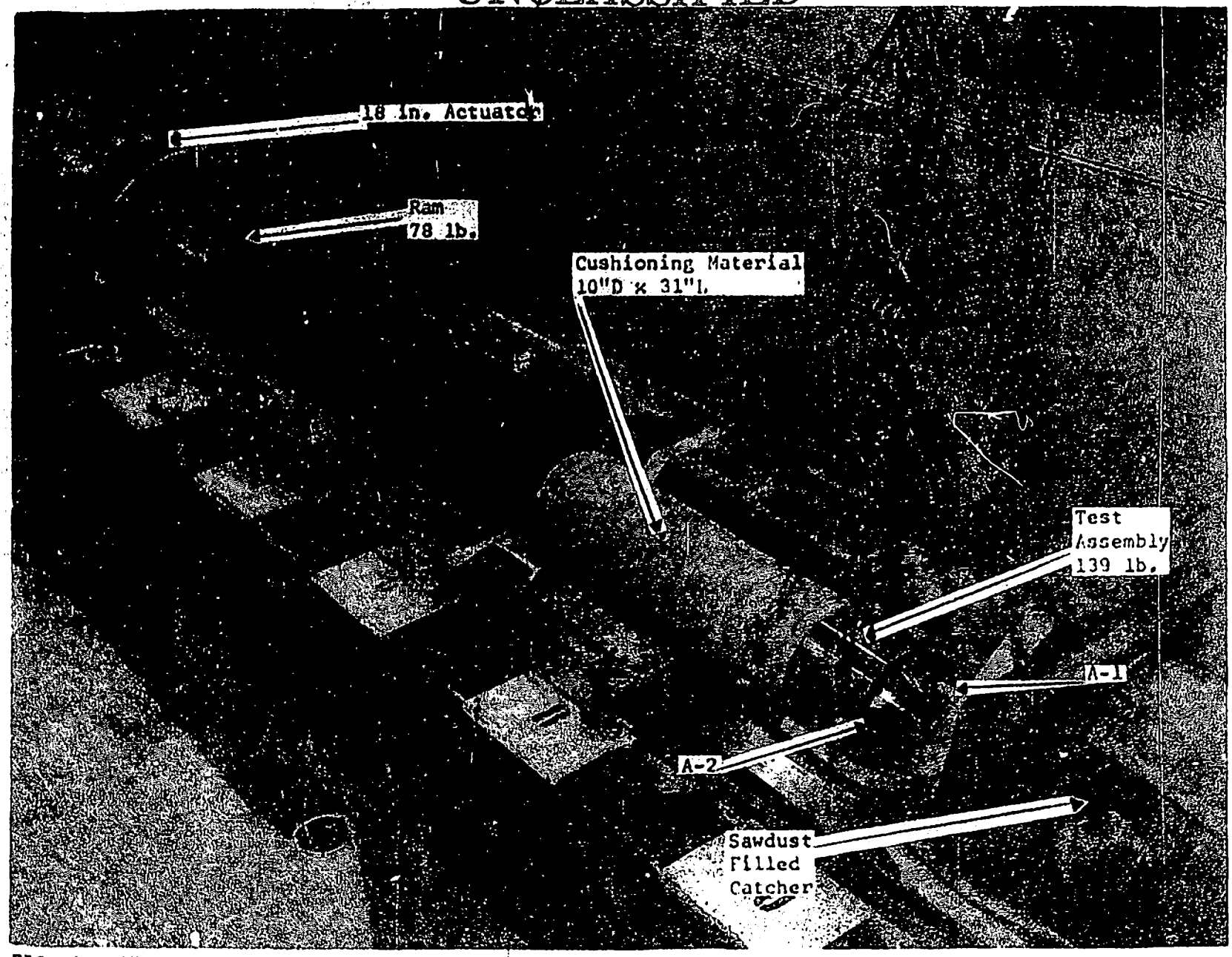

FIG. 1 TEST SETUP. SHOCK TEST OF LRL ASSEMBLY 1183-A.

