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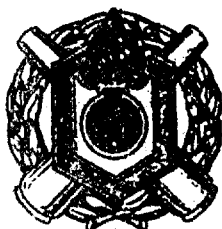
Technical Report ARAED-TR-93026

**INSTRUMENTATION FOR THE FOREIGN WEAPONS
EVALUATION PROGRAM**

Joseph Petrellese, Jr.

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April 1994



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INTRODUCTION

The objective of the Foreign Weapons Evaluation Program is to test the foreign 155-mm semiautomatic artillery loader/assist device (SAL) for performance and applicability to U.S. Army artillery systems using the M284 cannon. After a series of tests and evaluations, several SAL candidates will be narrowed down to a single system which will ultimately be recommended for procurement.

Testing was first performed using two currently accepted ramming methods, hand ramming and positive-stroke piston ramming (hydraulic ramming). These tests were performed to establish baseline values for future evaluation of semiautomatic artillery ramming devices. Testing was then conducted on three different SAL under the same test parameters as the hand and hydraulic ram tests.

Telemetry data was recorded for each and every test, with quick look data also available. A block diagram of the telemetry test setup is shown in figure 1.

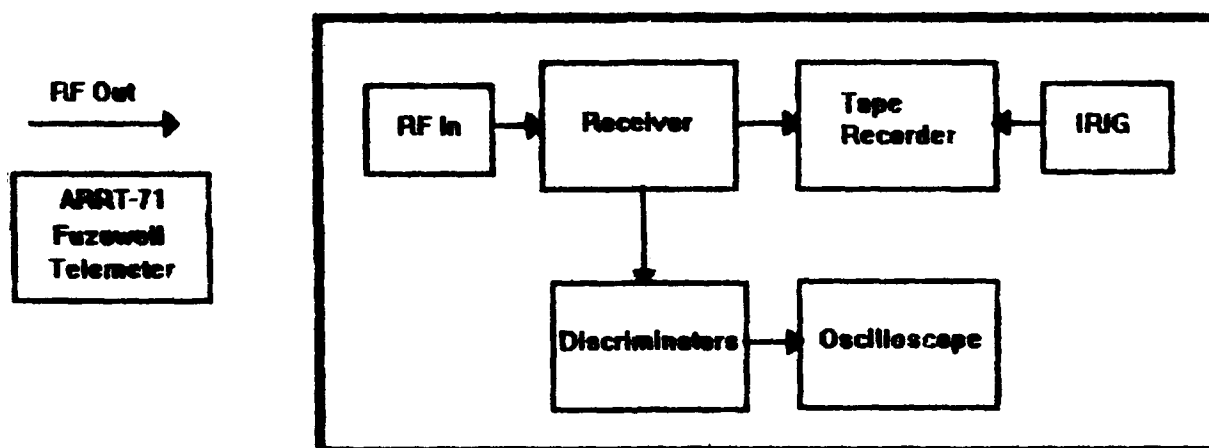


Figure 1. Telemetry test van

All tests were conducted using an ARDEC model ARRT-71 fuze well telemeter (TM). The TM consisted of a tri-axial accelerometer, transmitter, batteries, and related electronic components. A block diagram of the TM is shown in figure 2.

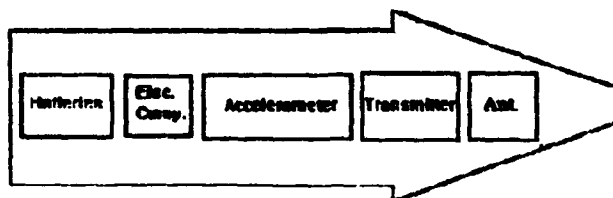


Figure 2. ARDEC model ARRT-71 fuze well telemeter

The tri-axial accelerometer was used to measure acceleration in three different axis: the traverse, vertical, and longitudinal axis.

Testing Procedure

On all test series the test configuration was as shown in figure 3.

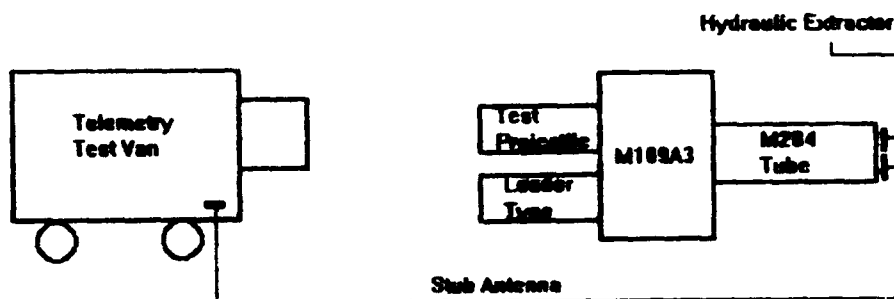


Figure 3. Test series configuration

The tests were conducted using three different inert projectile models, the M107A1, M549A1, and the M483A1. Data was recorded using each of these models at various quadrant elevation (QE) values of the howitzer. The following data was logged prior to ramming:

Vehicle type	Loader type
Vehicle serial number	Loader serial number
Tube type	Sample number
Tube serial number	Projectile number
Projectile Model	Ram number
Ram QE	

Once these parameters were recorded, an ARRT-71 TM would be installed in place of the fuze in the nose of the projectile. The round would then be placed on the loading tray. The TM was then activated to confirm TM operation and zero baseline. All data was recorded with IRIG time on 1 in. magnetic tape. Once the recorder was up

to speed the engineer would then give a 3 to 5 sec countdown to the gun crew, following which the ram would take place using either the hand ram, the hydraulic ram, or one of the SAL. Upon completion of the ram, the data was recorded for an additional 5 sec. After the round was removed from the chamber, the TM was deactivated and the peak pressure was measured. The extraction force was then calculated from the peak pressure. This procedure was repeated for the various types of loaders and projectile models used, with the data being recorded for each test. A digital oscilloscope was also used in the telemetry van, so that a quick-look analysis could be given on the ram test including the maximum longitudinal (axial) acceleration.

Testing Results

A total of 288 ramming tests were performed using a hand rammer, hydraulic rammer, and three different SAL with all data recorded on magnetic tape. Data from each test was analyzed for maximum positive and negative acceleration in the transverse, vertical, and longitudinal axis for both before seating, seating, and after seating acceleration. Maximum seating velocity was also computed by integrating the longitudinal seating acceleration. A summary of all the results can be found in tables 1 through 42. For certain loader types, the before seating acceleration (balloting) measured was so small that it was not included in summary tables. Typical sample plots for each table are shown in appendixes A through D.

SUMMARY

The telemetry section of the Armament Engineering Directorate working jointly with the Fire Support Armaments Center (FSAC) personnel obtained excellent quality telemetry data on all ramming tests. The data was analyzed, tabulated, plotted, and provided to FSAC for their use in determining future testing and/or procurement actions. Data was also provided to the Project Manager for Advance Field Artillery System (AFAS) for assistance in developing an AFAS loading system.

Table 1. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/std hyd

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																						
DATE: OCT 12, 1980		VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M107			LOADER TYPE: STD HYD											
SHEET # : 1		VEH SER#: 1813			TUBE SER#: 762			RAM QE: 264 mils			LOADER SER#: UNKNOWN											
SEATING ACCELERATION																						
AFTER SEATING ACCELERATION																						
		SEATING			TRANSV			VERTICAL			LONGITUDE			VERTICAL			LONGITUDE					
		EXTRA			POS			NEG			POS			NEG			POS			NEG		
SAMP	PROJ	RAM	FORCE	SEATING	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
#	#	#	(LBS)	(FT/SEC)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	
1	1	1	12588	11.32	103	139	150	94	61	496	152	96	225	138	324	184						
2	2	1	15900	11.81	172	318	87	130	0	511	306	220	124	136	397	193						
3	3	1	15238	11.41	254	224	282	257	0	569	278	194	207	119	551	281						
4	4	1	16563	11.52	206	200	150	81	0	600	212	297	150	263	422	159						
5	5	1	14575	13.28	184	214	155	149	23	567	441	231	266	149	426	301						
6	6	1	18550	11.92	42	85	160	172	0	487	188	151	141	172	490	309						
7	7	1	14575	11.73	98	122	80	118	0	414	147	104	87	149	306	187						
8	8	1	14575	12.19	91	133	175	157	21	474	211	315	144	250	413	254						
9	9	1	12588	11.73	86	18	149	93	0	426	122	165	136	285	386	312						
10	10	1	16563	12.60	67	79	203	191	0	490	61	103	135	310	563	447						

Table 5. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/std hyd

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: OCT 12, 1990				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: STD HYD			
SHEET # : 5				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 284 mils				LOADER SER#: UNKNOWN			
				SEATING ACCELERATION								AFTER SEATING ACCELERATION							
				TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE					
SAMP	PROJ	RAM	FORCE	SEATING	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG			
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)			
43	1	2	21863	12.79	139	67	263	213	0	477	109	140	163	182	955	600			
44	2	1	20538	13.08	43	80	111	142	0	608	250	214	143	180	1080	690			
45	3	1	22525	14.04	128	91	88	170	0	558	109	200	200	163	1067	715			
46	4	1	22525	12.58	67	86	161	161	0	540	116	141	111	124	958	704			
47	5	1	22194	13.34	157	115	81	88	0	566	188	145	188	163	911	823			
48	6	1	23188	12.03	104	214	173	186	0	535	135	153	80	155	862	472			
49	7	1	21863	14.54	61	151	194	194	0	636	133	115	76	113	1146	891			
50	8	1	23519	11.78	86	61	229	188	0	613	153	110	87	186	1094	794			
51	9	1	23188	12.92	73	97	162	213	0	578	103	97	69	138	1175	832			
52	10	1	22194	12.51	31	67	186	161	0	595	165	104	136	180	1112	749			

Table 7. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																		
DATE: JAN 7, 1991		VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M107			LOADER TYPE: SAL 1							
SHEET # : 7		VEH SER#: 1813			TUBE SER#: 782			RAM QE: 264 mils			LOADER SER#: UNKNOWN							
		SEATING ACCELERATION						AFTER SEATING ACCELERATION										
		EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
63	21	1	34450	17.57	290	315	163	81	0	852	575	206	250	244	989	764		
64	22	1	33125	14.93	386	355	136	328	0	753	447	398	297	235	781	508		
65	23	1	38438	17.08	204	477	285	346	0	1150	297	290	458	180	946	937		
66	24	1	38438	18.19	0	257	200	100	0	950	777	704	470	695	1058	558		
67	25	1	35775	15.31	373	367	182	223	0	821	343	361	377	143	767	504		
68	26	1	31800	16.59	254	483	149	359	0	740	359	334	402	198	918	422		
69	27	1	33788	18.44	182	339	100	100	0	1013	345	224	670	157	886	338		
70	28	1	34450	16.20	330	416	241	365	0	767	306	288	200	167	921	704		
71	29	1	31800	17.65	87	186	235	265	0	998	668	309	786	766	2565	2307		
72	30	1	33125	14.84	224	264	319	270	0	783	442	321	401	563	1126	588		

Table 11. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING - SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																	
DATE: JAN 7, 1991			VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M549			LOADER TYPE: SAL 1					
SHEET # : 11			VEH SER#: 1813			TUBE SER#: 7d2			RAM QE: 264 mils			LOADER SER#: UNKNOWN					

Table 12. Semiautomatic 155-mm artillery loader/assist device results, M549/600 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 1			
SHEET # : 12				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 600 mils				LOADER SER#: UNKNOWN			

Table 13. Semiautomatic 155-mm artillery loader/assist device results, M549/900 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																
DATE: JAN 7, 1991			VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M549			LOADER TYPE: SAL 1				
SHEET # : 13			VEH SER#: 1813			TUBE SER#: 782			RAM QE: 900 mils			LOADER SER#: UNKNOWN				
SAMP #	PROJ #	RAM #	EXTRA FORCE (LBS)	SEATING VELOCITY (FT/SEC)	SEATING ACCELERATION				AFTER SEATING ACCELERATION							
					TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	POS	NEG	POS	NEG		
															POS	NEG
103	36	1	25838	13.07	177	208	62	111	0	812	202	263	124	155	849	404
104	37	1	30475	13.88	186	93	136	235	0	670	241	248	303	167	651	417
105	38	1	32463	14.03	109	133	200	200	0	514	145	224	282	207	720	641
106	39	1	32463	11.78	190	73	142	192	0	462	196	128	186	229	536	275
107	40	1	27163	13.04	136	149	142	99	0	644	105	93	124	155	469	252

Table 14. Semiautomatic 155-mm artillery loader/assist device results, M549/0 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 1			
SHEET # : 14				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 0 mls				LOADER SER#: UNKNOWN			

Table 15. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 1			
SHEET # : 15				VEH SER#: 1813				TUBE SER#: 782				RAM OE: 264 mils				LOADER SER#: UNKNOWN			
				SEATING ACCELERATION								AFTER SEATING ACCELERATION							
		EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE			
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	
113	21	1	33125	17.71	353	235	188	210	0	925	452	526	241	309	1722	1042			
114	22	1	34450	19.80	242	176	113	138	0	1065	127	272	413	200	1469	1542			
115	23	1	35113	17.16	229	165	142	93	0	919	477	447	192	167	1804	1418			
116	24	1	31800	15.68	37	99	272	285	0	925	223	328	173	217	1792	1628			
117	25	1	34450	19.83	339	176	213	75	0	893	127	133	144	169	1775	1922			
118	26	1	32463	15.16	245	184	179	192	0	874	220	226	192	173	1850	1237			
119	27	1	35113	18.87	118	149	254	192	0	972	279	217	174	241	2003	1300			
120	28	1	34450	19.87	145	151	125	119	0	1114	188	157	351	213	2020	1824			
121	29	1	34450	16.33	171	104	210	254	0	685	171	220	167	167	930	994			
122	30	1	31138	16.60	81	229	229	272	0	937	415	216	253	217	759	637			

Table 17. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 1			
SHEET # : 17				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 600 mils				LOADER SER#: UNKNOWN			

Table 21. Semiautomatic 155-mm artillery loader/assist device results, M107/600 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																									
DATE: JUN 24, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M204					PROJ MODEL: M107					LOADER TYPE: SAL 2					
SHEET # : 21					VEH SER#: 1813					TUBE SER#: 782					RAM OF: 600 mils					LOADER SER#: UNKNOWN					
SAMP #	PROJ #	RAM #	FORCE (LBS)	SEATING VELOCITY (FT/SEC)	BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION								
					EXTRA	SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE										
							POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS
163	61	1	45050	26.61		776	927	676	282	330	336	508	426	300	0	1136	242	281	476	476	1678	378			
165	62	2	38088	20.17		1004	942	644	284	238	208	318	486	371	0	886	342	284	421	198	865	328			
168	63	1	38426	22.18		884	322	486	371	187	881	644	782	844	0	1078	371	782	883	817	788	361			
167	64	1	19875	9.80		567	428	378	122	147	888	1088	881	761	0	638	121	702	801	878	514	171			
168	65	1	47038	23.13		881	1411	1411	488	634	480	538	584	470	0	888	387	416	272	322	861	510			

Table 22. Semiautomatic 155-mm artillery loader/assist device results, M107/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M204				PROJ MODEL: M107				LOADER TYPE: SAL 2							
SHEET # : 22				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 1000 mils				LOADER SER#: UNKNOWN							

Table 23. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																				
DATE: JUN 24, 1991				VEHICLE TYPE: M109A1				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2				
SHEET # : 23				VEH SER#: 1813				TUBE SER#: 782				RAM DE: 264 mils				LOADER SER#: UNKNOWN				
SAMP	PROJ	RAM	EXTRA	SEATING	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION				LONGITUDE	POS	NEG	LONGITUDE
					FORCE	VELOCITY	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.				
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	POS	NEG	(g's)	(g's)	POS	NEG	(g's)	(g's)	POS	NEG	(g's)	(g's)	(g's)	
104	46	1	57638	31.50	416	661	470	545	250	186	294	223	223	248	272	2806	2859			
105	47	1	57638	32.18	1077	458	520	371	340	235	285	619	449	693	421	3010	2840			
106	48	1	56550	30.08	808	1270	701	927	807	832	264	303	801	448	376	476	3133	3064		
107	49	1	56975	28.76	404	378	545	448	227	204	257	428	421	551	421	371	2383	1498		
108	50	1	61613	32.07	1040	520	470	668	445	445	173	272	223	3169	1188	1486	2899	2202		
109	51	1	56963	31.00	557	436	560	761	367	362	169	145	576	242	501	501	3133	2688		
170	52	1	60250	31.45	367	343	828	804	409	489	122	122	458	318	359	681	2804	2632		
141	53	1	56650	28.74	396	421	584	371	234	351	297	644	124	618	743	584	2647	2272		
172	54	1	56313	26.73	254	302	276	276	245	186	327	302	426	157	401	276	1071	685		
173	55	1	56650	23.58	367	284	346	223	182	136	220	294	248	223	89	173	817	613		

* Output Clipped (maximum output of Accelerometer obtained)
 Projectiles #46-53 have thick bases
 Projectiles #54-55 have normal bases

Table 24. Semiautomatic 155-mm artillery loader/assist device results, M483/0 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2							
SHEET # : 24				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 0 mils				LOADER SER#: UNKNOWN							
								</															

Table 25. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																											
DATE: JUN 24, 1991				VEHICLE TYPE: M108A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2											
SHEET # : 26				VEH SER#: 1813				TUBE SER#: 782				RAM OE: 600 mils				LOADER SER#: UNKNOWN											
				BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION											
		EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE					
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG			
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)			
179	01	1	55650	28.34	416	293	384	235	227	156	220	268	532	433	0	1678	318	343	260	359	2905	2859					
180	02	1	57638	28.53	582	334	607	557	223	248	334	384	384	308	0	1558	334	358	631	409	2776	2846					
181	03	1	56875	31.08	208	133	551	826	257	267	278	278	278	76	0	1677	351	303	200	200	3121	1359					
182	04	1	42400	26.00	607	433	520	782	351	482	384	681	817	782	0	1078	285	235	124	98	679	679					
183	05	1	47700	21.86	308	845	421	421	277	182	355	502	186	386	0	882	134	257	188	223	1203	1180					

Table 26. Semiautomatic 155-mm artillery loader/assist device results, M483/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JUN 24, 1991		VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2					
SHEET # : 28		VEH SER#: 1813				TUBE SER#: 782				RAM CE: 1000 mils				LOADER SER#: UNKNOWN					

Table 27. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: JUN 24, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M204					PROJ MODEL: M549					LOADER TYPE: SAL 2				
SHEET # : 27					VEH SER#: 1813					TUBE SER#: 782					RAM QE: 264 mls					LOADER SER#: UNKNOWN				
					BEFORE SEATING ACCELERATION					SEATING ACCELERATION					AFTER SEATING ACCELERATION									
SAMP	PROJ	RAM	FORCE	SEATING VELOCITY	EXTRA	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	
#	#	#	(LBS)	(FT/SEC)		POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
189	46	1	37783	24.09		1337	966	1077	978	597	597	618	297	260	334	0	948	868	594	181	210	808	821	
190	47	1	36439	22.66		449	449	368	363	428	232	230	208	368	236	0	1183	376	187	413	213	771	749	
191	48	1	30475	15.41		598	538	446	471	227	227	318	343	371	173	0	817	171	171	248	173	999	545	
192	49	1	35113	19.45		693	347	285	483	176	223	604	421	557	137	0	1013	396	248	285	235	999	433	
193	50	1	30475	19.52		805	847	884	588	636	367	218	218	288	213	0	978	281	97	138	213	734	583	
194	51	1	33788	18.28		838	418	828	878	378	328	220	288	334	805	0	1032	343	318	334	334	824	374	
195	52	1	27826	17.47		388	148	347	371	184	308	297	347	818	173	0	728	322	74	272	173	538	234	
196	53	1	41075	24.58		726	605	551	578	282	267	412	798	428	150	0	1383	387	315	275	351	747	1040	
197	54	1	36438	18.85		480	288	408	508	183	183	220	288	582	210	0	887	288	343	210	138	692	898	
198	55	1	17225	10.53		388	188	470	822	187	281	271	148	272	348	0	773	148	50	124	188	422	211	

Table 30. Semiautomatic 155-mm artillery loader/assist device results, M549/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M264				PROJ MODEL: M649				LOADER TYPE: SAL 2							
SHEET # : 30				VEH BEW: 1813				TUBE BEW: 782				RAM OE: 1000 mils				LOADER BEW: UNKNOWN							
SAMP	PROJ	#	RAM	EXTRA	SEATING	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION				LONGITUDE					
						TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE									
#	#	#	#	(LBS)	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	(g's)	
209	06	1	25176	13.76	342	406	286	857	183	126	176	147	210	186	0	406	318	343	111	186	352	218	
210	07	1	30476	16.36	471	603	708	334	164	117	347	371	608	186	0	1078	767	321	3160	662	606	1622	
211	08	1	37100	21.73	303	376	614	436	308	426	187	472	363	186	0	673	406	2060	3193	1066	3121	667	
212	08	1	6300	6.14	343	606	446	747	147	170	60	74	60	66	0	170	60	26	60	60	126	67	
213	70	1	21200	12.62	646	246	296	366	187	211	267	246	186	236	0	656	186	124	136	136	361	211	

* Output Clipped (maximum output of Accelerometer obtained)

Table 31. Semiautomatic 155-mm artillery loader/assist device results, M107/600 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																						
DATE: OCT 2, 1981		VEHICLE TYPE: M109A3		TUBE TYPE: M284		PROJ MODEL: M107		LOADER TYPE: SAL 3														
SHEET # : 31		VSM SRM: 1813		TUBE SRM: 782		RAM CE: 600 mm		LOADER SRM: UNKNOWN														
BAMP	PROJ	RAM	FORCE	EXTRA	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION									
					SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE					
g	g		VELOCITY		POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG		
			(FT/SEC)	(LBS)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)		
214	87	1	36778	24.28	484	983	1316	1038	330	358	363	828	283	287	0	84°	383	353	138	238	1877	771
216	88	1	38778	20.78	282	378	308	404	81	81	404	477	428	404	0	1087	308	233	308	282	1338	636
218	88	1	38778	22.38	1283	1084	718	1086	281	224	287	888	371	248	0	1101	322	287	322	347	1670	482
217	80	1	33128	21.81	870	488	421	888	223	128	347	470	388	470	0	1131	188	188	223	173	828	434
218	81	1	34480	22.82	1077	884	1218	813	404	320	303	381	838	884	0	1040	811	848	283	438	1481	887