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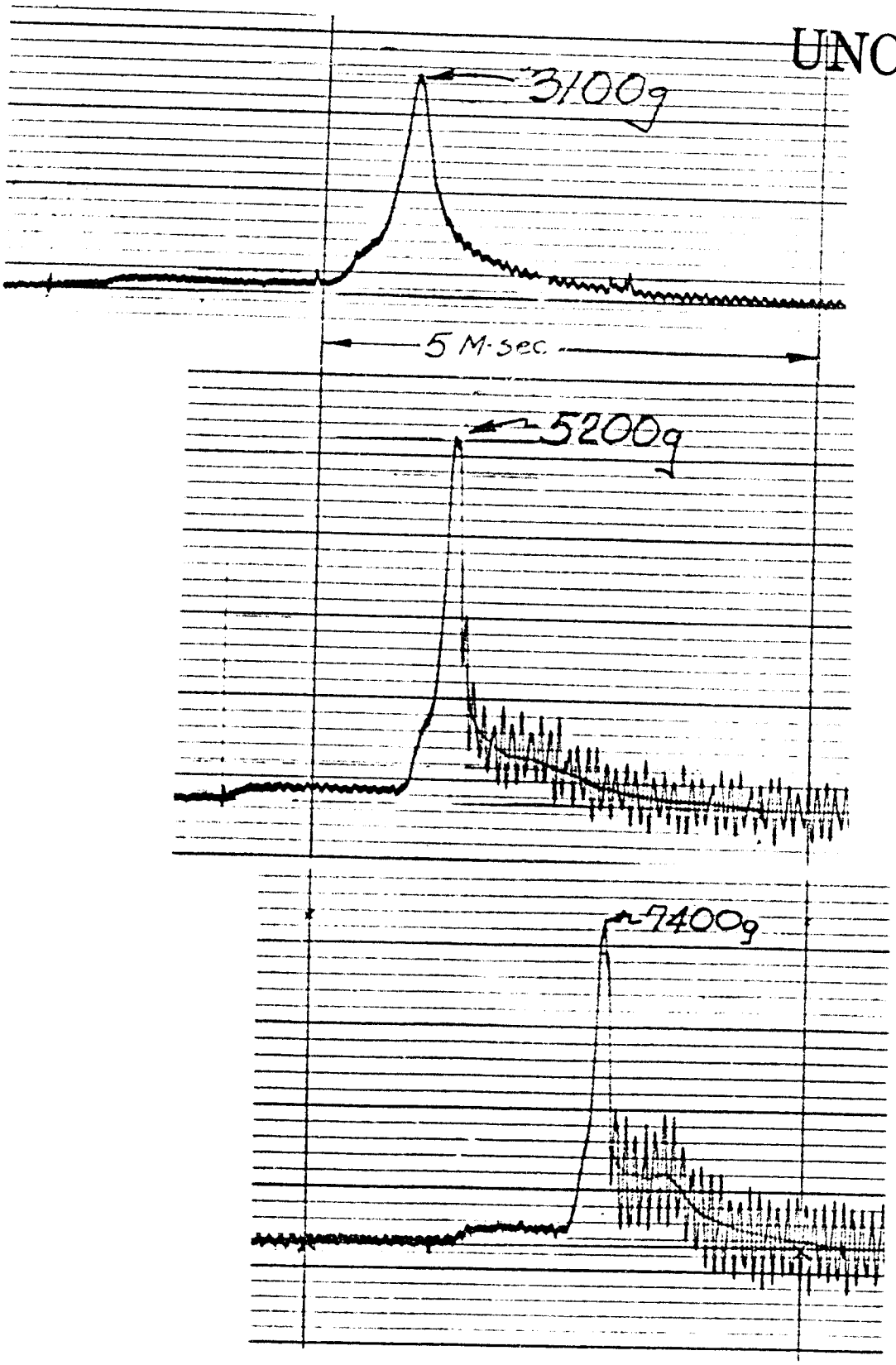

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FIG. 2 ACCELERATION RECORDS OBTAINED USING FREE PROJECTILE IMPACT INTO ENSOLITE. TEST ITEM WEIGHT 130 LBS. SHOCK TEST OF LRL ASSEMBLY 1183-A.

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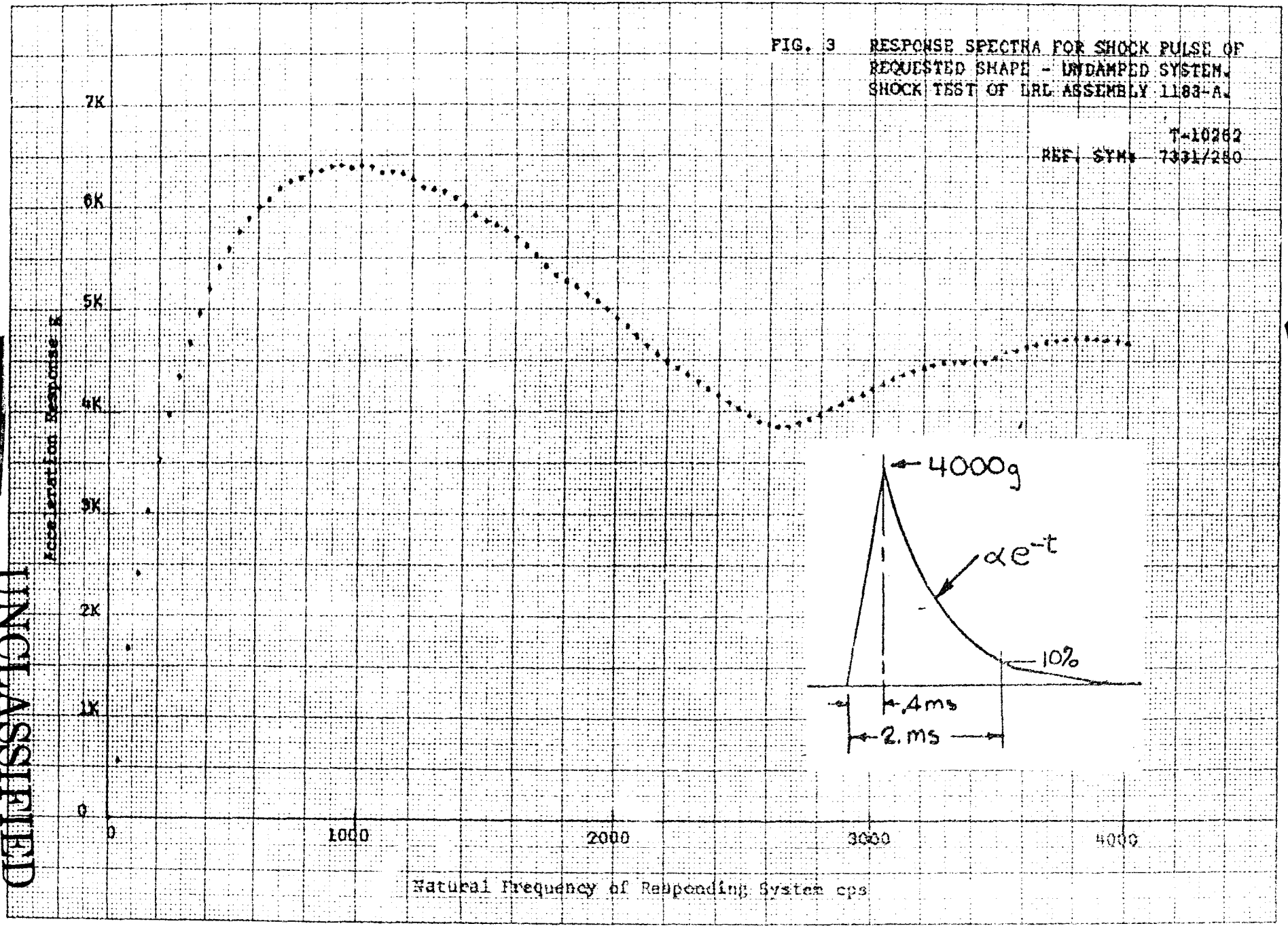
FIG. 3 RESPONSE SPECTRA FOR SHOCK PULSE OF REQUESTED SHAPE - UNDAMPED SYSTEM. SHOCK TEST OF LRL ASSEMBLY 1183-A.

T-10262
REF. SYM: 7331/280



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K•E 10 X 10 TO THE CENTIMETER 46 1513
KEUFFEL & ESSER CO.