Table 32. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																													
DATE: OCT 2, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M264					PROJ MODEL: M107					LOADER TYPE: SAL 3									
SHEET # : 32					VEH SER#: 1813					TUBE SER#: 782					RAM QE: 264 mils					LOADER SER#: UNKNOWN									
					</																								

Table 33. Semiautomatic 155-mm artillery loader/assist device results, M107/0 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: OCT 2, 1991		VEHICLE TYPE: M109A3		TUBE TYPE: M284		PROJ MODEL: M107		LOADER TYPE: SAL 3															
SHEET # : 33		VSH GENP: 1013		TUBE GENP: 792		RAM GENP: 0 mls		LOADER GENP: UNKNOWN															
SAMP	PROJ	RAM	FORCE	EXTRA	BEATING VELOCITY (FT/SEC)	BEFORE BEATING ACCELERATION				BEATING ACCELERATION				AFTER BEATING ACCELERATION									
						TRANSH.	VERTICAL	LONGITUDE	TRANSH.	VERTICAL	LONGITUDE	TRANSH.	VERTICAL	LONGITUDE	TRANSH.	VERTICAL	LONGITUDE						
						POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG				
g	g	g	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
229	102	1	40413		22.81	864	844	926	926	189	293	141	1018	1497	1820	0	1746	1144	446	1300	1126	808	340
230	103	1	27826		24.67	638	392	488	369	236	170	416	367	236	286	0	866	122	166	161	308	866	367
231	104	1	38113		24.86	866	796	796	614	206	136	836	303	666	366	0	616	327	520	313	263	1040	477
232	106	1	38640		21.81	920	477	567	1037	216	236	1016	722	1077	1226	0	1101	666	824	1161	608	861	367
233	108	1	36086		26.36	842	1267	661	1374	263	246	466	841	1003	1466	0	1206	644	366	730	266	866	367

Table 35. Semiautomatic 155-mm artillery loader/assist device results, M483/0 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
DATE: OCT 2, 1981			VEHICLE TYPE: M108A3			TUBE TYPE: M284			PROJ MODEL: M483			LOADER TYPE: SAL 3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
SHEET # : 35			VEH SER#: 1813			TUBE SER#: 782			RAM CE: 0 mls			LOADER SER#: UNKNOWN																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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					SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
					VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
g	g	g	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)

* Output Clipped (maximum output of Accelerometer obtained)
 Projectiles #71-72 have normal bases
 Projectiles #73-75 have thick bases

Table 36. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																													
DATE: OCT 2, 1991										VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: SAL 3				
SHEET # : 36										VEH BERN: 1813					TUBE BERN: 782					RAM OE: 264 mm					LOADER BERN: UNKNOWN				

Table 37. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: OCT 2, 1981					VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: SAL 3				
SHEET # : 37					VEH SER#: 1013					TUBE SER#: 762					RAM CE: 600 mils					LOADER SER#: UNKNOWN				
SAMP	#	PROJ	RAM	FORCE (LBS)	SEATING VELOCITY (FT/SEC)	BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION						
						EXTRA	TRANSV.	VERTICAL		LONGITUDE		TRANSV.	VERTICAL		LONGITUDE		TRANSV.	VERTICAL		LONGITUDE				
								POS	NEG	POS	NEG		POS	NEG	POS	NEG		POS	NEG	POS	NEG	POS	NEG	POS
g	g	g	g			(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	
254	83	1		44398	20.80	278	351	276	351	73	68	230	254	250	250	0	881	157	182	150	260	1287	876	
266	84	1		42400	17.91	233	261	267	223	48	67	404	232	306	297	0	830	208	330	297	248	1272	1187	
266	85	1		43083	25.74	188	161	334	607	117	141	607	433	296	532	0	1548	286	308	507	483	2248	2014	
267	12	2		48375	26.26	81	84	413	436	72	88	600	388	413	538	0	1543	303	263	313	338	2886	2426	
268	13	2		48035	23.18	233	308	295	384	137	188	184	186	236	508	0	1318	285	308	181	587	2808	2018	

* Output Clipped (maximum output of Accelerometer obtained)

Projectiles #83-84, 86, 87 have normal bases

Projectiles #85, 88, 12-14, 16 have thick bases

Table 39. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 3

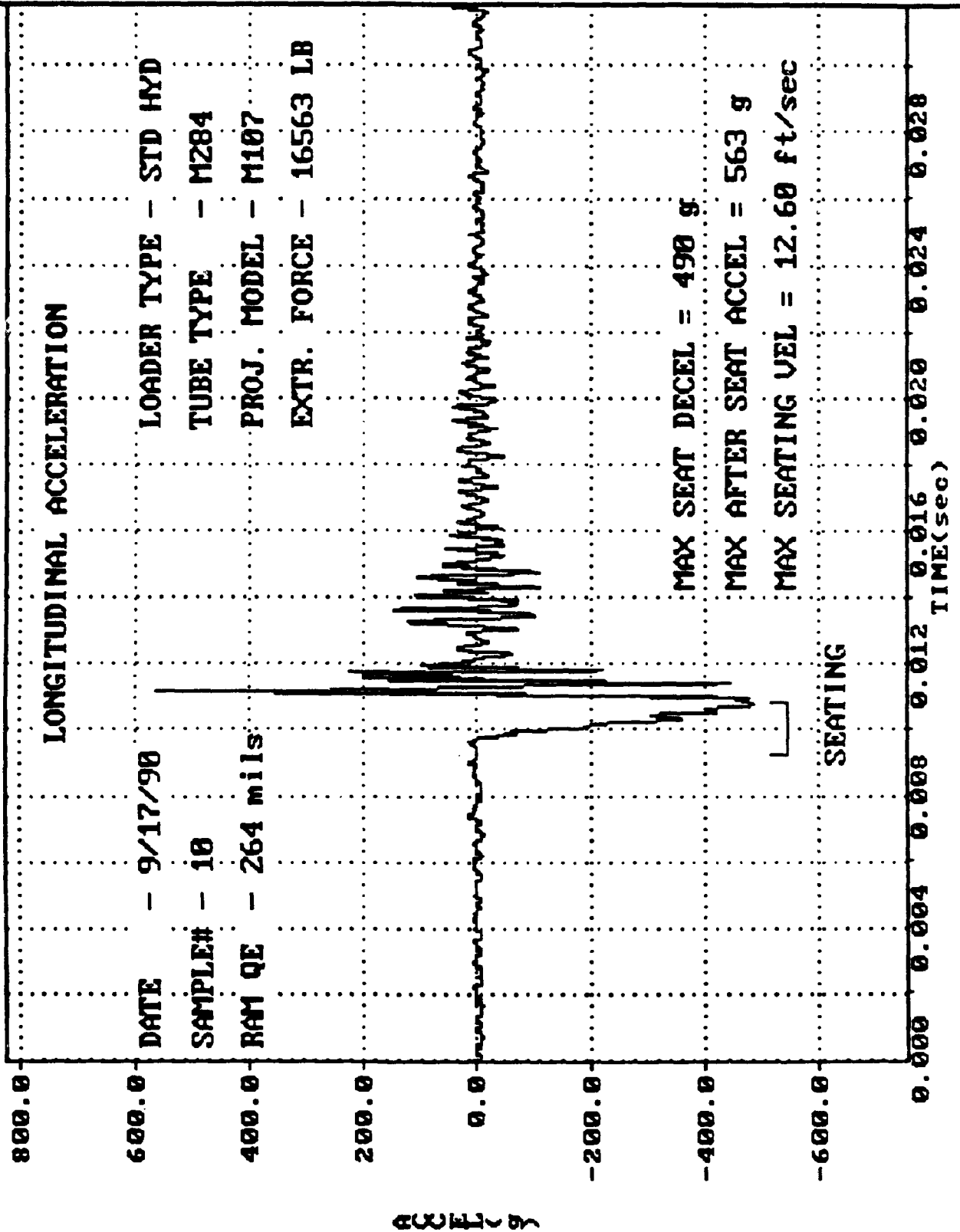
FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																																			
DATE: OCT 2, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 3																			
SHEET 6 : 39				VSH SER#: 1813				TUBE SER#: 782				RAM CE: 264 mils				LOADER SER#: UNKNOWN																			
BEFORE SEATING ACCELERATION												SEATING ACCELERATION												AFTER SEATING ACCELERATION											
EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE									
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG							
θ	ϕ	θ	(LB)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)							
264	71	1	35778	18.08	331	452	470	398	102	124	180	232	223	124	0	824	180	188	297	420	868	351													
265	72	1	35778	23.84	384	458	390	408	99	105	235	483	433	188	0	908	260	483	188	334	574	851													
266	73	1	37100	22.82	382	278	212	288	87	123	207	277	338	183	0	736	278	180	237	288	880	417													
267	74	1	31138	17.80	331	427	488	881	171	238	180	232	235	308	0	801	234	232	181	188	488	183													
268	75	1	37108	23.10	805	807	336	181	308	375	238	238	280	210	0	887	260	334	338	188	798	518													
269	76	1	40413	21.72	284	381	438	838	188	233	278	381	338	283	0	788	288	284	438	288	1018	878													
270	77	1	42400	20.00	803	427	388	388	88	108	331	305	280	285	0	788	331	878	483	488	798	318													
271	78	1	37783	20.01	881	978	488	238	308	422	188	384	238	188	0	738	210	188	238	280	837	482													
272	79	1	48713	24.88	170	217	188	188	48	74	170	188	283	282	0	868	281	183	208	282	880	780													
273	80	1	48080	19.88	603	624	334	388	137	188	627	330	433	181	0	748	478	288	433	288	704	821													

Table 42. Semiautomatic 155-mm artillery loader/assist device results, M549/0 mils/SAL 3

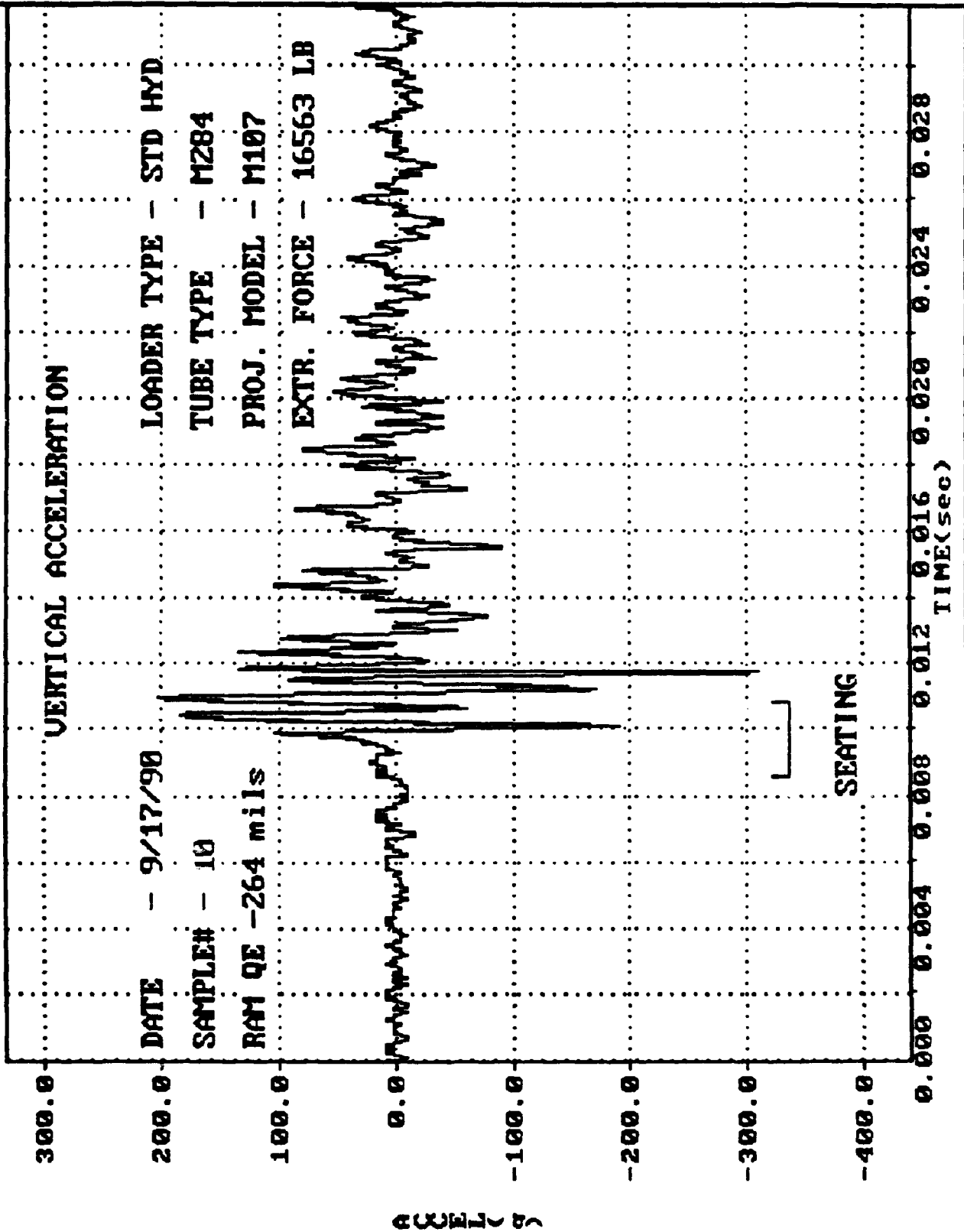
FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																													
DATE: OCT 2, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M264					PROJ MODEL: M549					LOADER TYPE: SAL 3									
SHEET # : 42					VSH SENS: 1813					TUBE SENS: 782					RAM CE: 0 min					LOADER SENS: UNKNOWN									

APPENDIX A
HAND AND HYDRAULIC RAMS

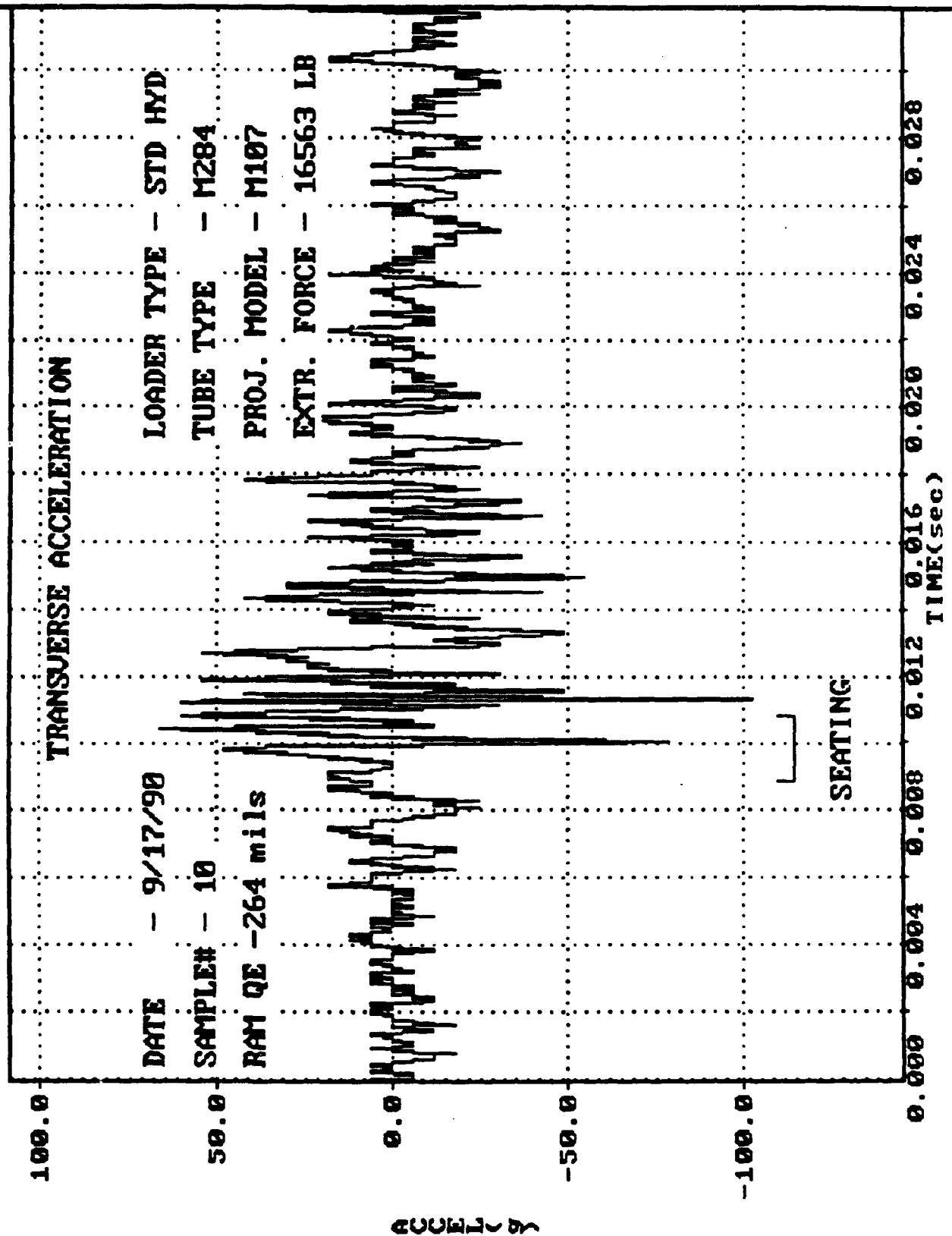
FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