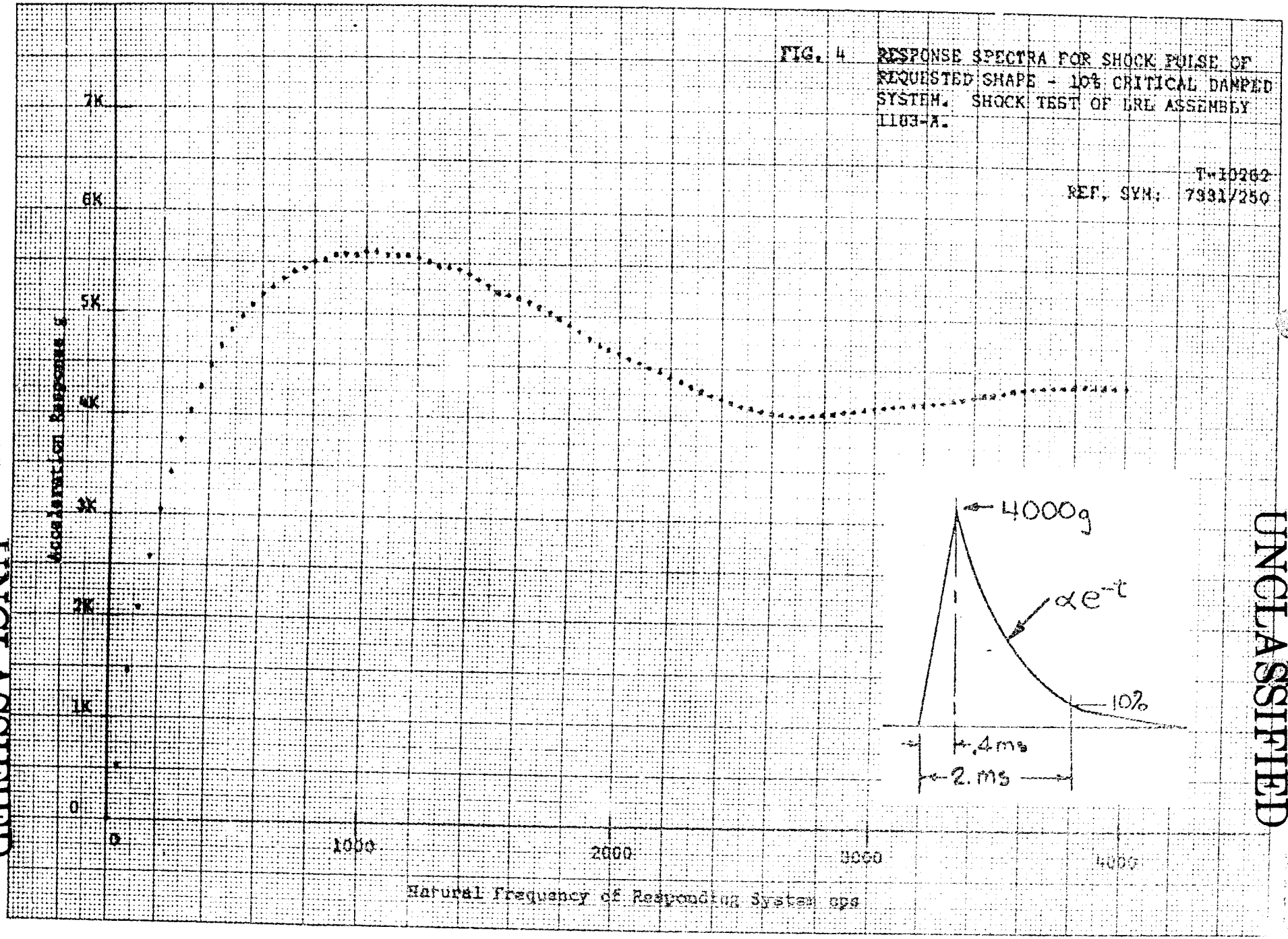

FIG. 4 RESPONSE SPECTRA FOR SHOCK PULSE OF REQUESTED SHAPE - 10% CRITICAL DAMPED SYSTEM. SHOCK TEST OF LRL ASSEMBLY 1103-A.