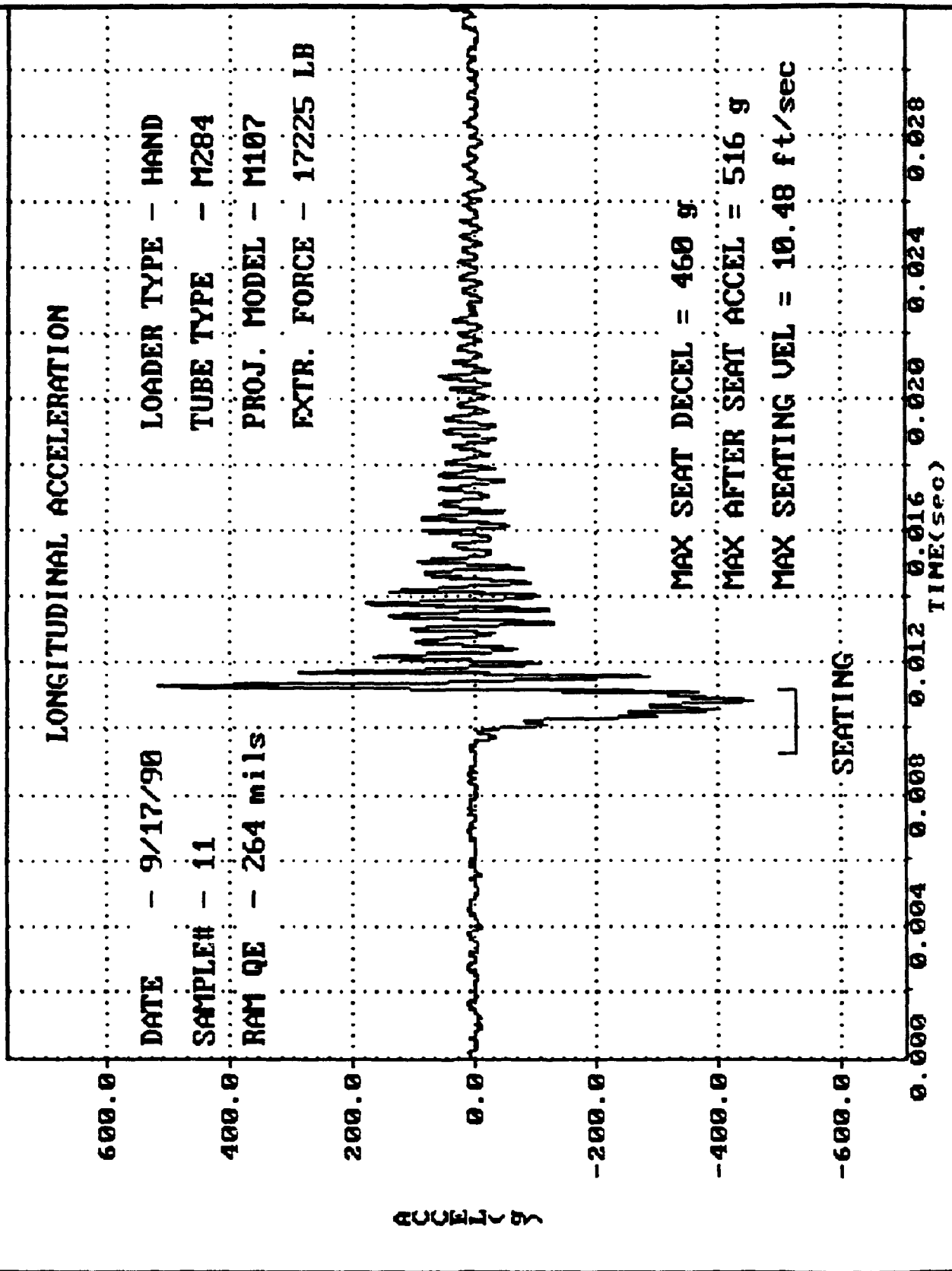
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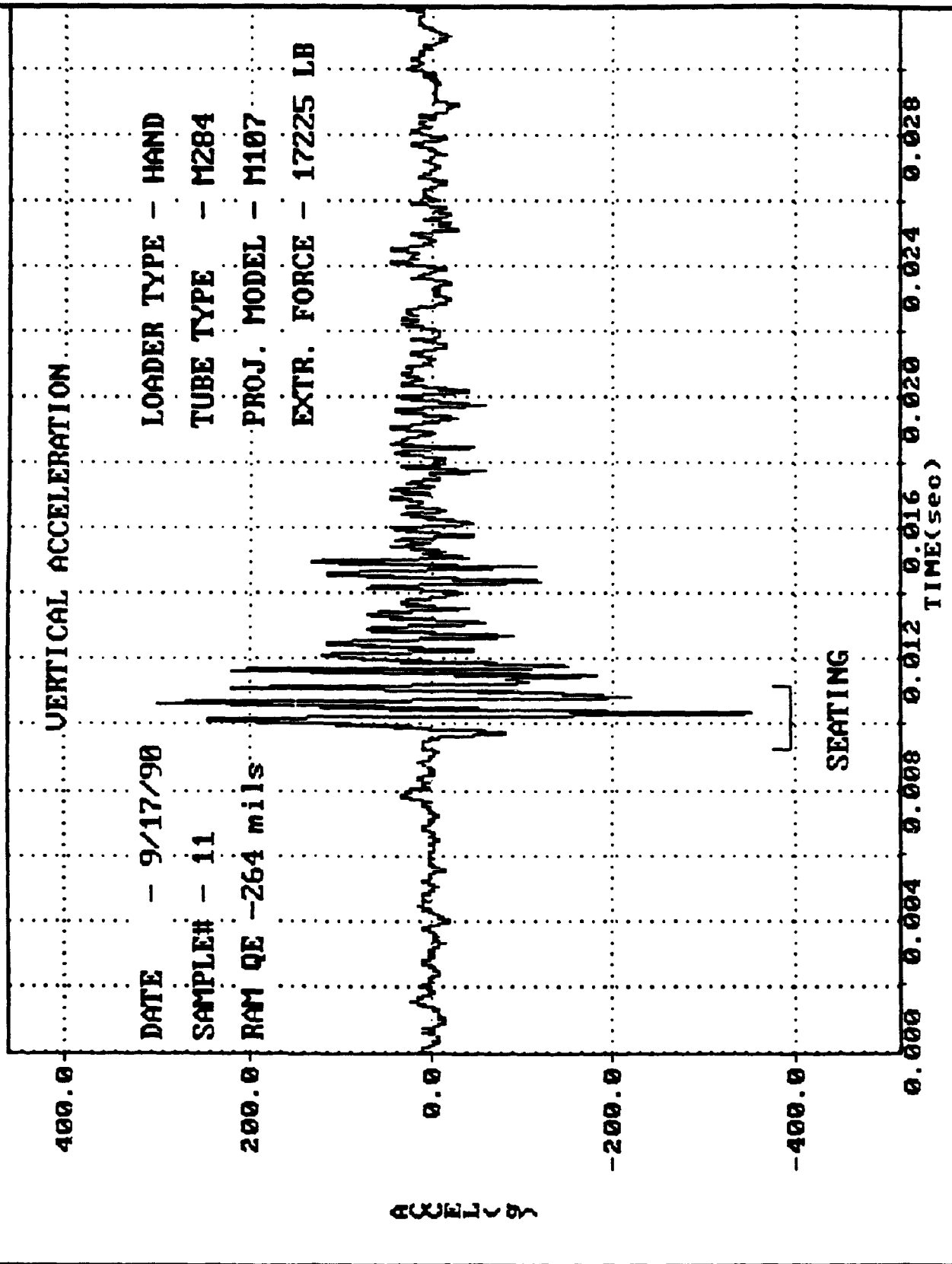
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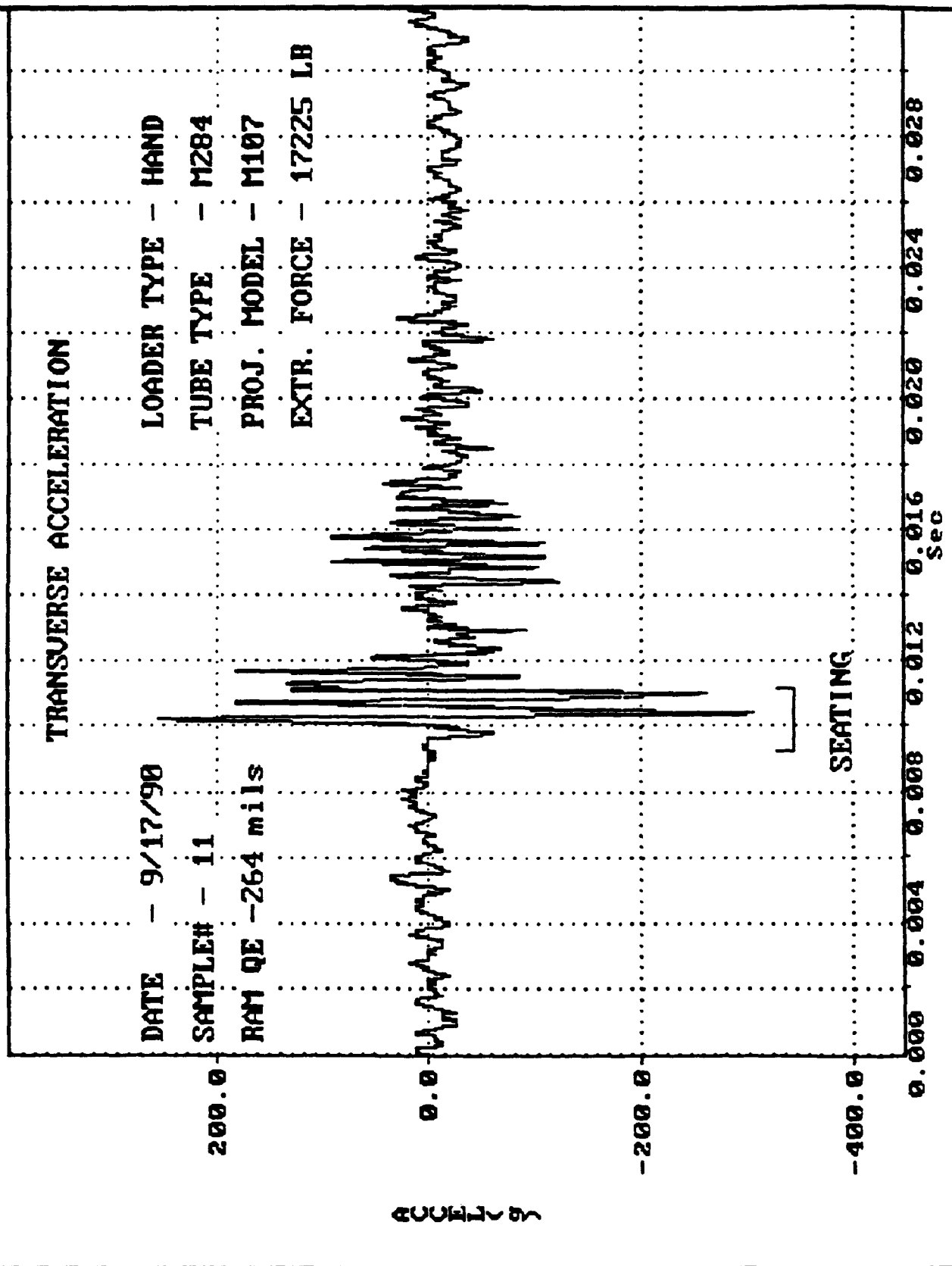
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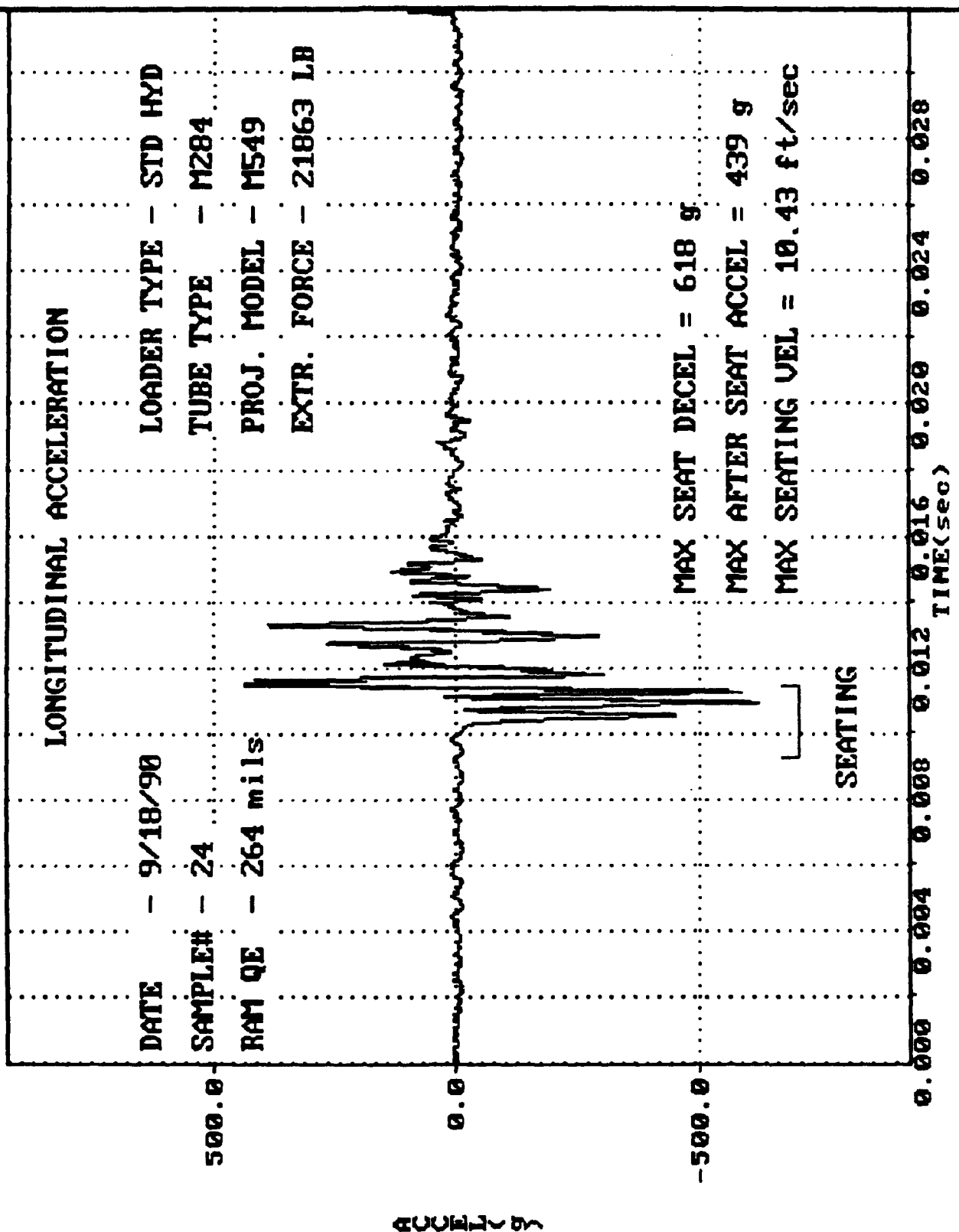
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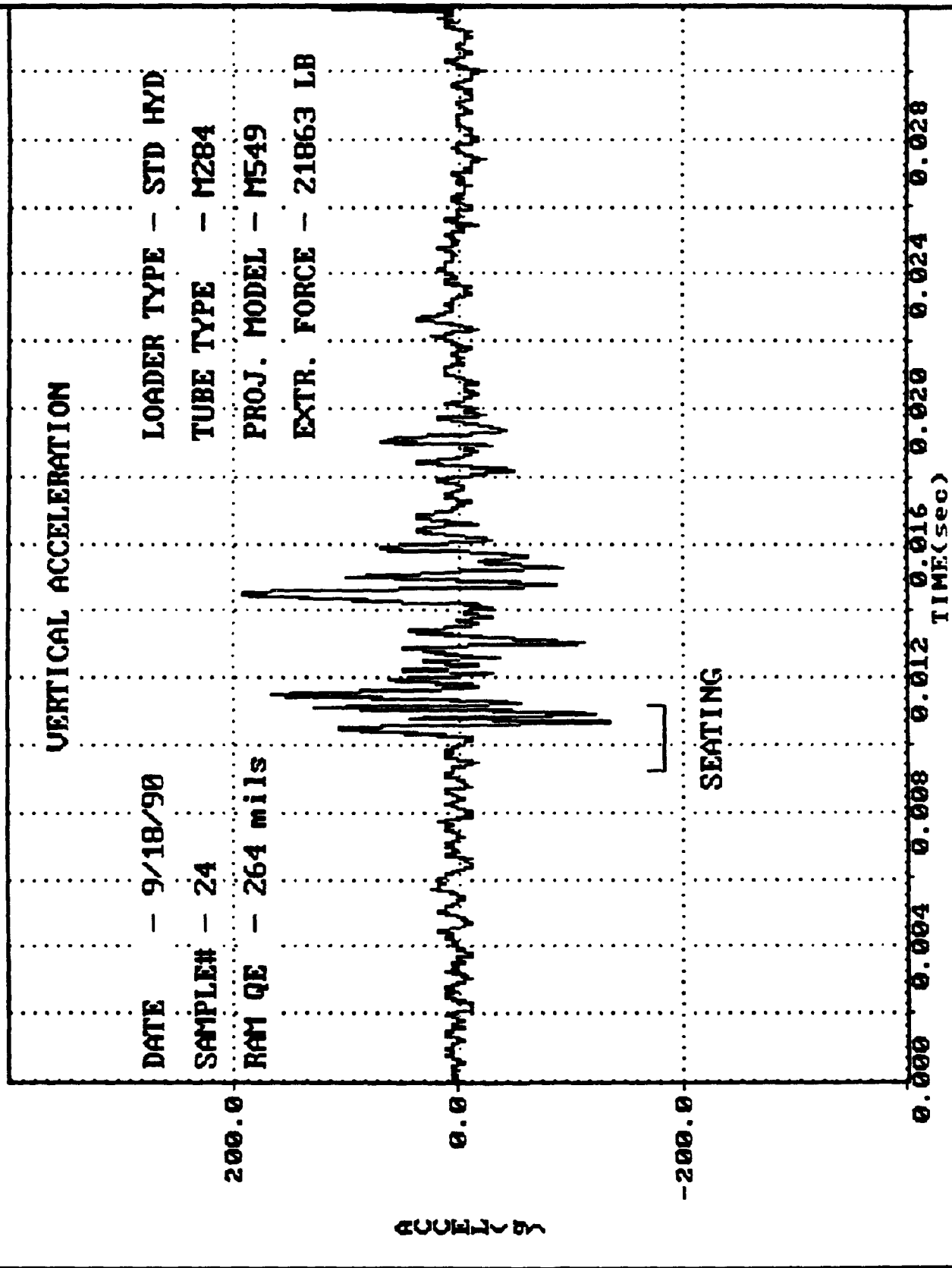
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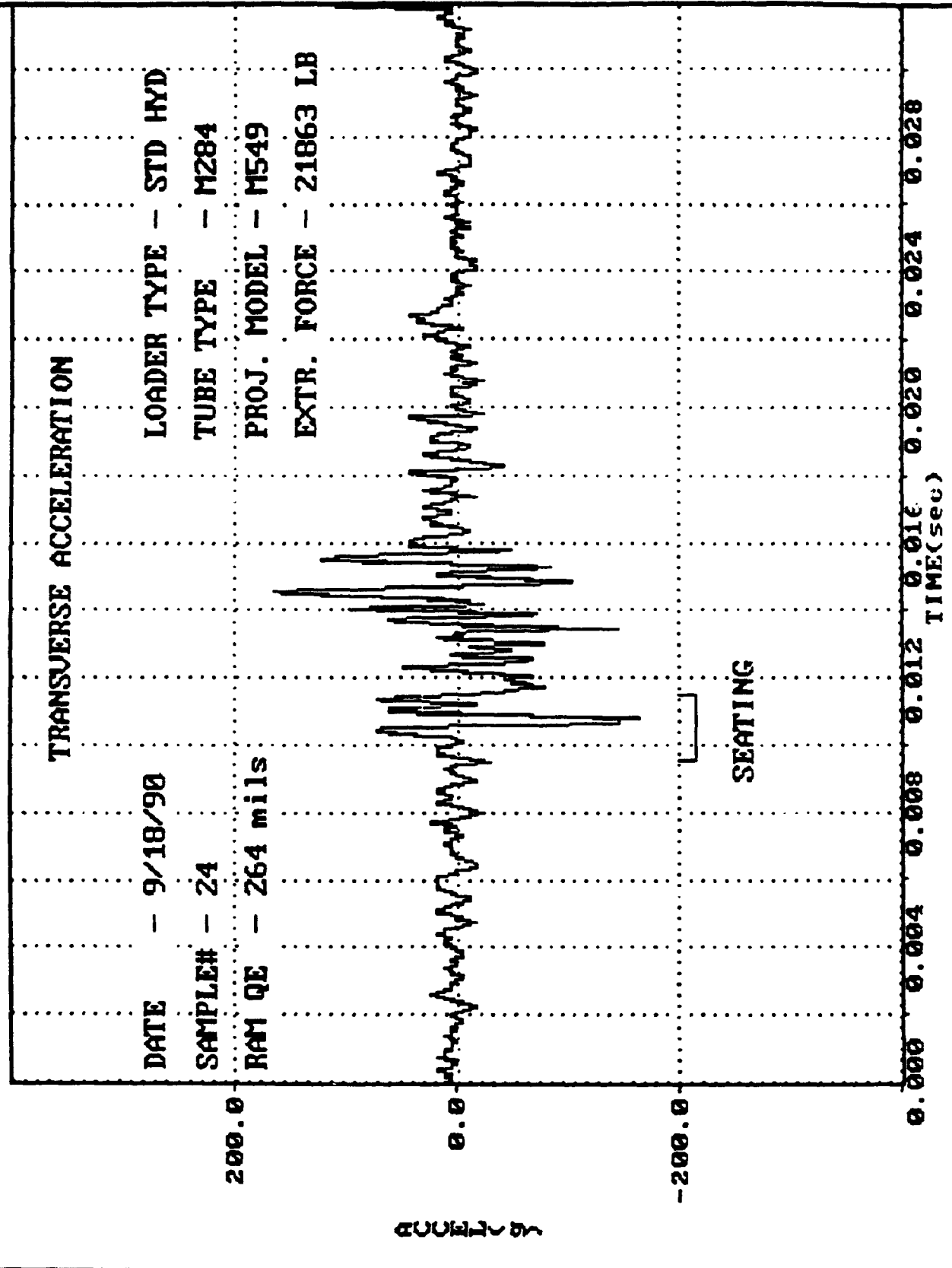
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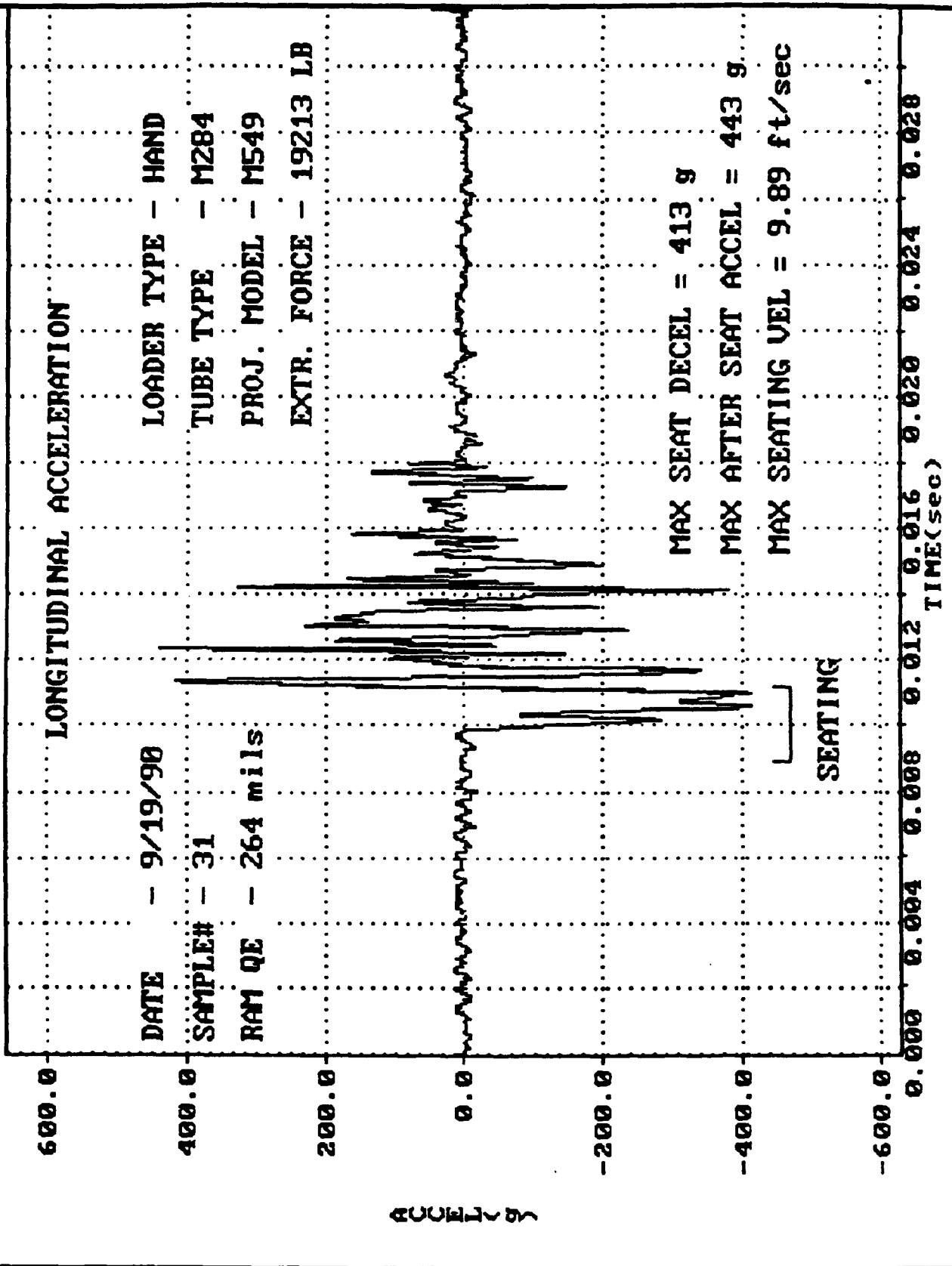
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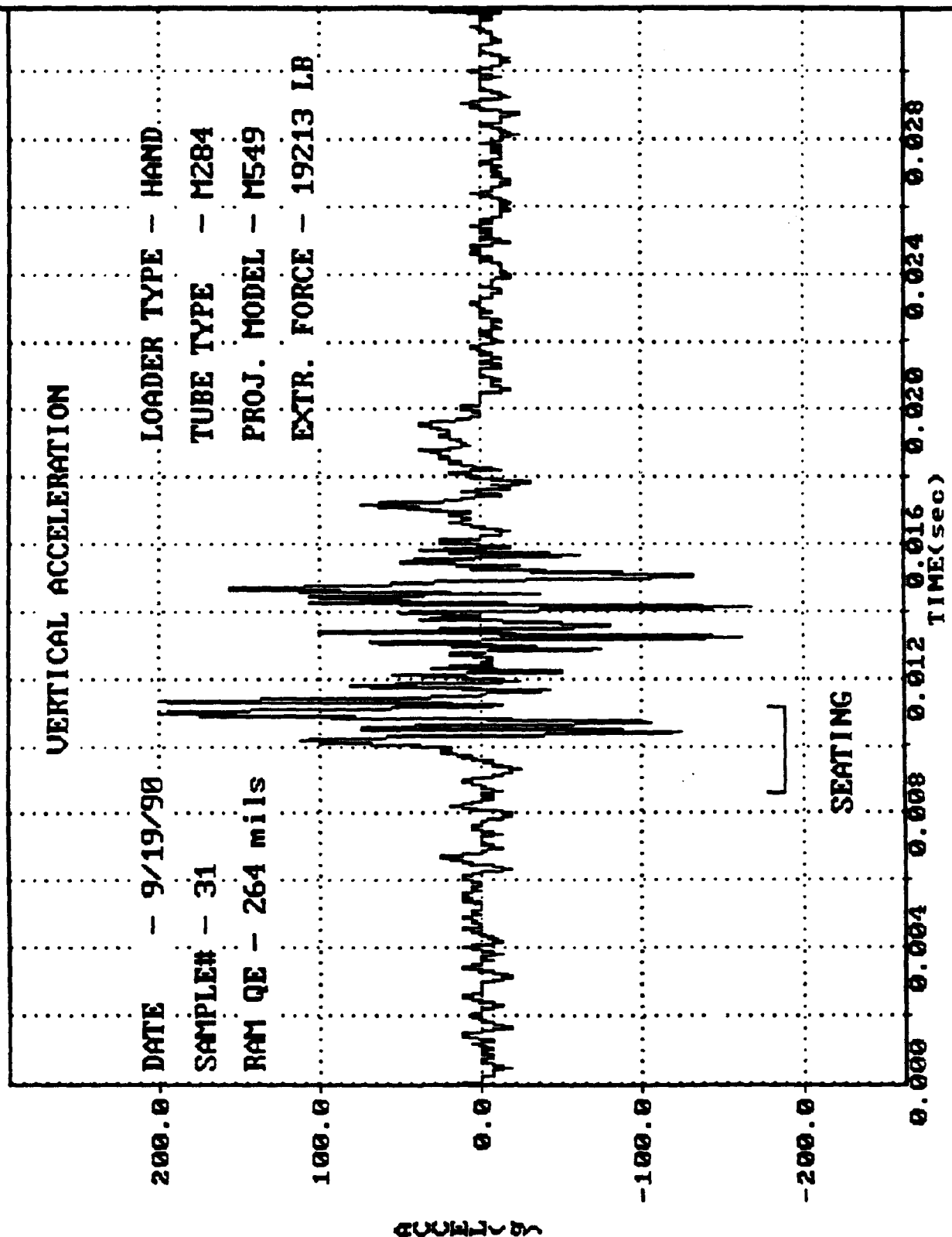
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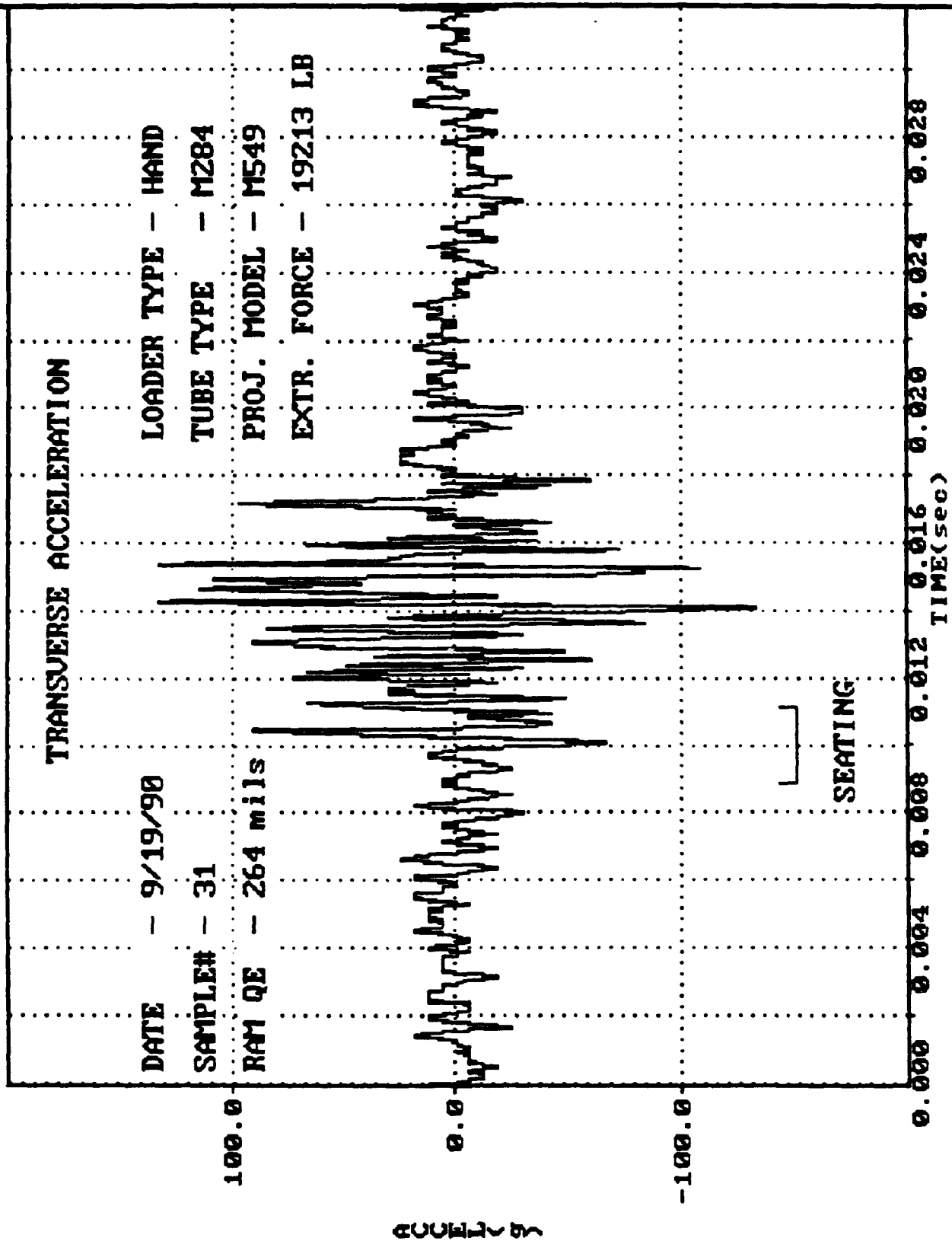
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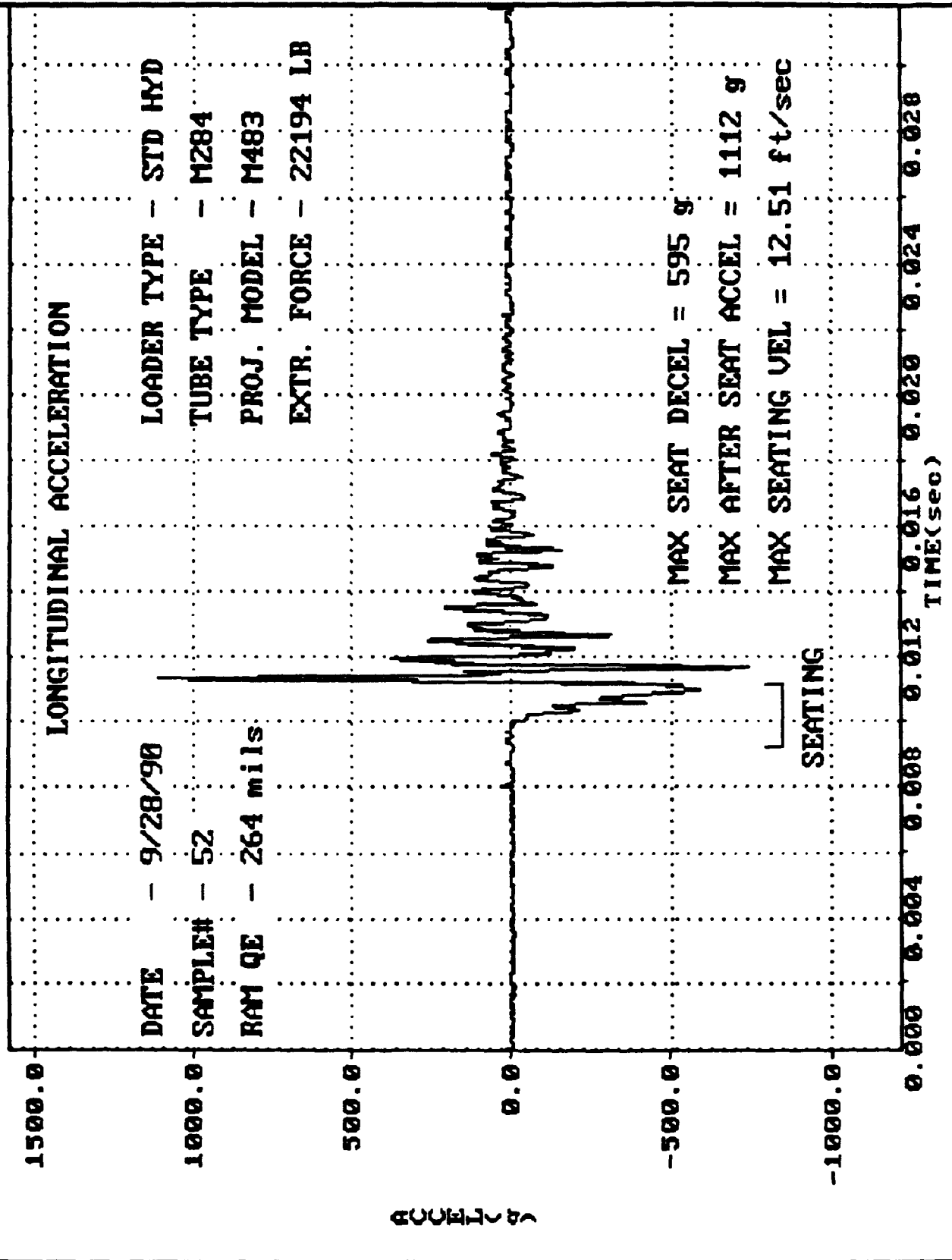
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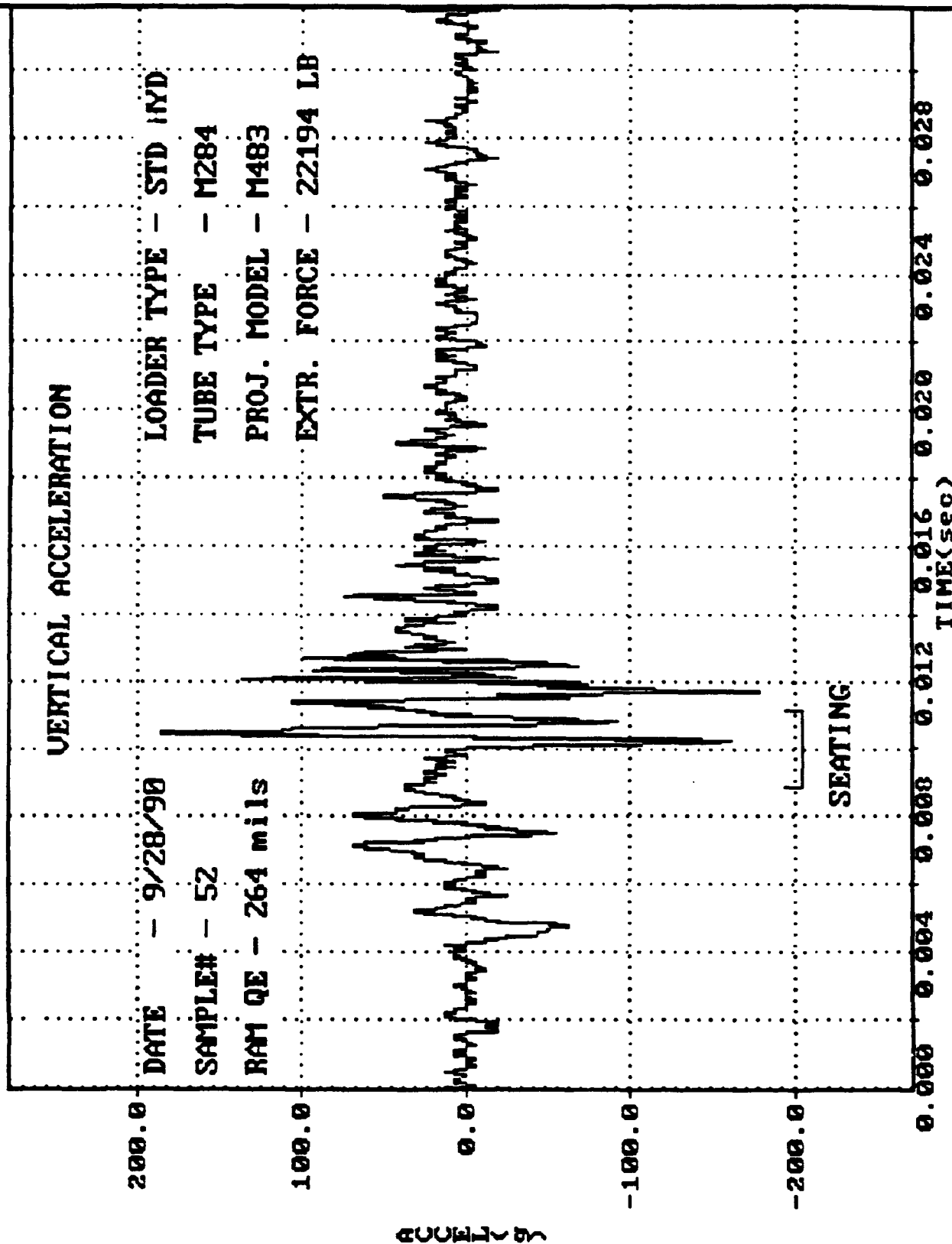
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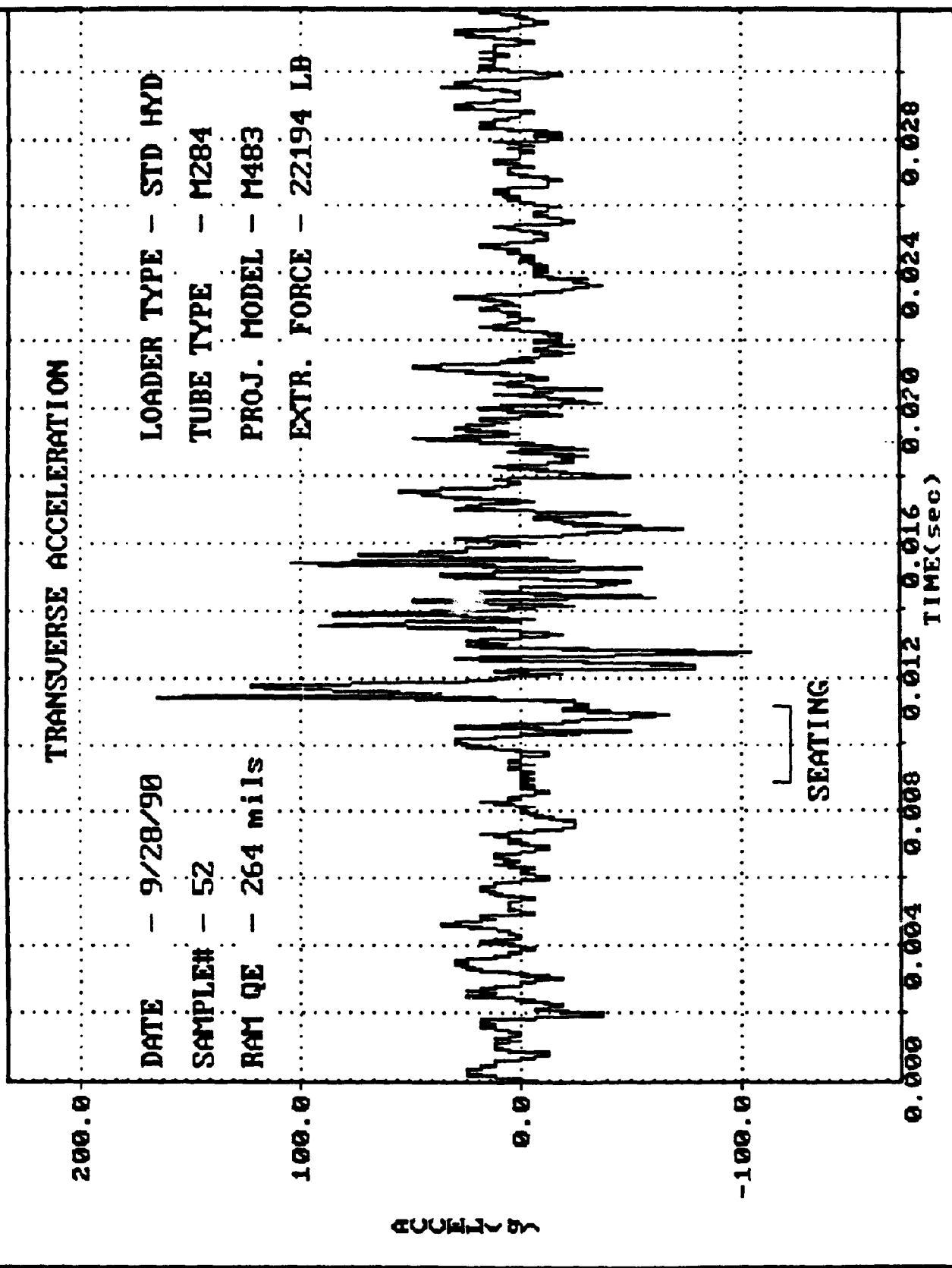
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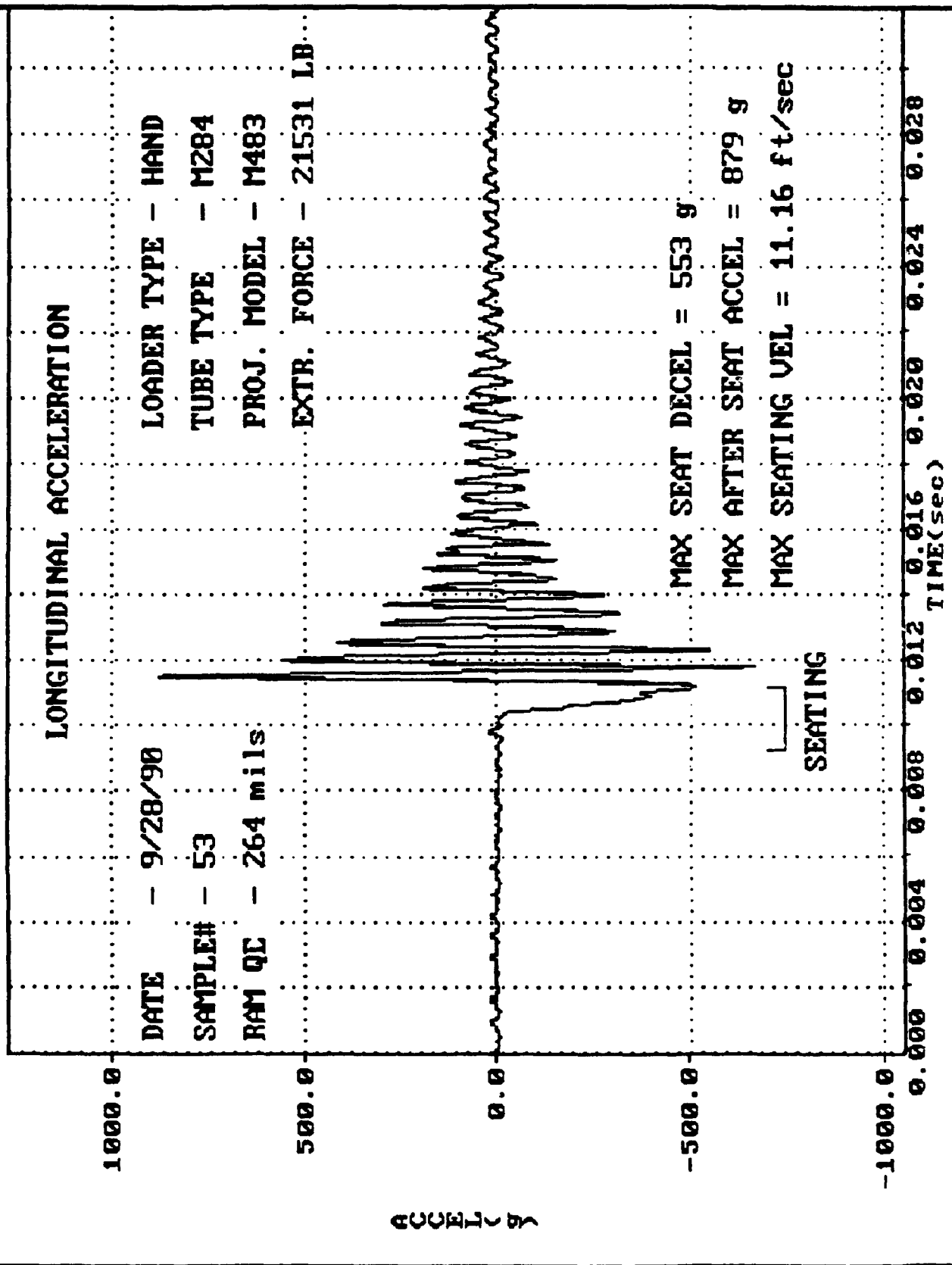
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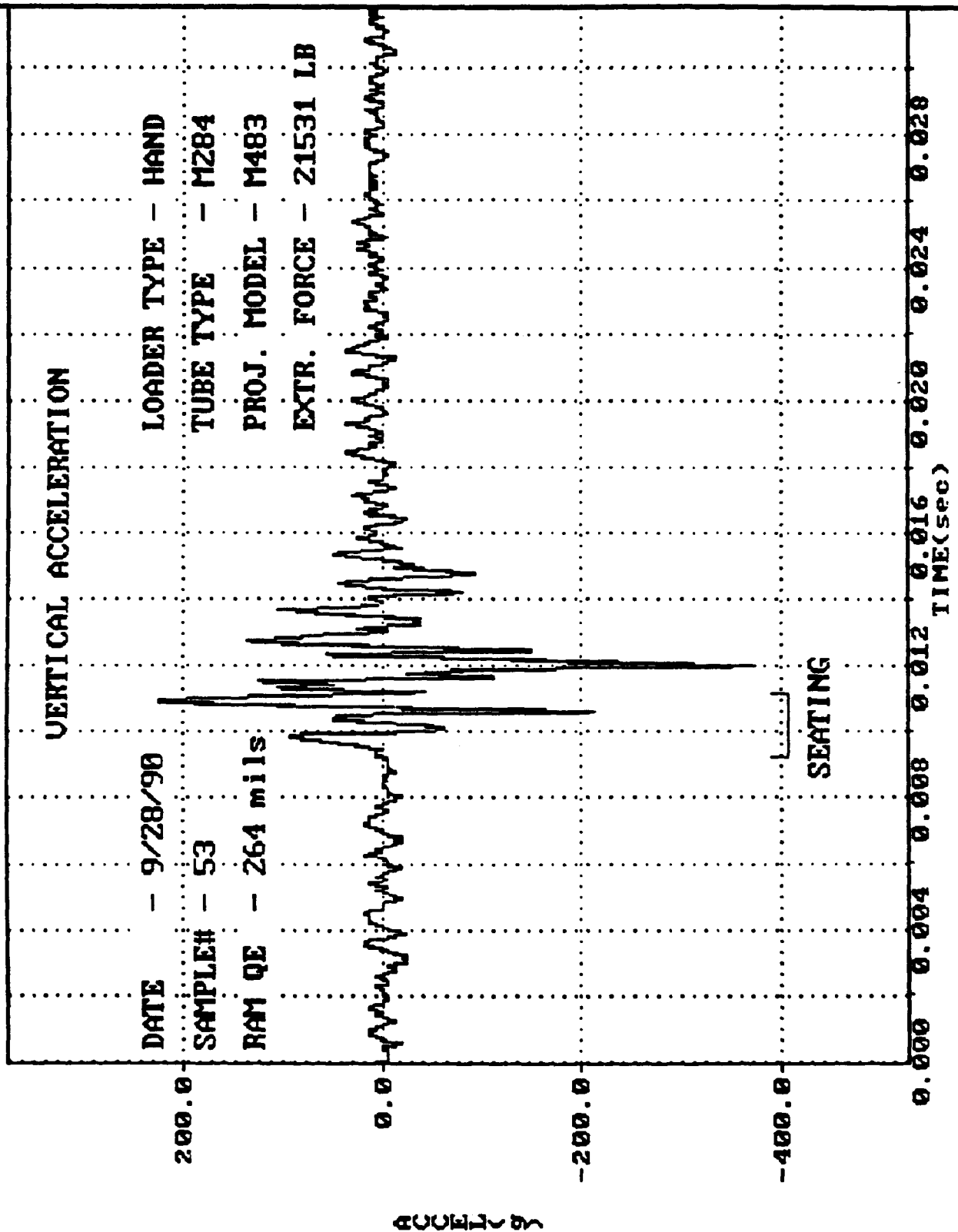
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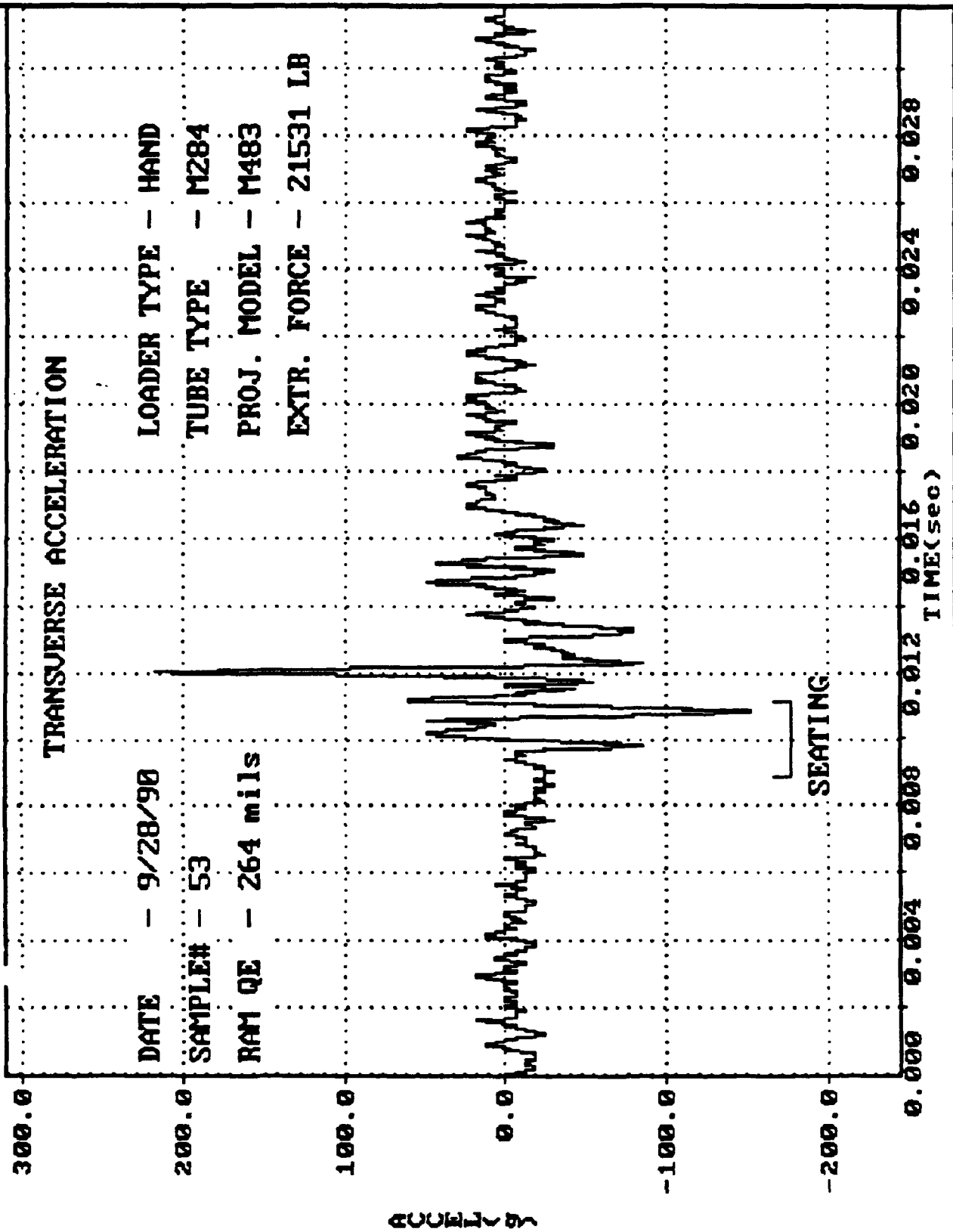
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FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