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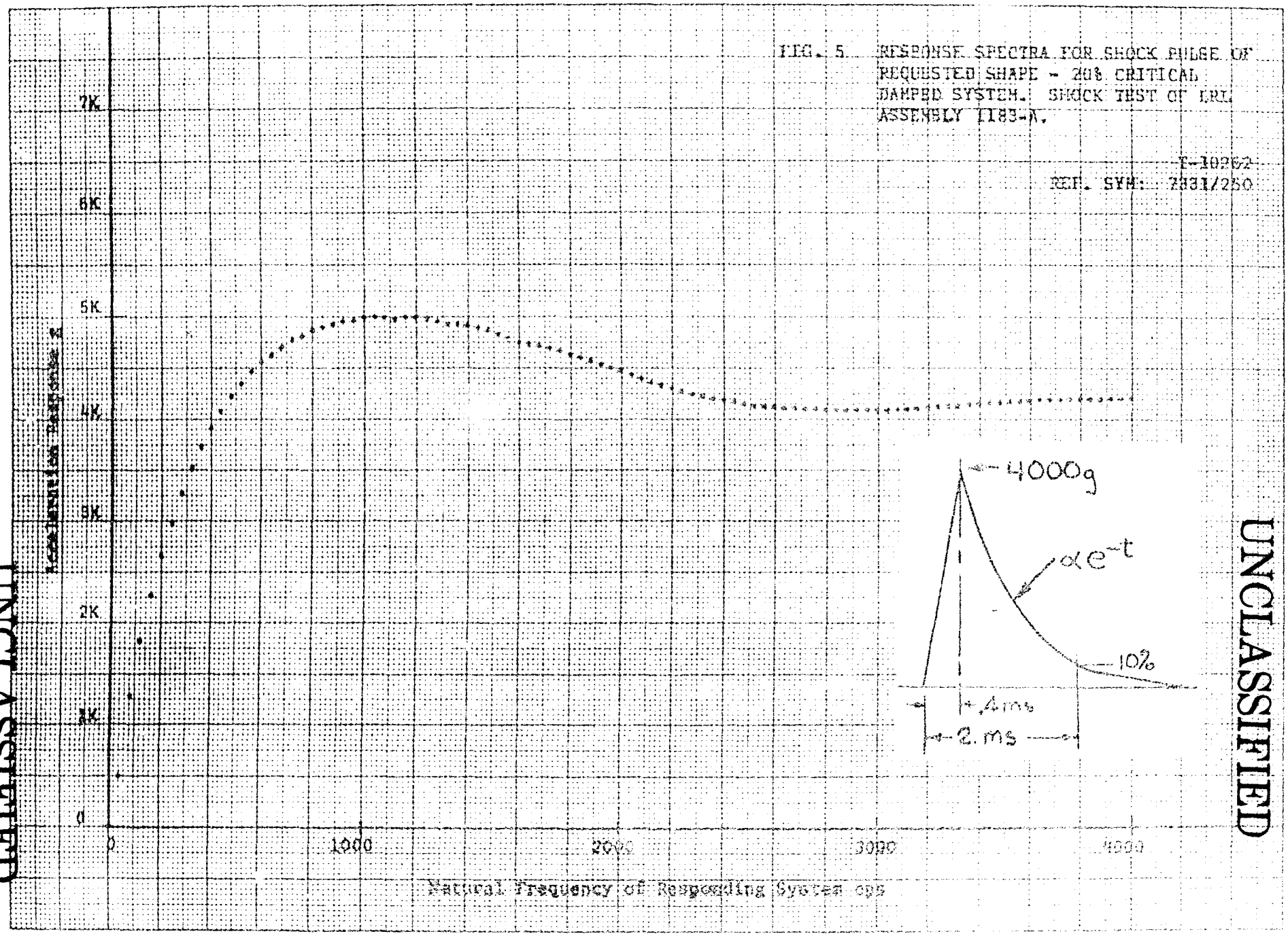
FIG. 5 RESPONSE SPECTRA FOR SHOCK PULSE OF REQUESTED SHAPE - 20% CRITICAL DAMPED