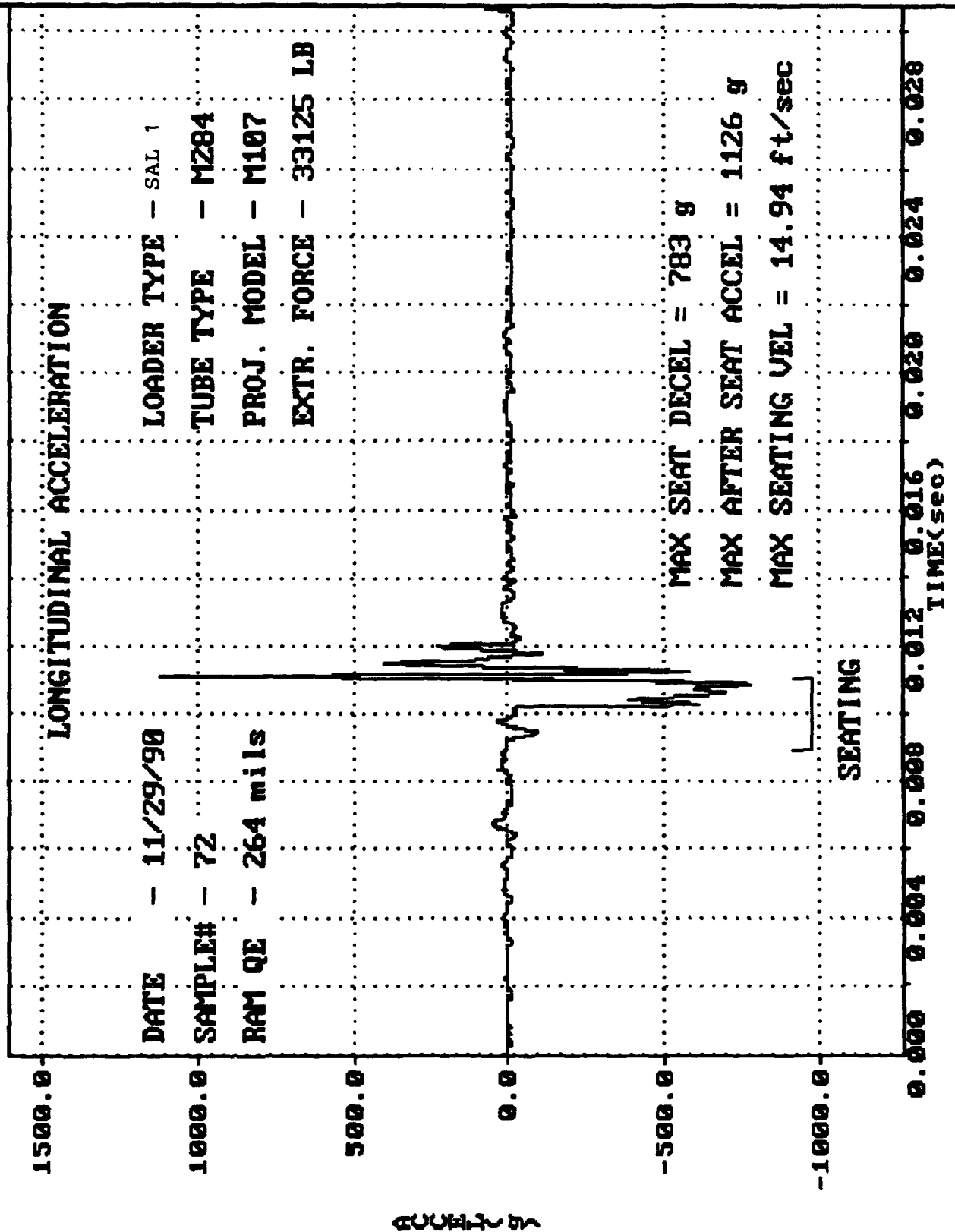
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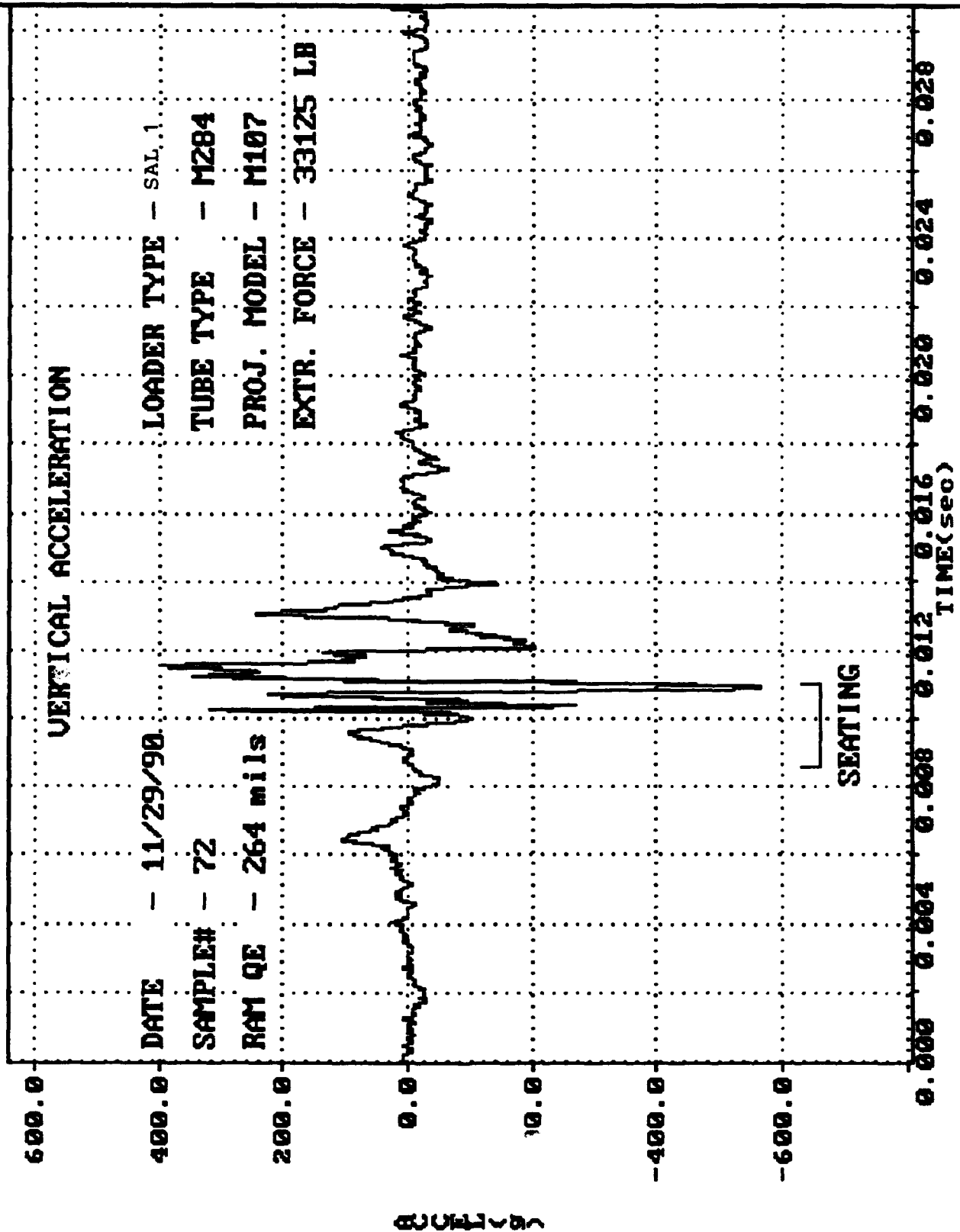
APPENDIX B