SYSTEM. SHOCK TEST OF ERL ASSEMBLY 1183-A.

T-10262
REF. SYM: 2831/250



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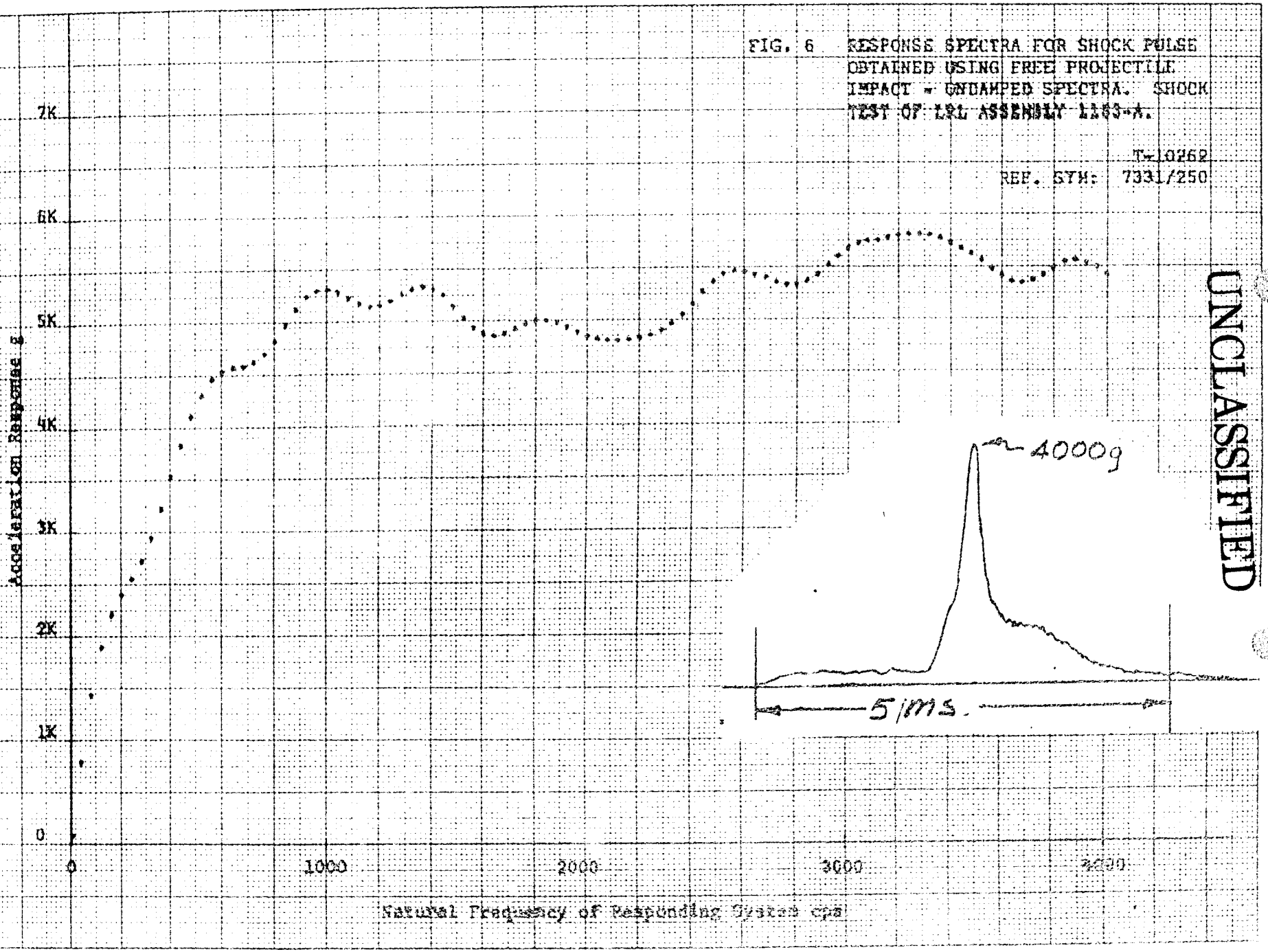