WF RAMS

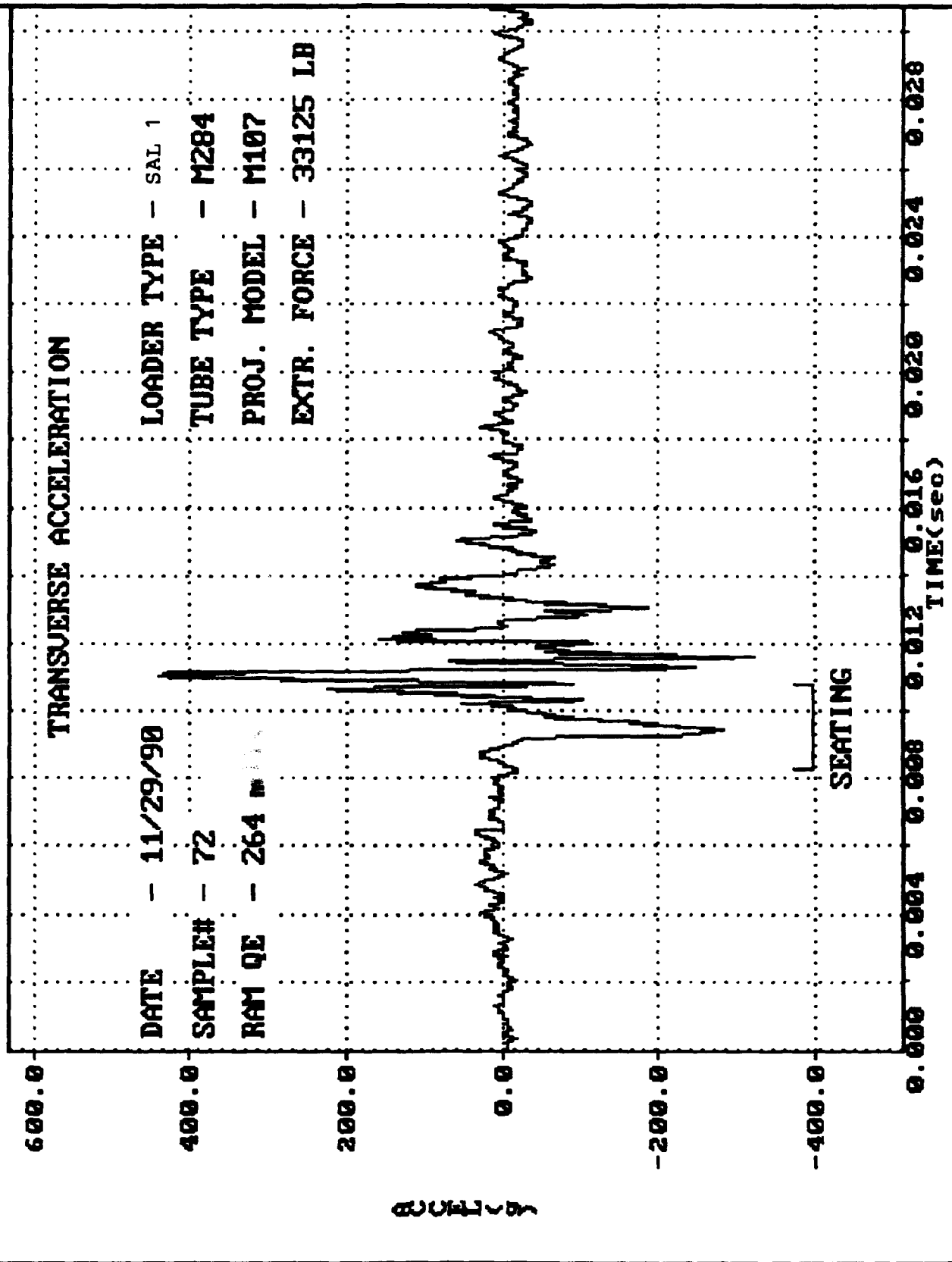
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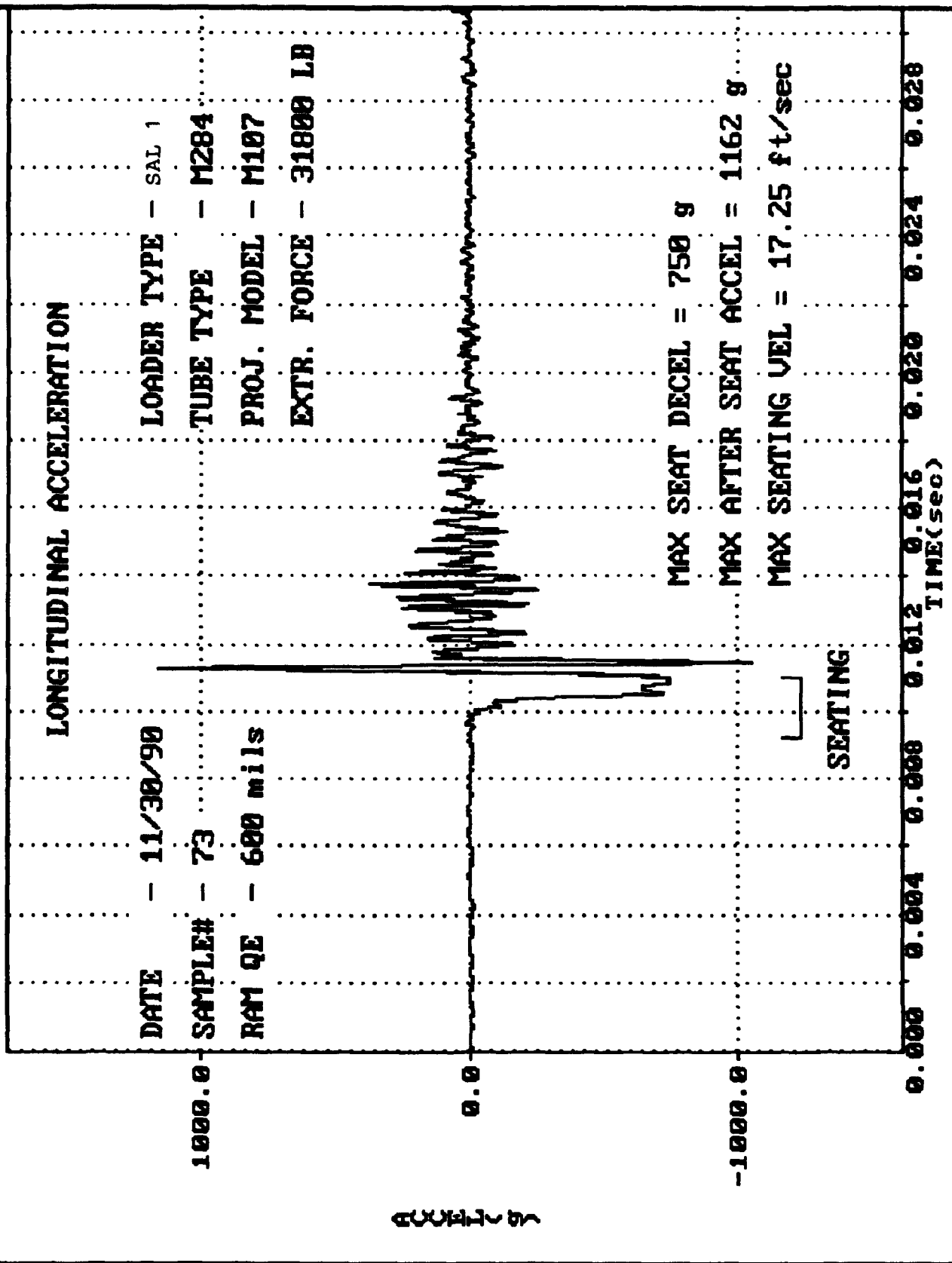
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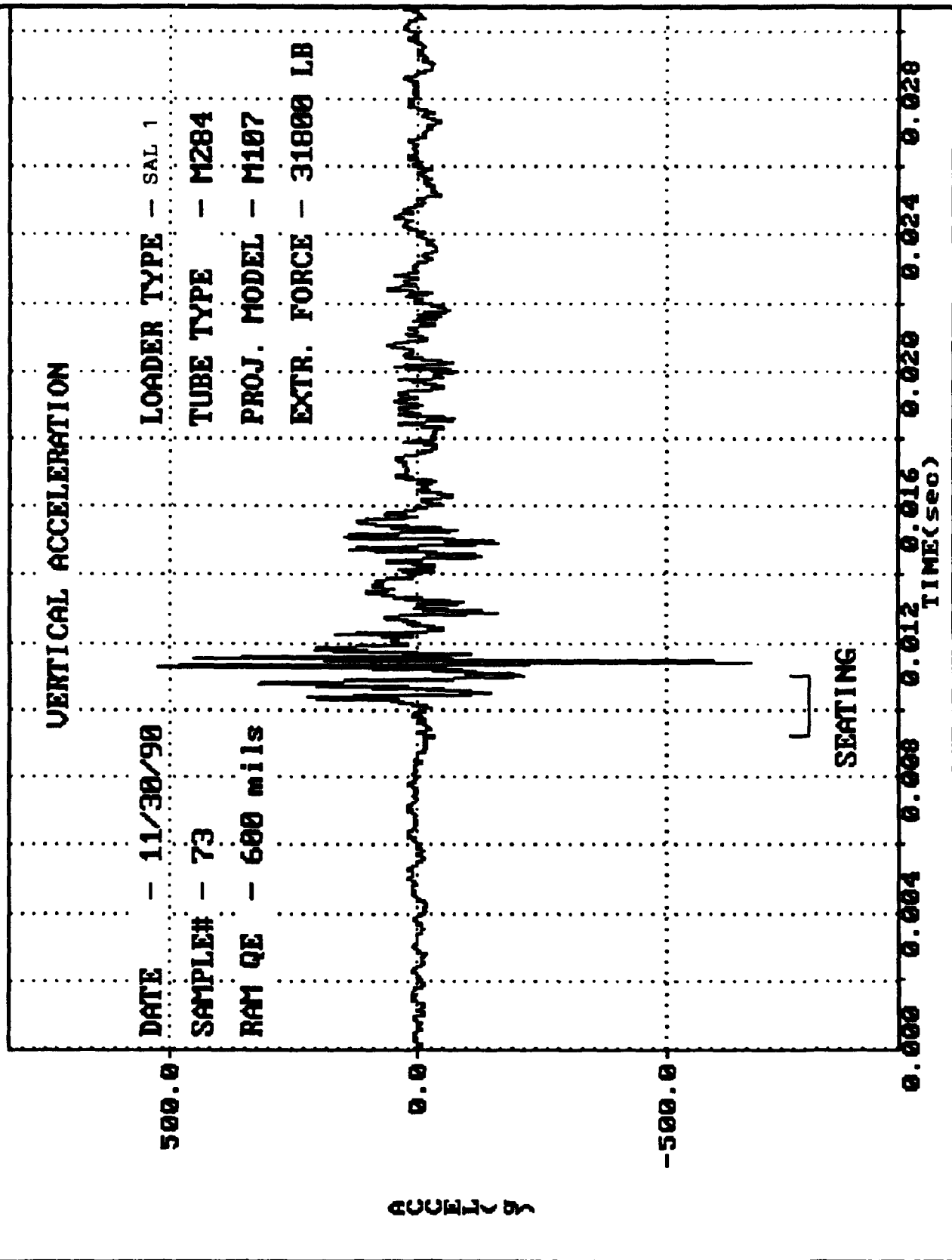
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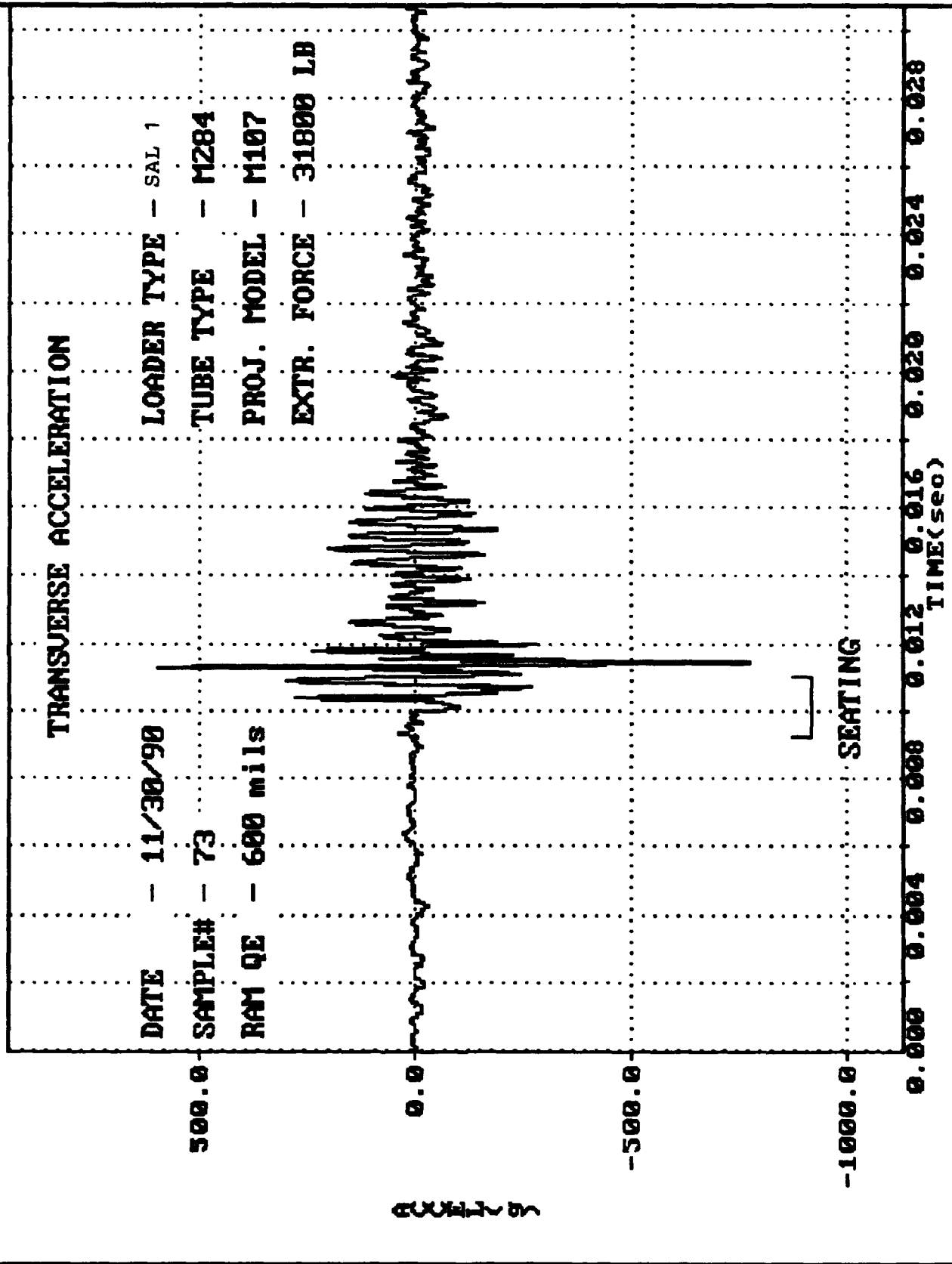
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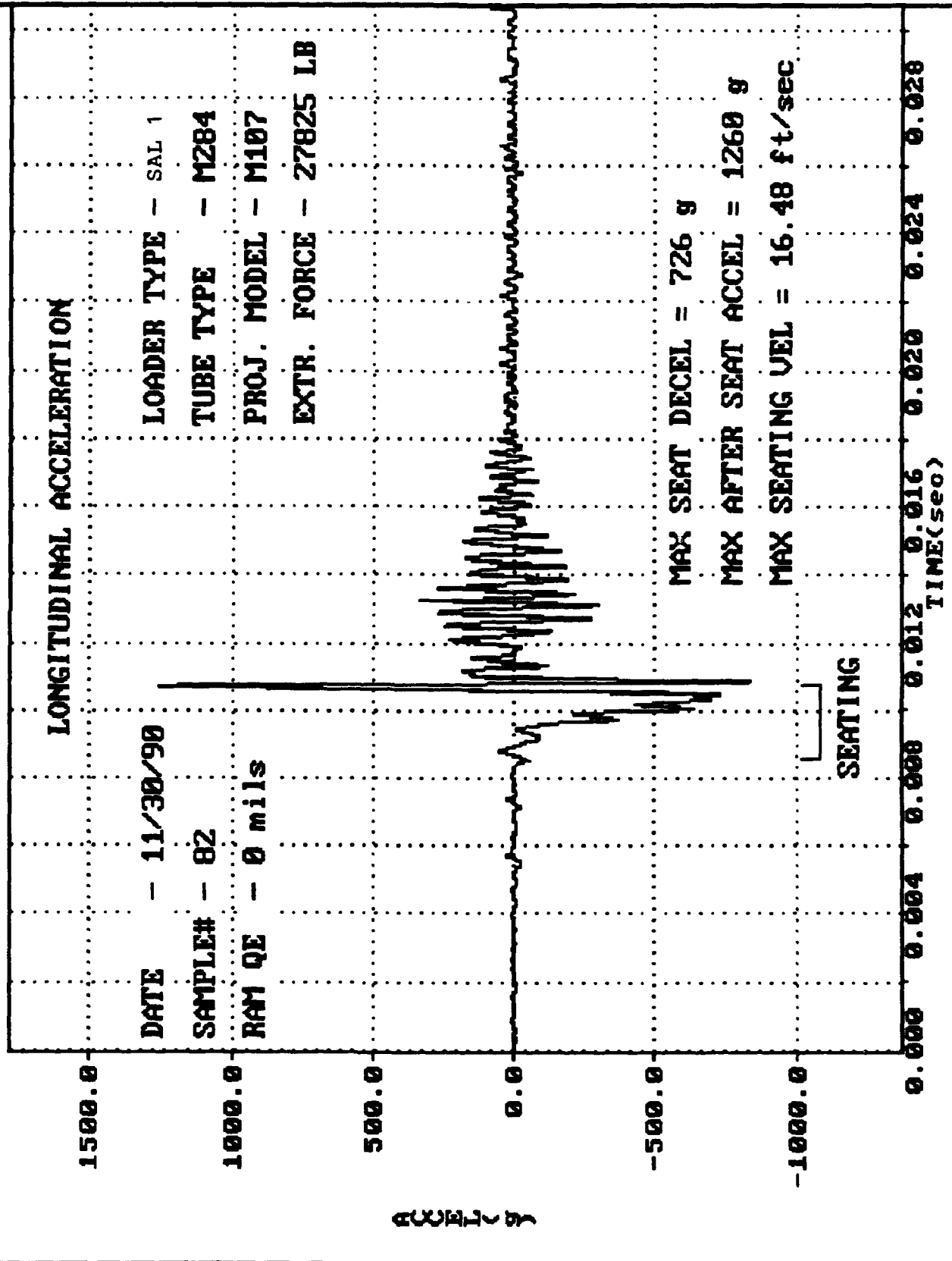
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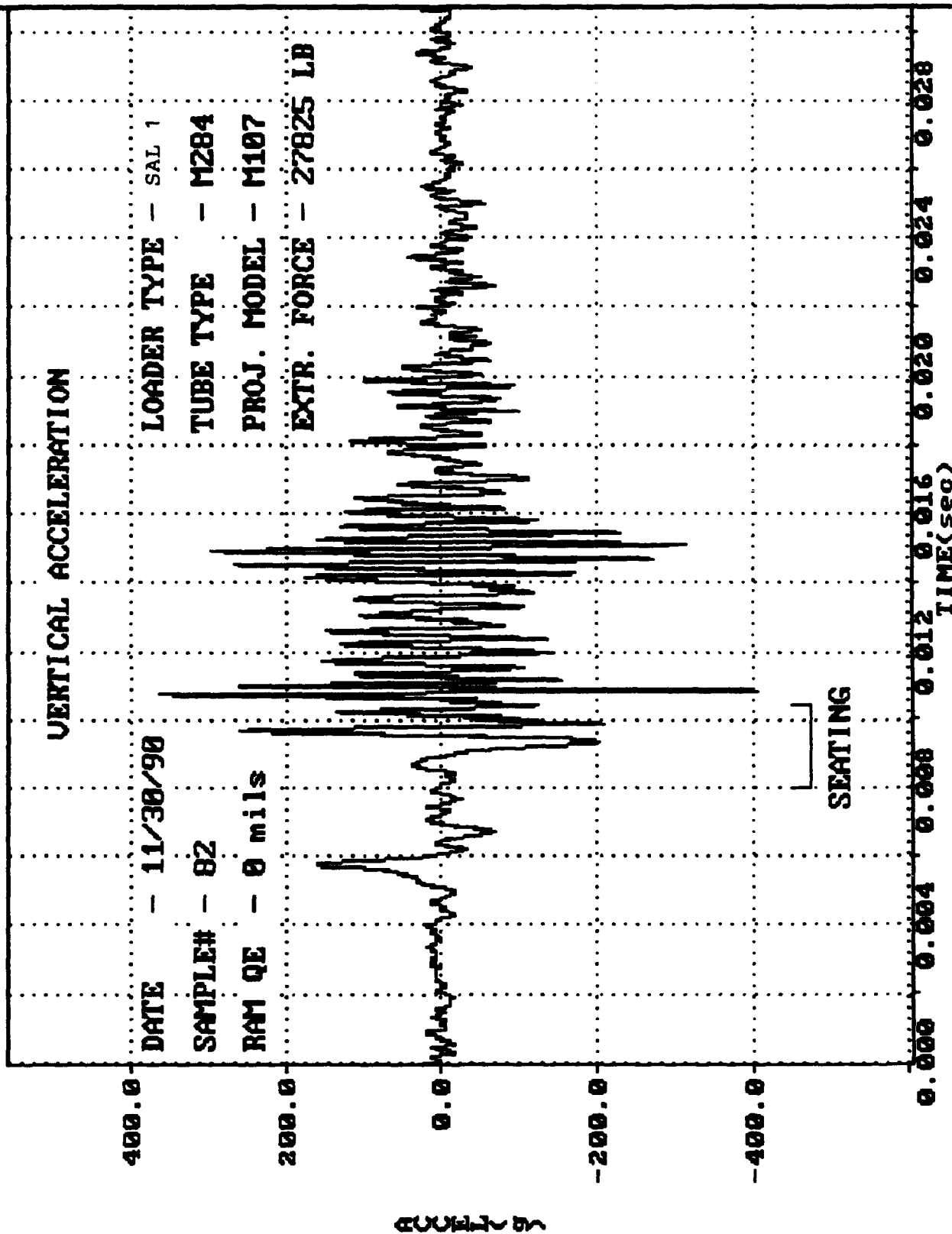
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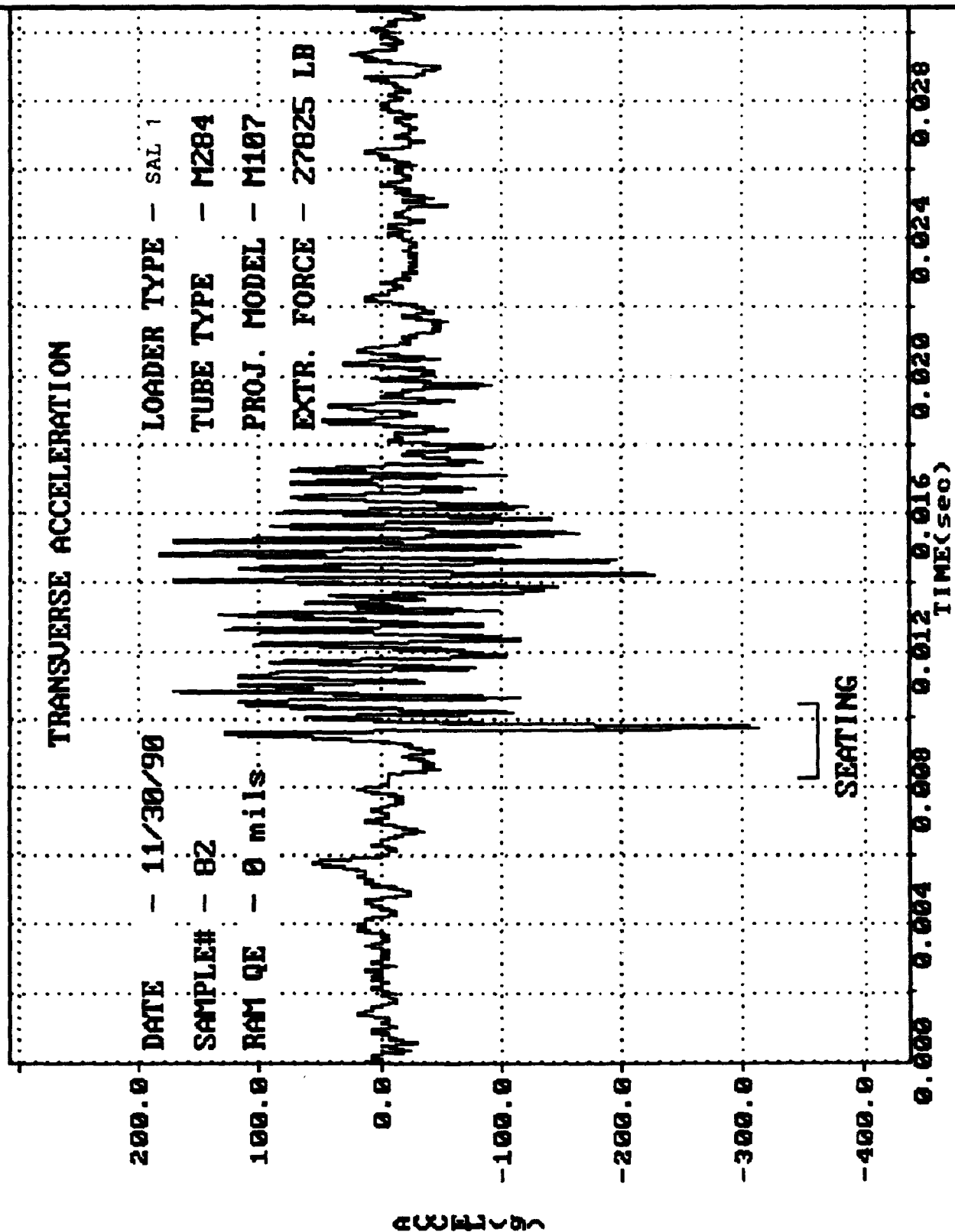