FIG. 6 RESPONSE SPECTRA FOR SHOCK PULSE OBTAINED USING FREE PROJECTILE IMPACT - UNDAMPED SPECTRA. SHOCK TEST OF LRL ASSEMBLY 1163-A.

T-10262

REF. SYM: 7331/250

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K+E 10 X 10 TO THE HALF INCH 46 1513

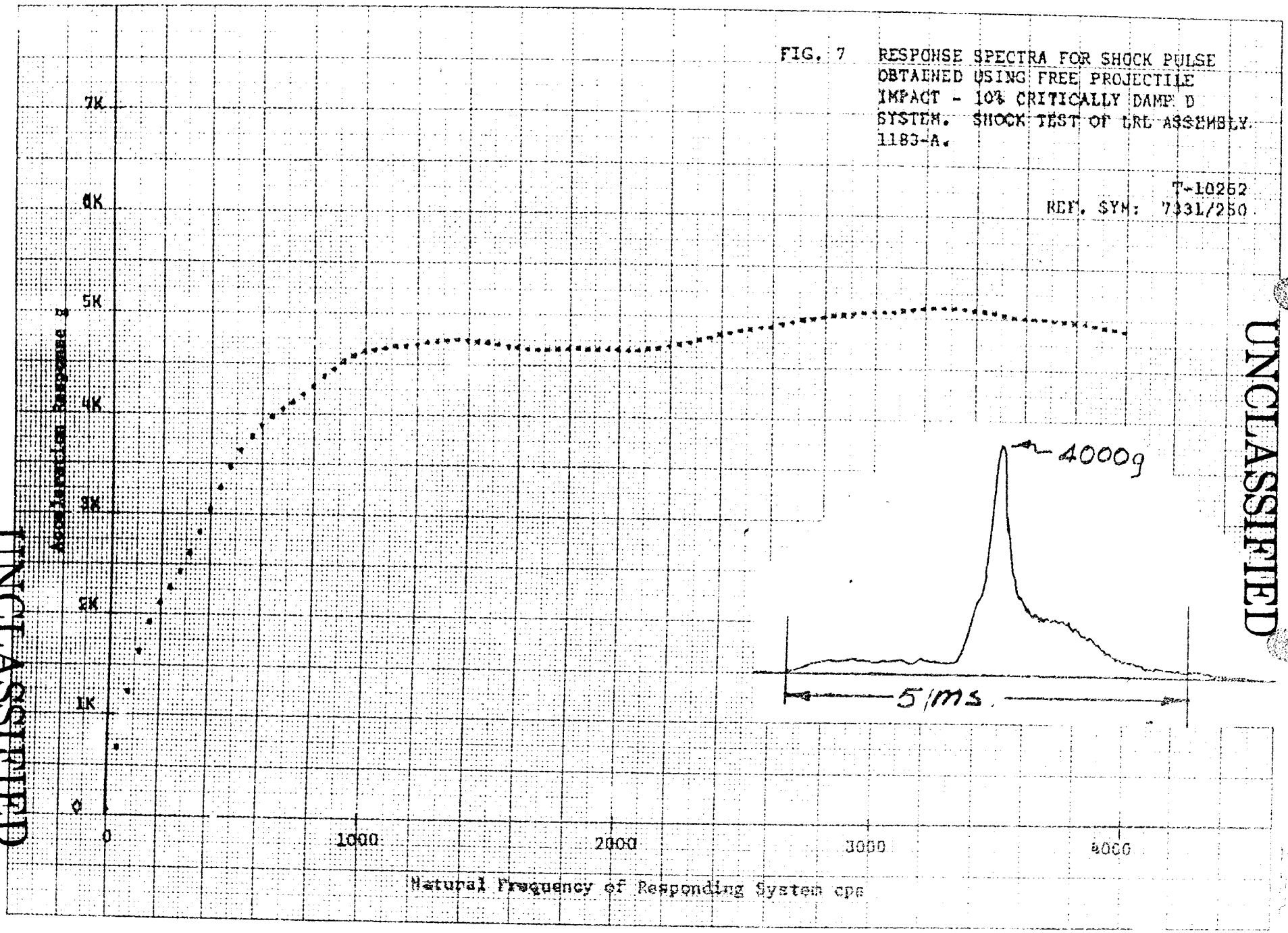

FIG. 7 RESPONSE SPECTRA FOR SHOCK PULSE OBTAINED USING FREE PROJECTILE IMPACT - 10% CRITICALLY DAMPED SYSTEM. SHOCK TEST OF LRL ASSEMBLY 1183-A.

T-10262
REF. SYM: 7331/250

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K•E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM MADE IN U.S.A.
KEUFFEL & ESSER CO.