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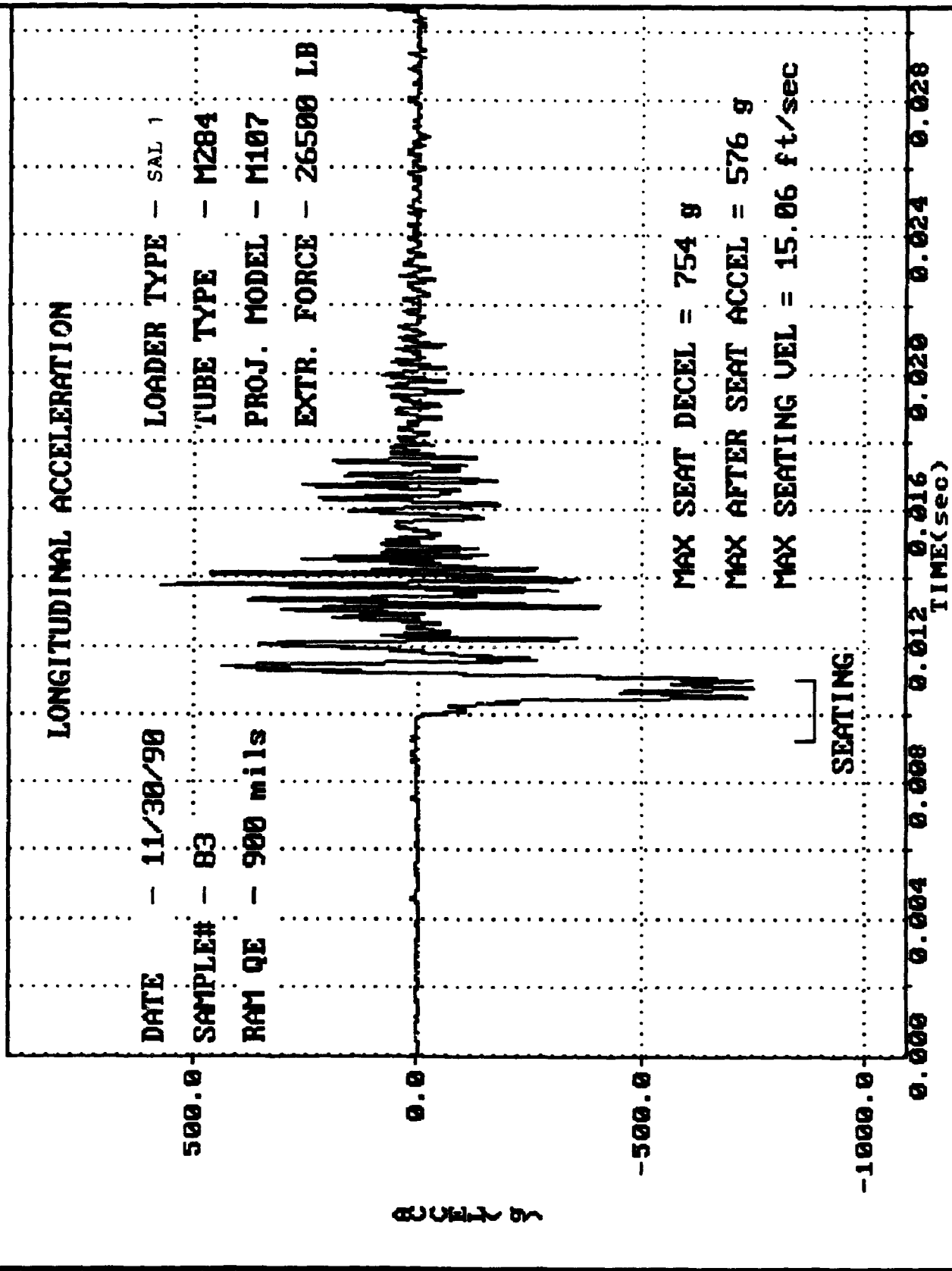
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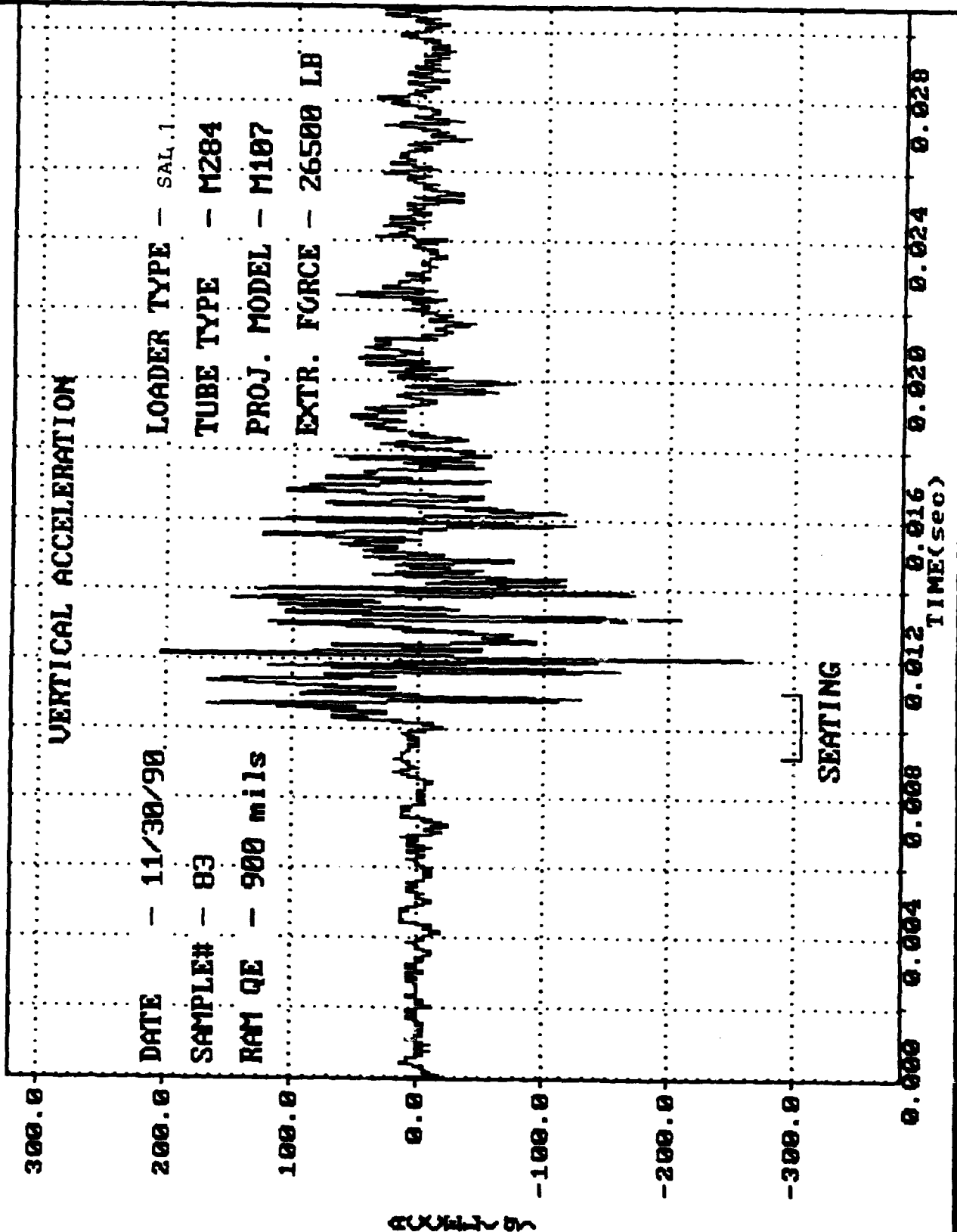
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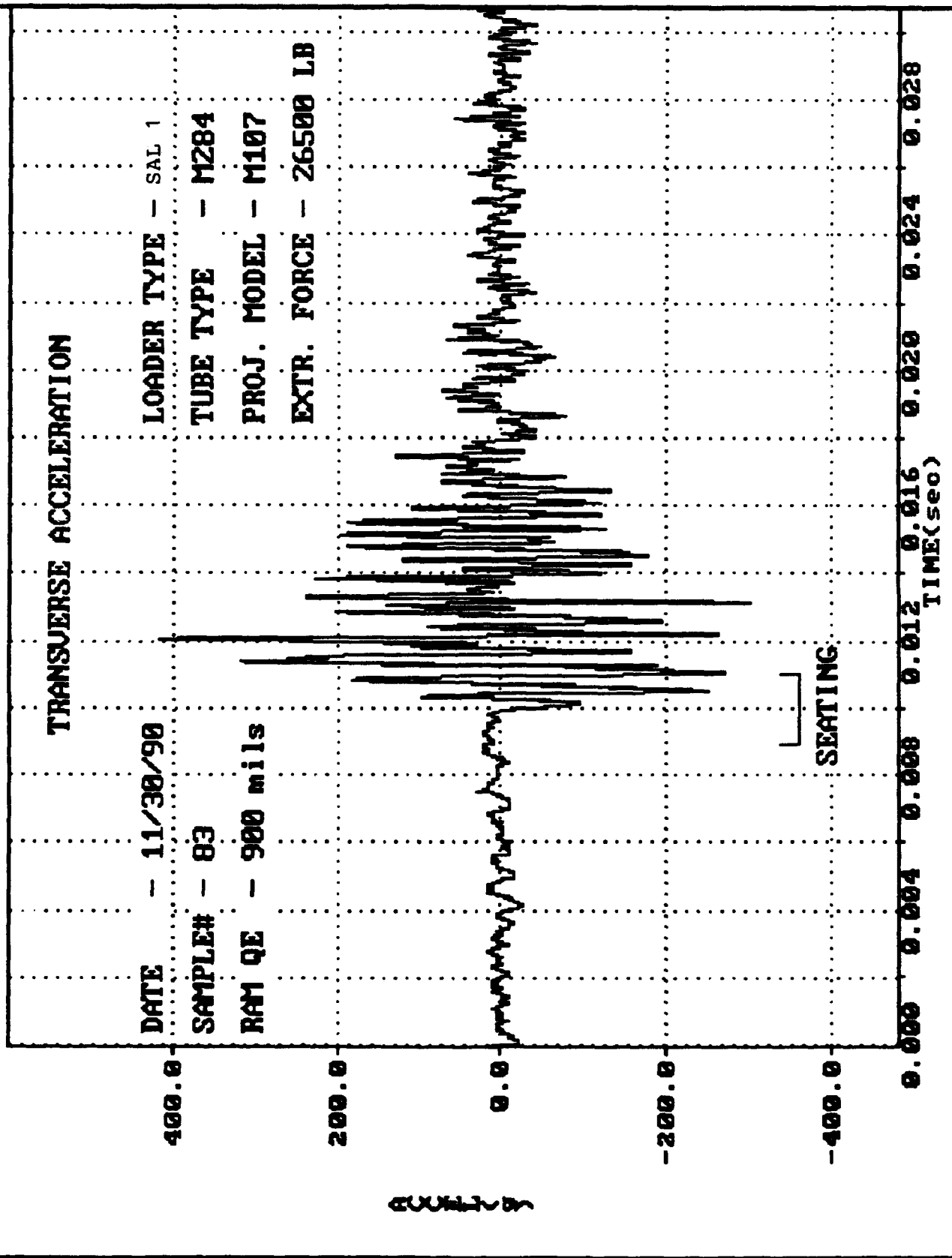
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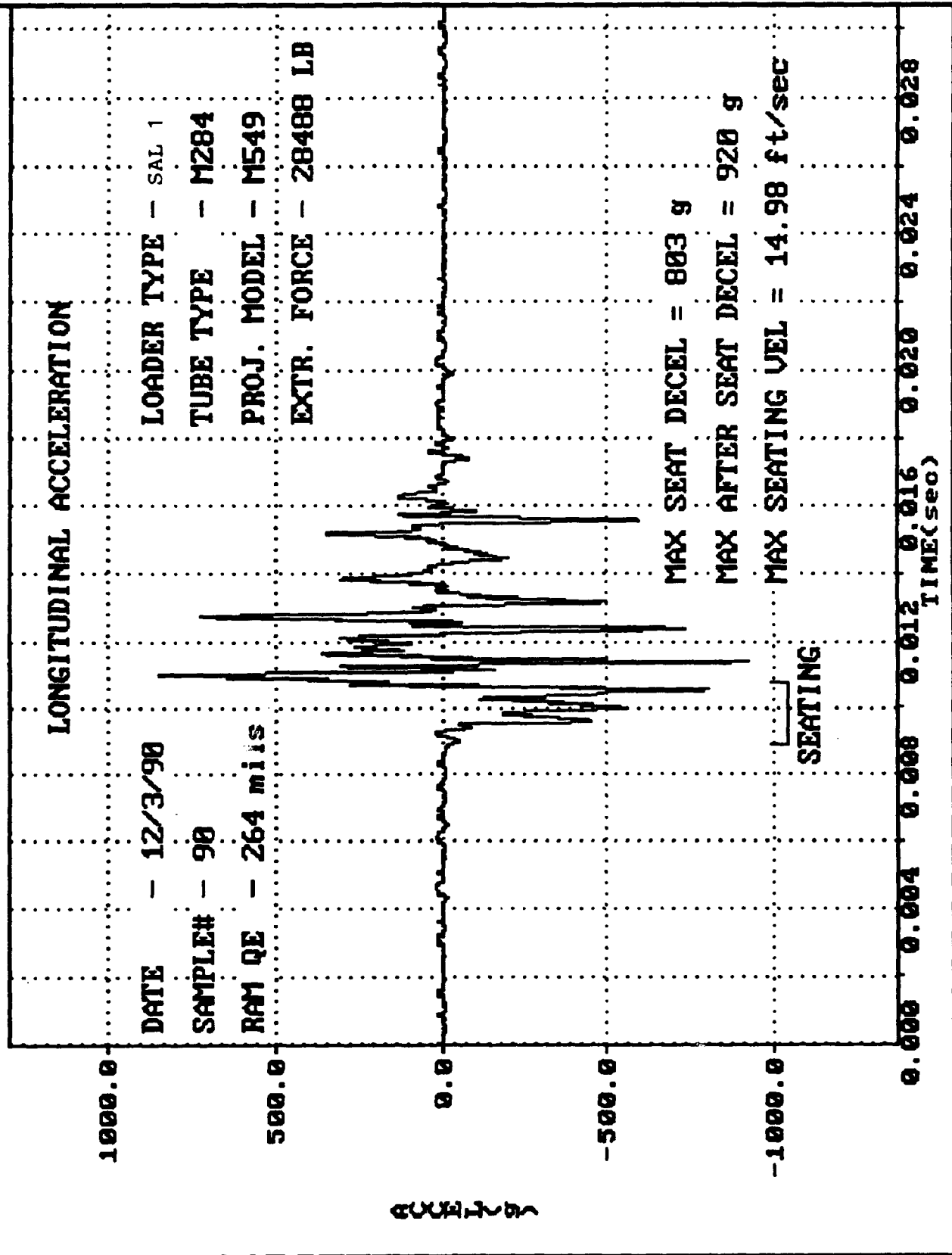
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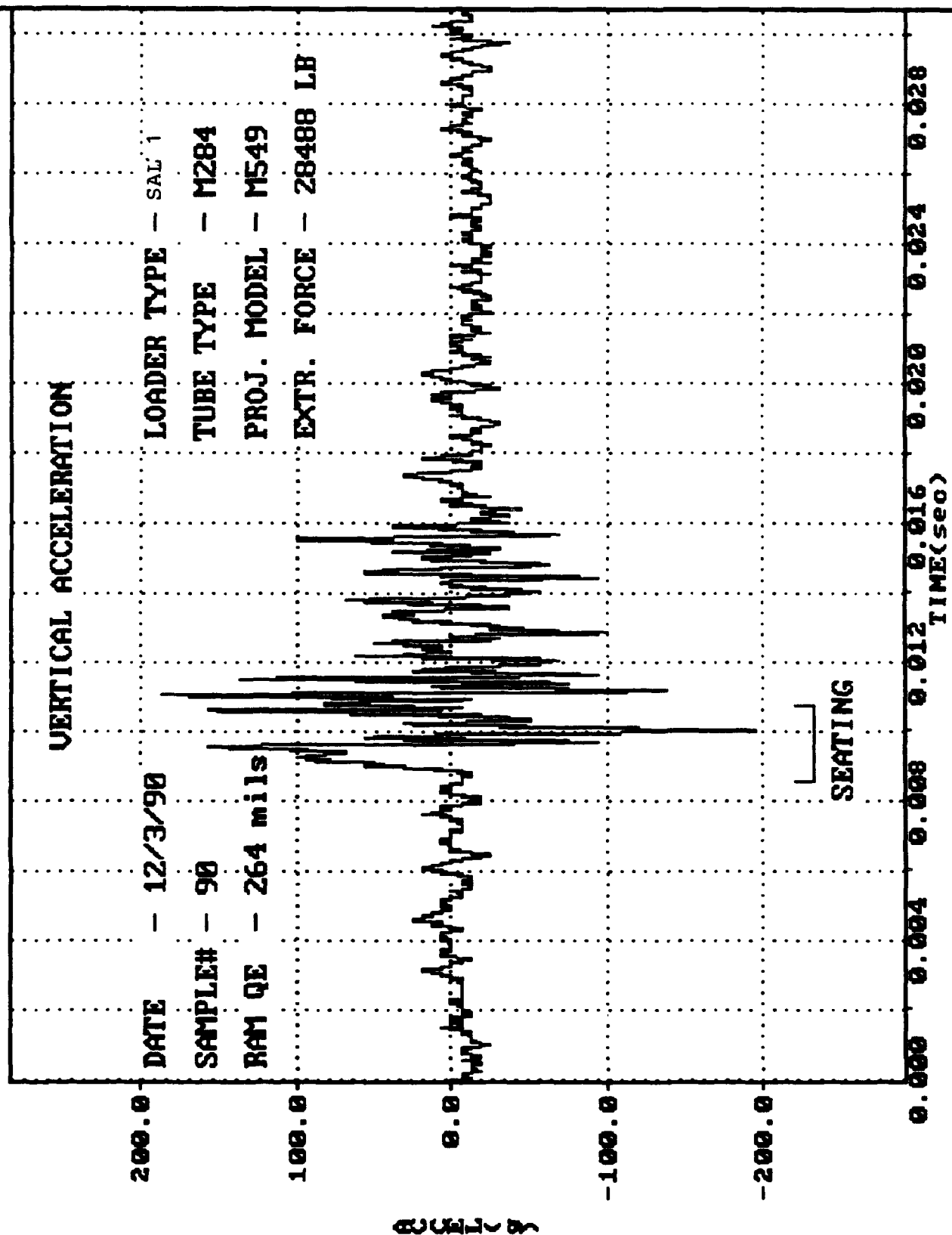
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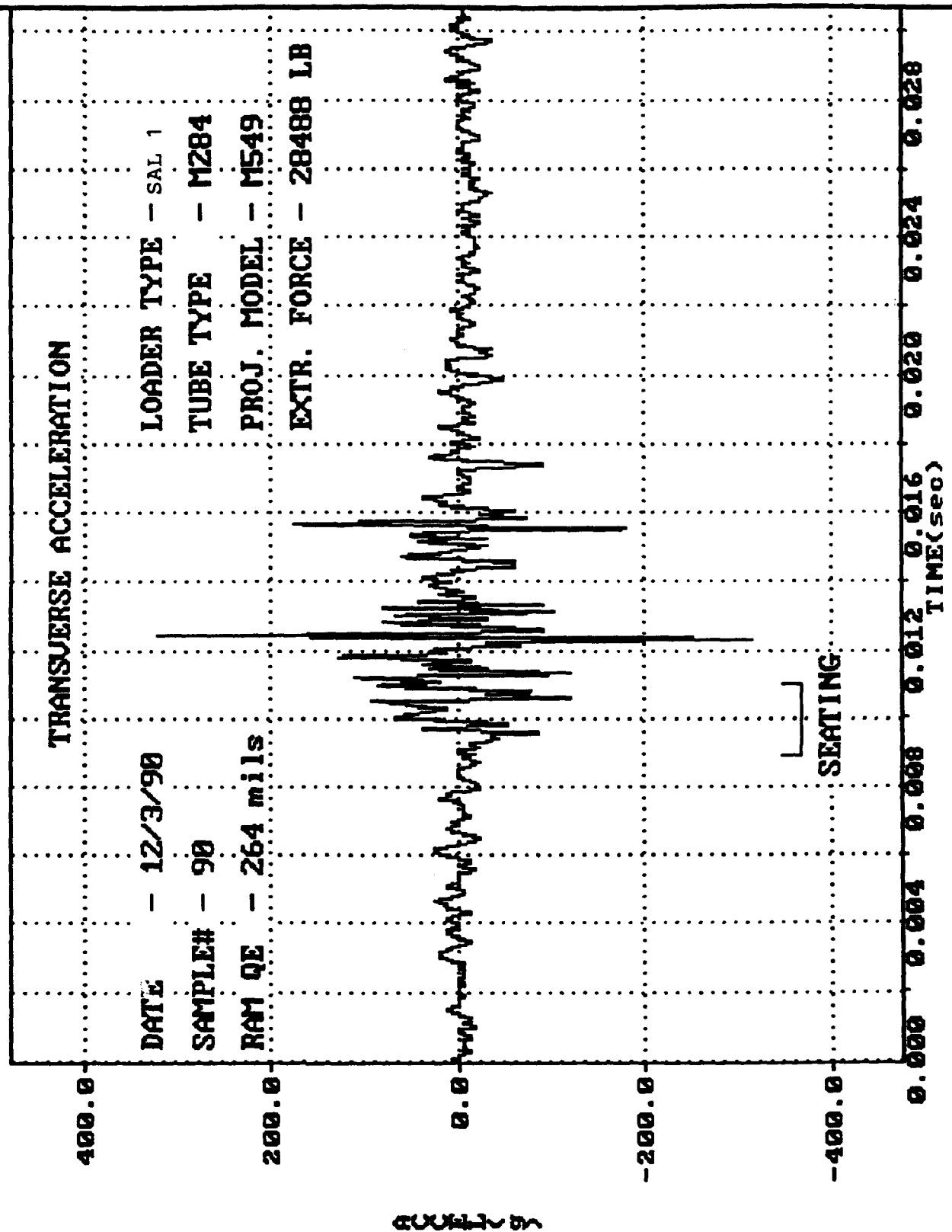
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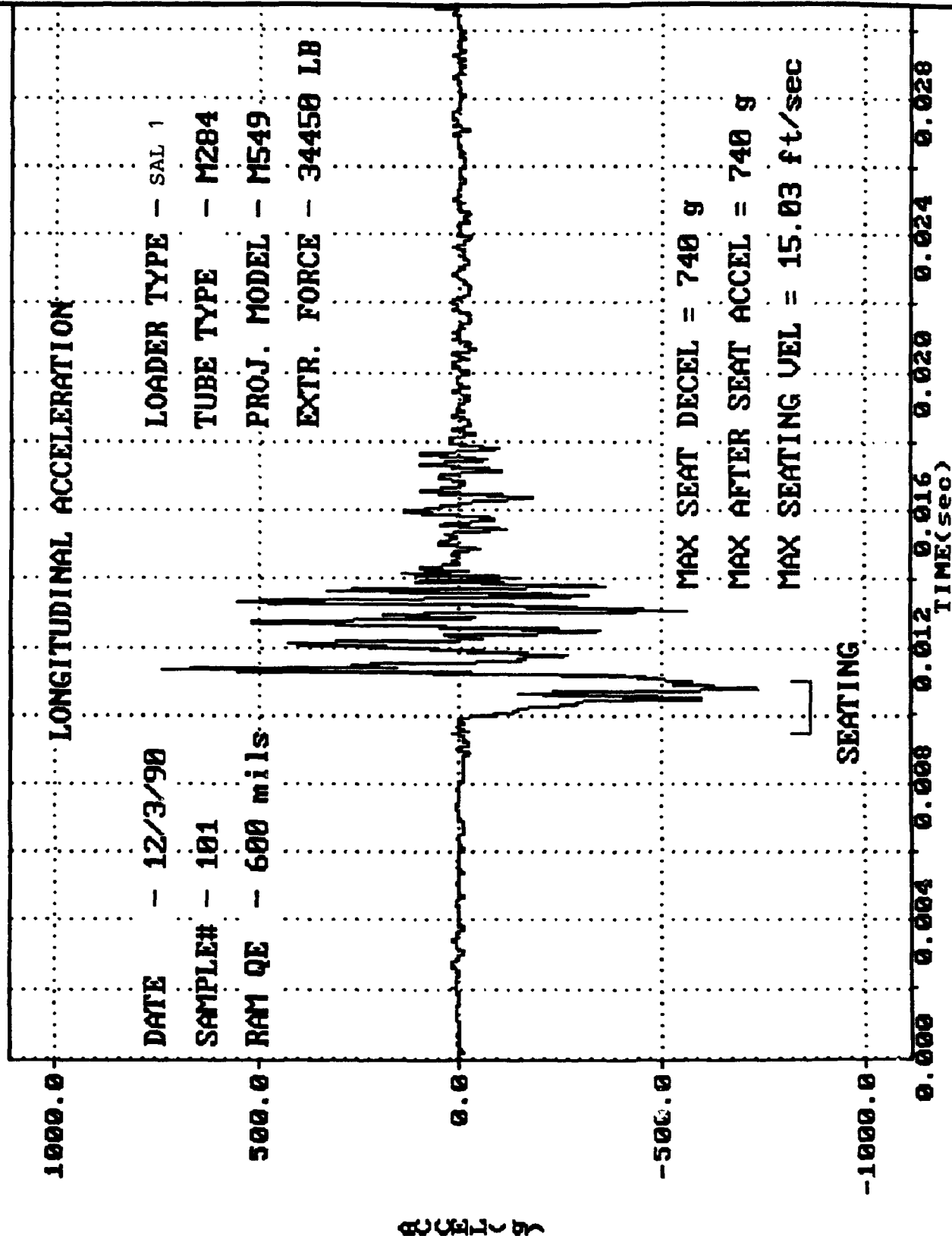