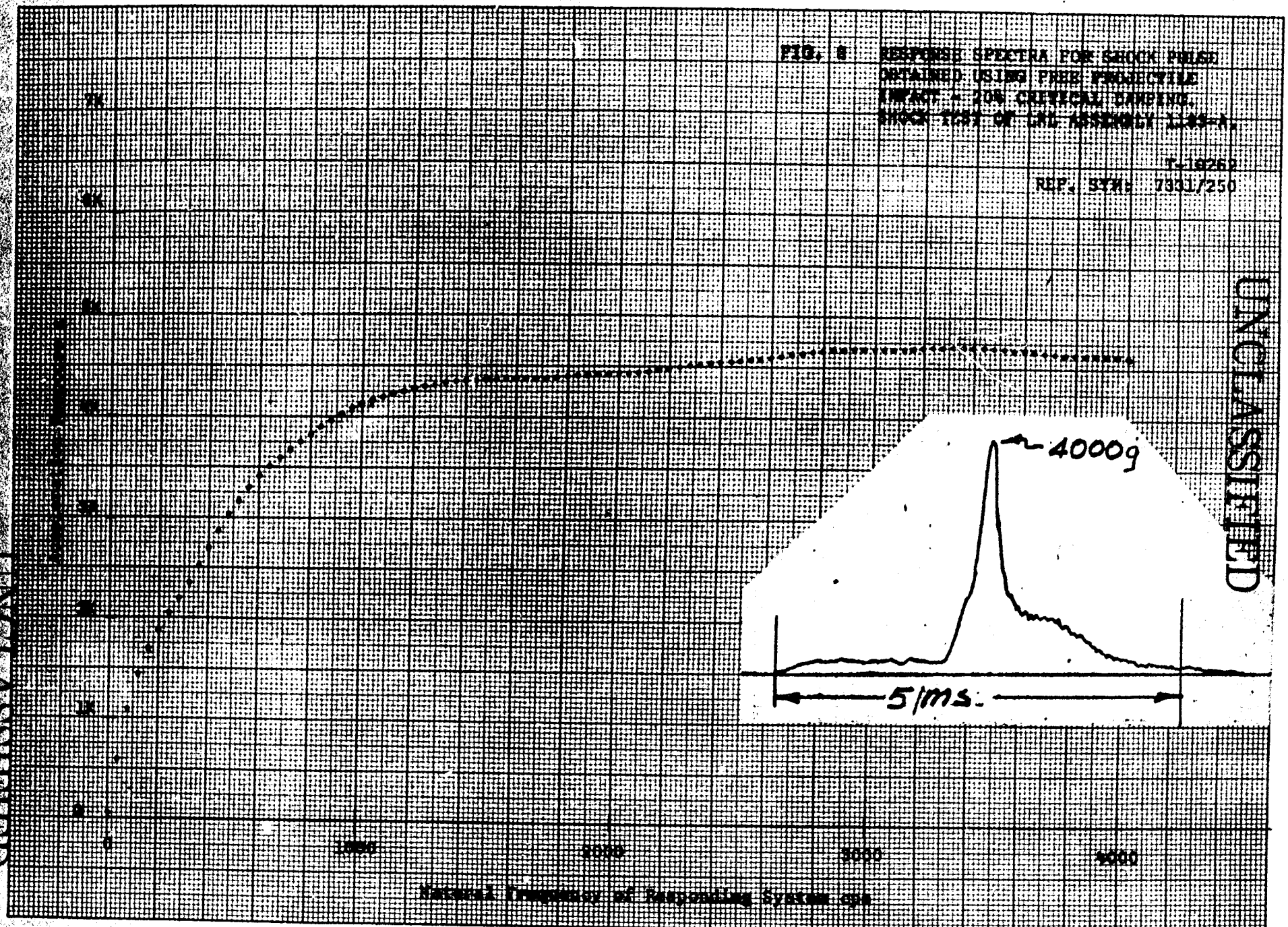

FIG. 8 RESPONSE SPECTRA FOR SHOCK PULSE OBTAINED USING FREE PROJECTILE IMPACT - 20% CRITICAL DAMPING. SHOCK TEST OF LAL ASSEMBLY 1183-A.

T-10262
REF. SYM: 7331/250

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SC 7198-NQ (2-64) TRANSDUCER TEST TABLE

TABLE I

TEST NO. T-10262
REF. SYM: 7331/250

SHOCK TEST OF LRL TEST ASSEMBLY 1183-A

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LEGEND:

PD - PULSE DURATION
RT - RISE TIME
MFP - MAXIMUM FAIRED PULSE
A - ACCELEROMETER

TEST CONDITIONS

Test Date - 4/30/64

SETUP:

Fire Pressure - 3400 psi
Set Pressure - 400 psi
Cushion Pressure - 560 psi
Projectile Weight - 78 #
Impact Velocity - 273 ft/sec
Test Item - 139 #

CUSHION:

26 ea - 10"D New Ensolite

RESULTS:

Damage - (1) Visual inspection of lead assembly. No damage due shock.

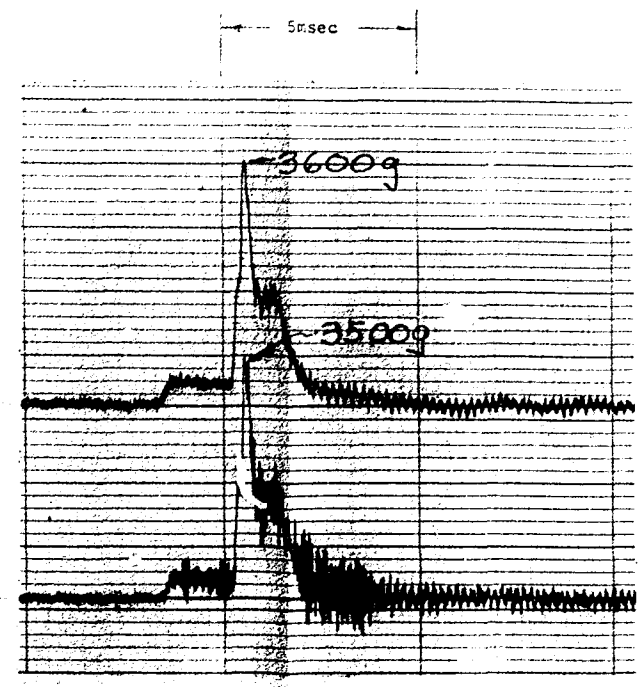
(2) Pressure before and after. No change.

TRANSDUCER INFORMATION						ACCELERATION DATA				
No.	Location and Orientation	Model	S/N	fn and Range	Fig. Ref.	Max. (+)	Max. (-)	MFP	RT (ms) 10%-90%	PD (ms) 10%-10%
A-1	Left Side Axial	Endevco 2225-M2		80KC 20,000g		3600	0	3600	.27	2.02
A-2	Right Side Axial	Endevco 2225-M2*		80KC 20,000g		3500	500	3500	.26	1.95

*A-2 Mounted on Isolation Stud.

CALIBRATE

Acceleration vs Time. Good to 40KC. No filtering.



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