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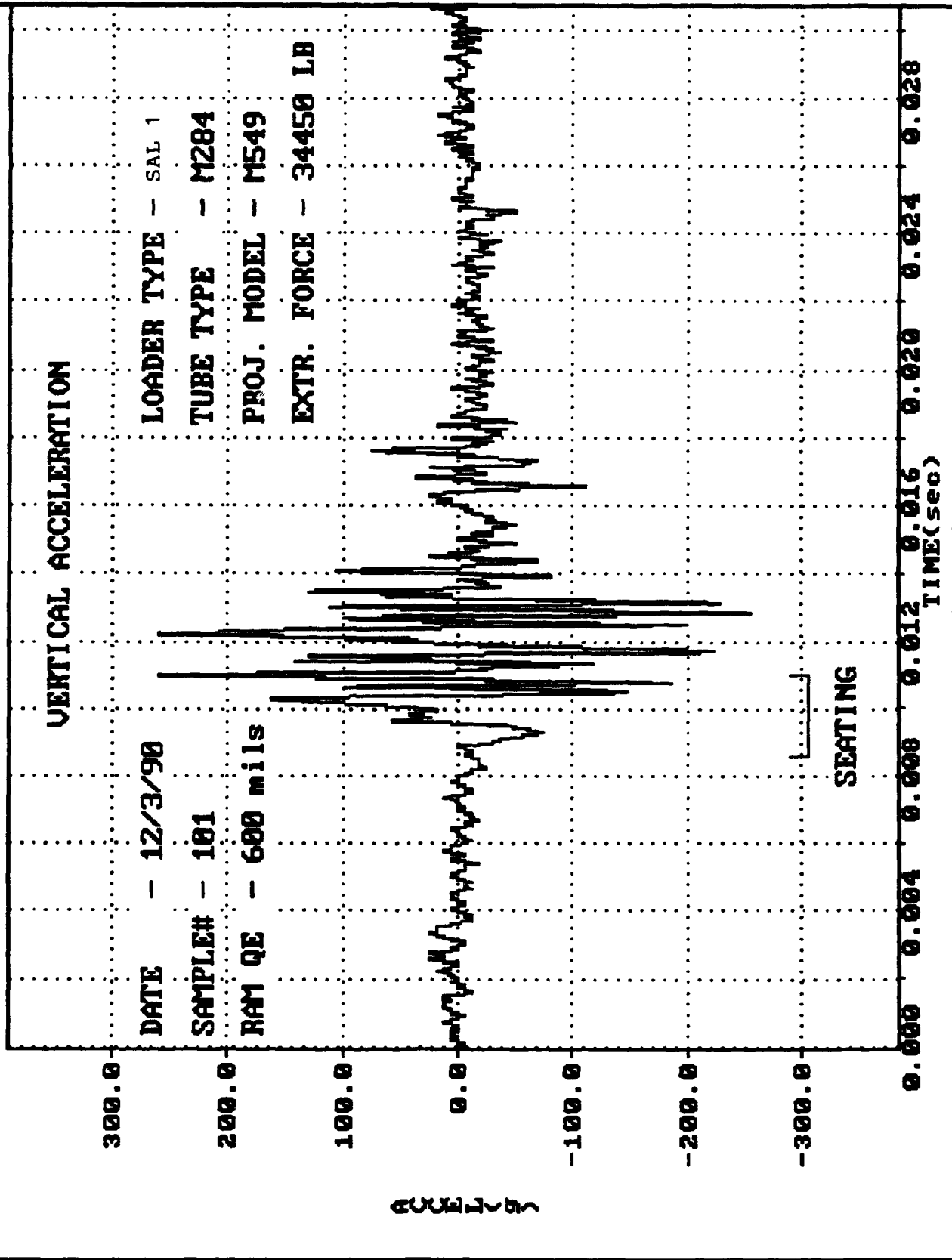
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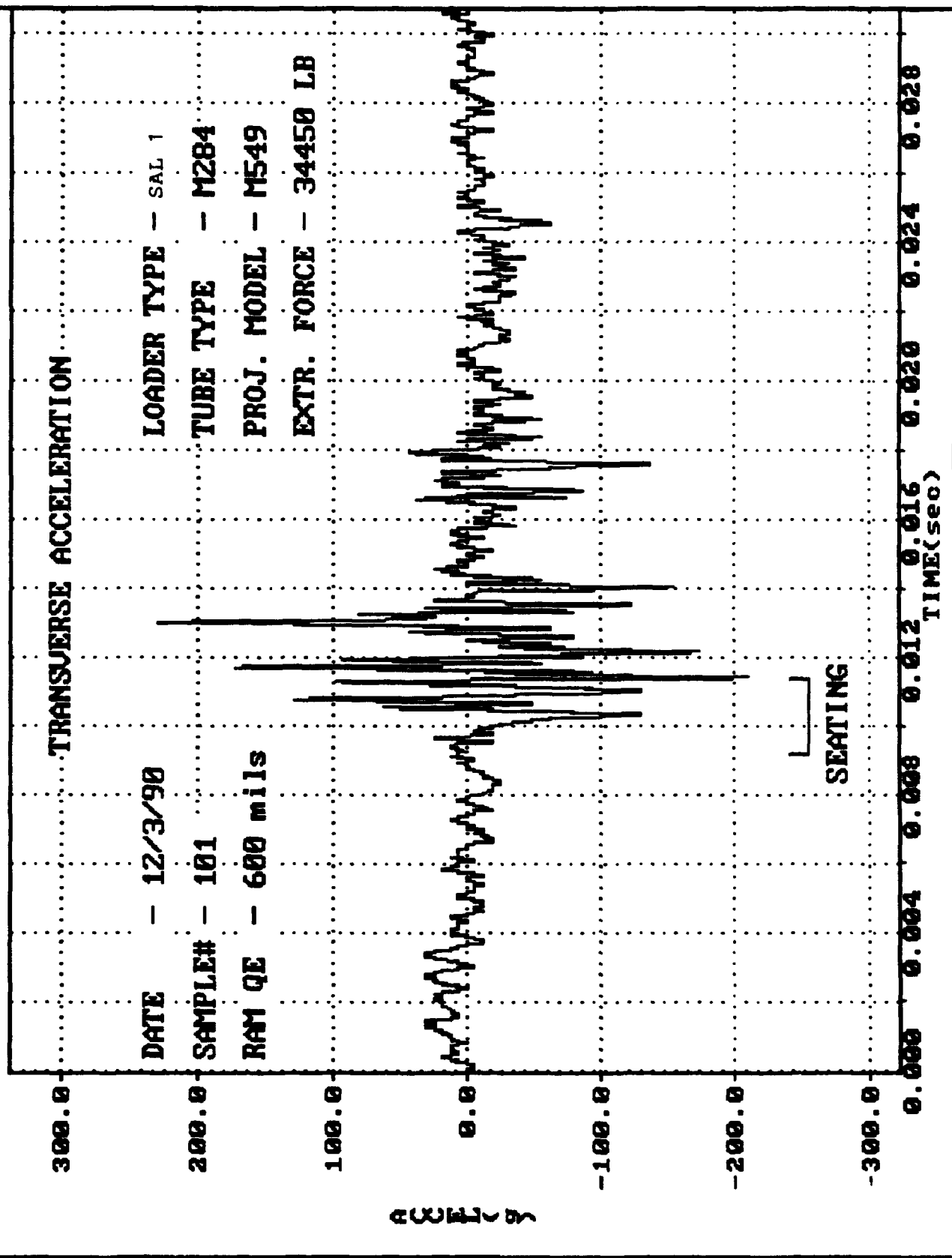
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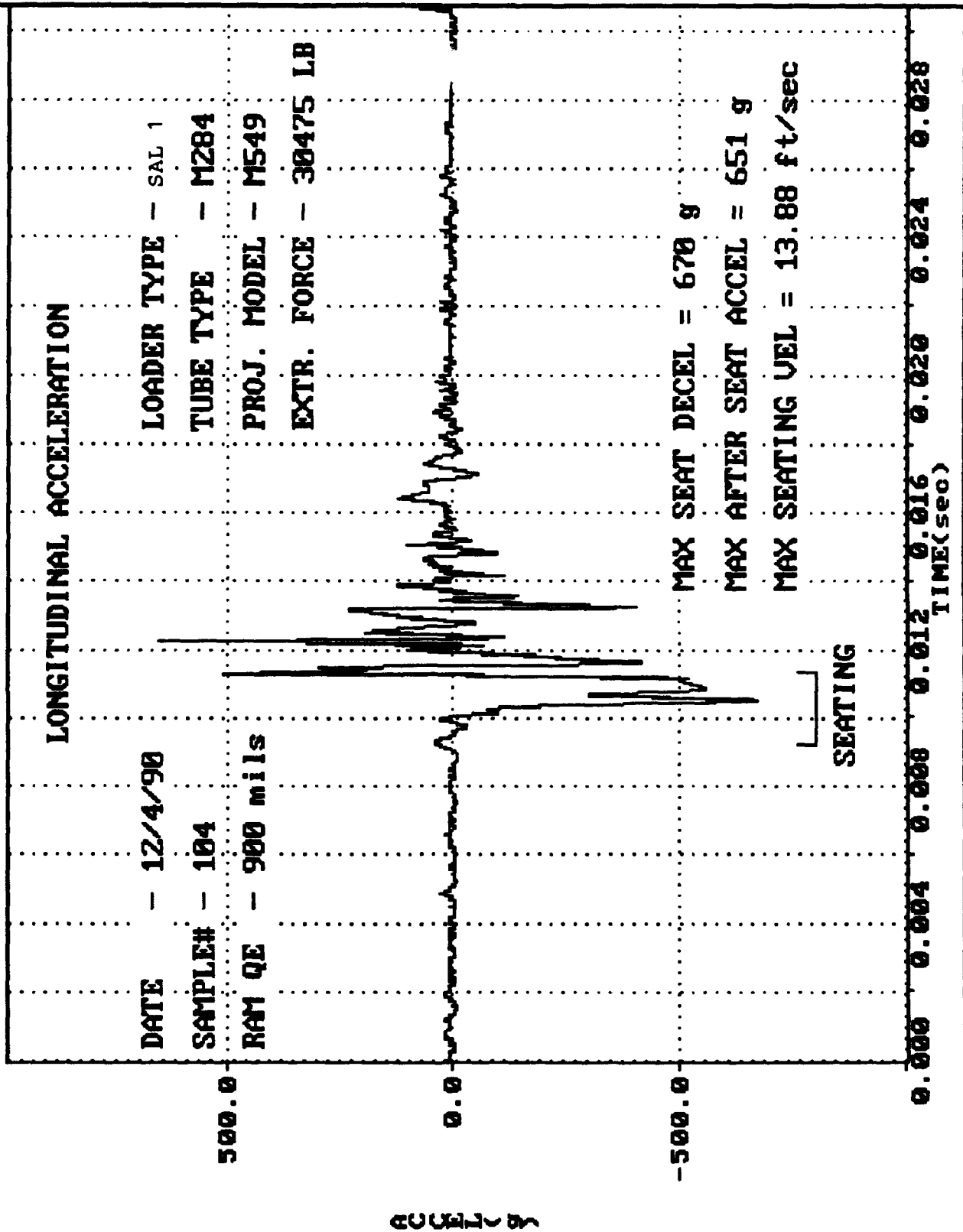
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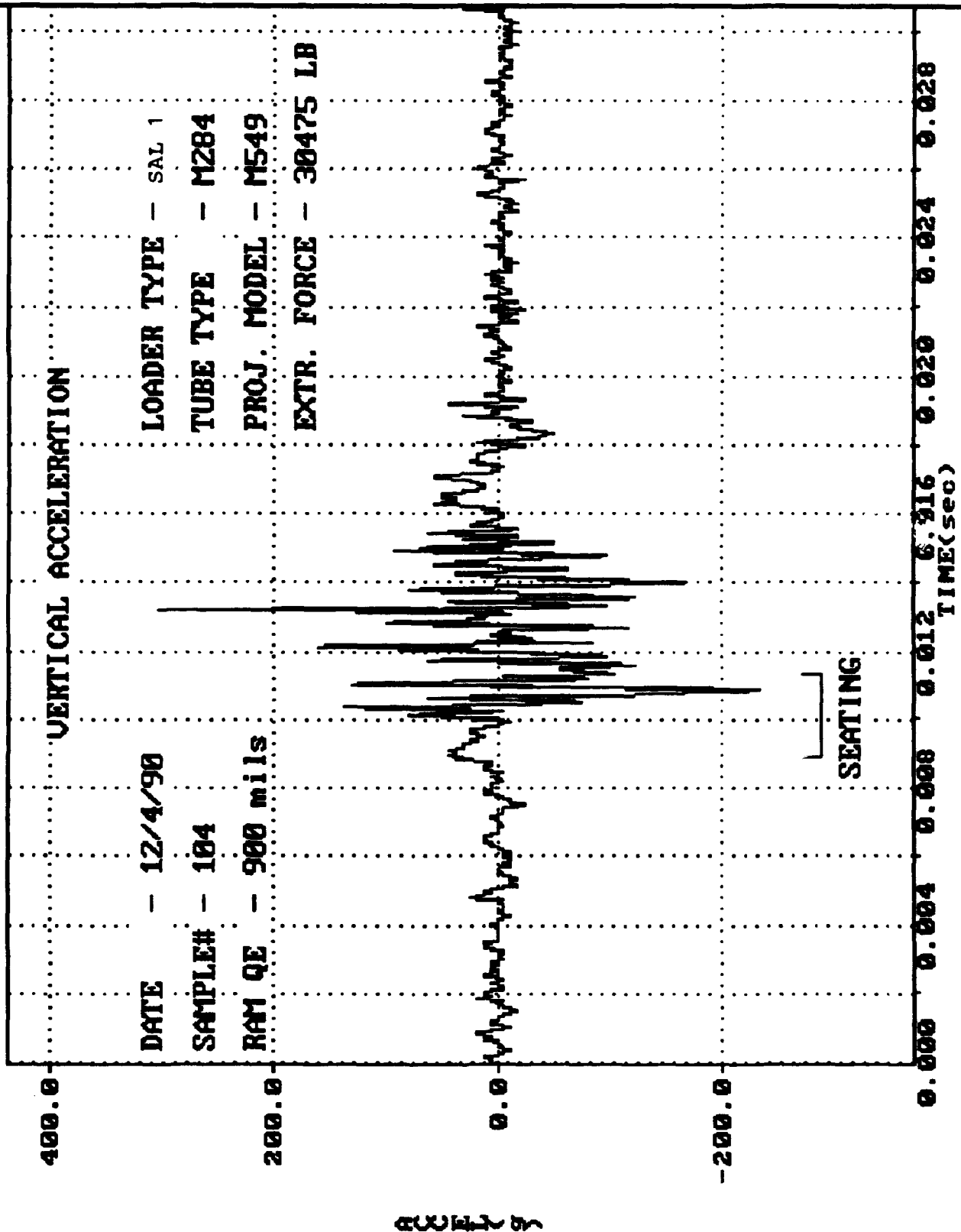
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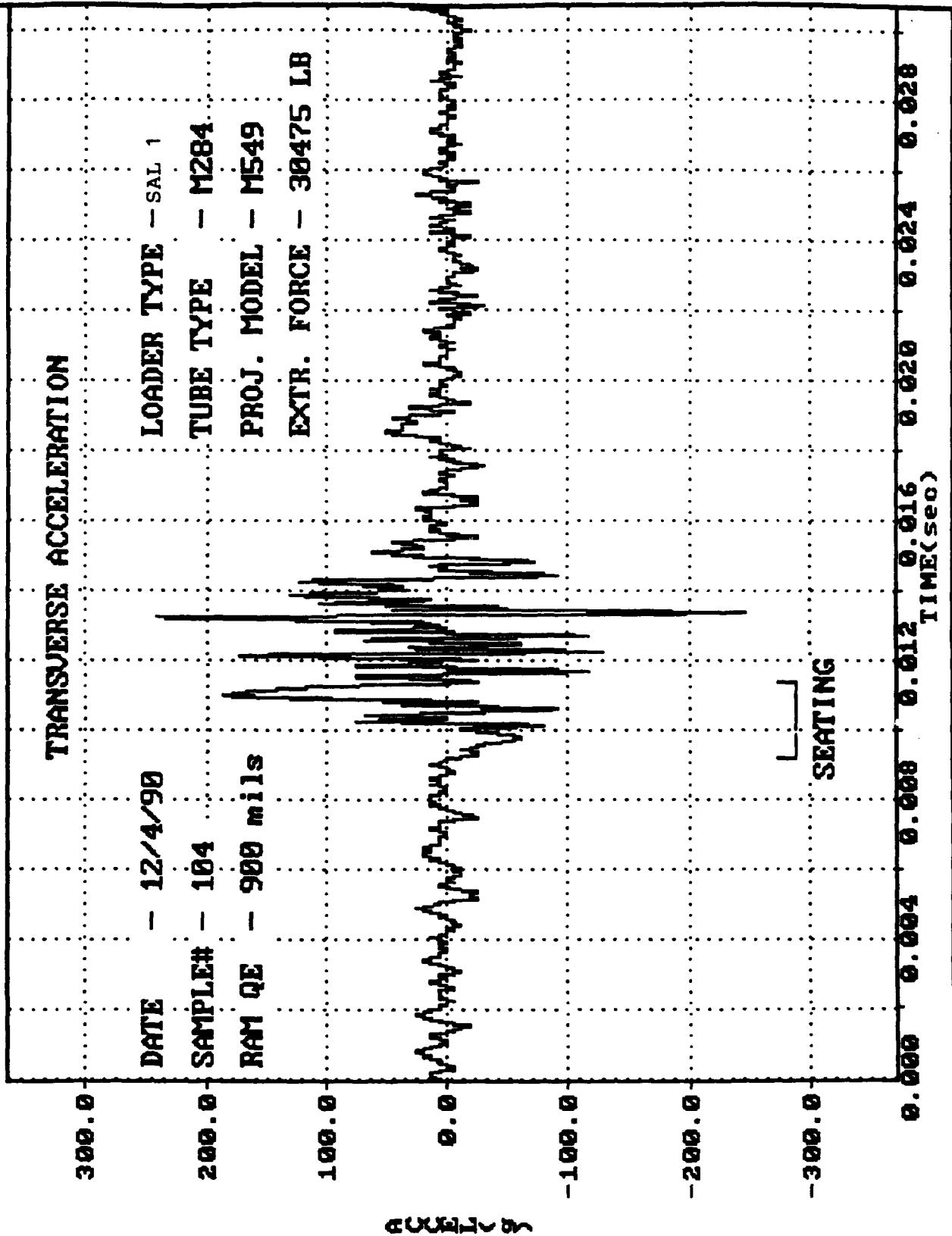
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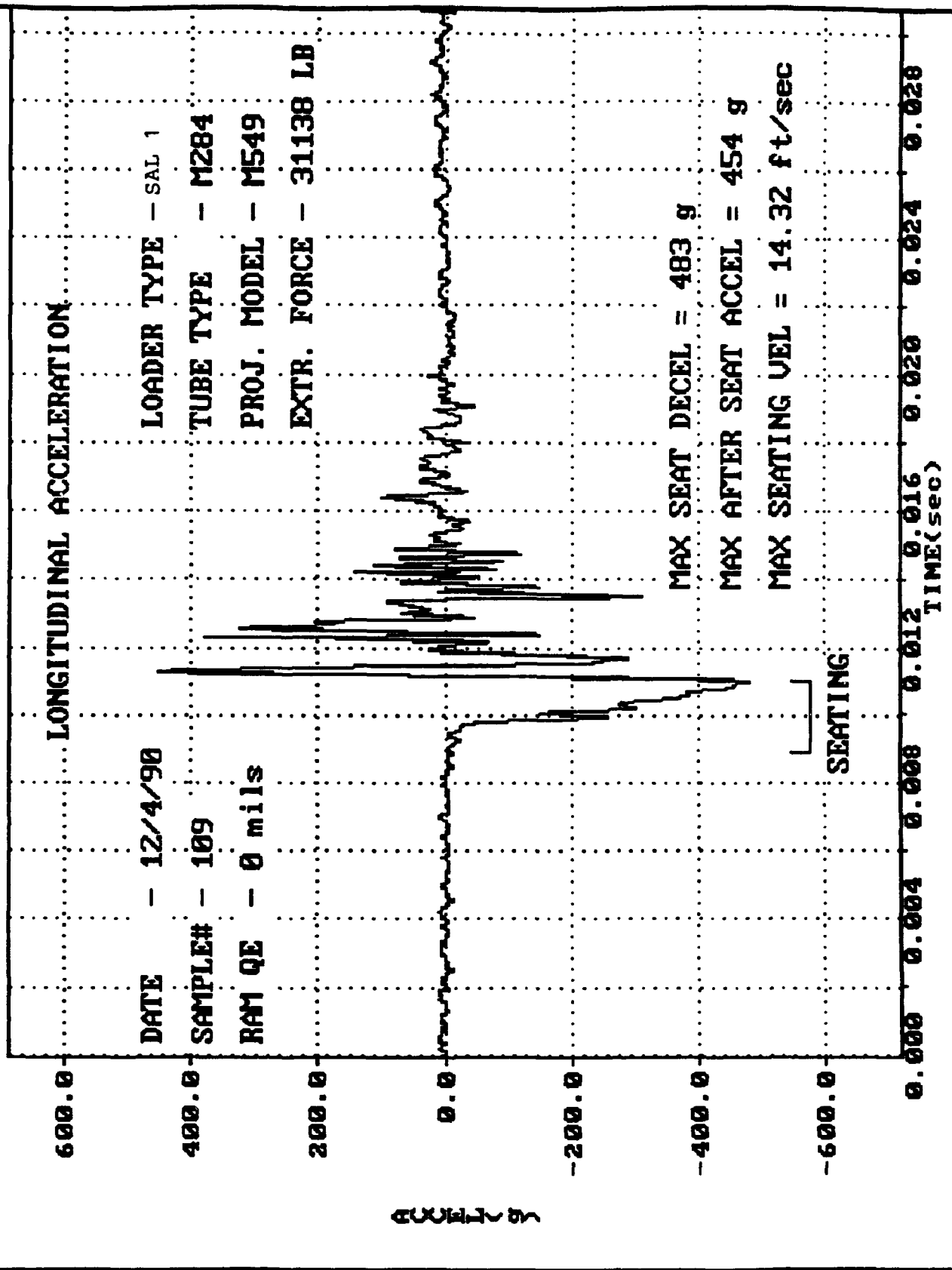
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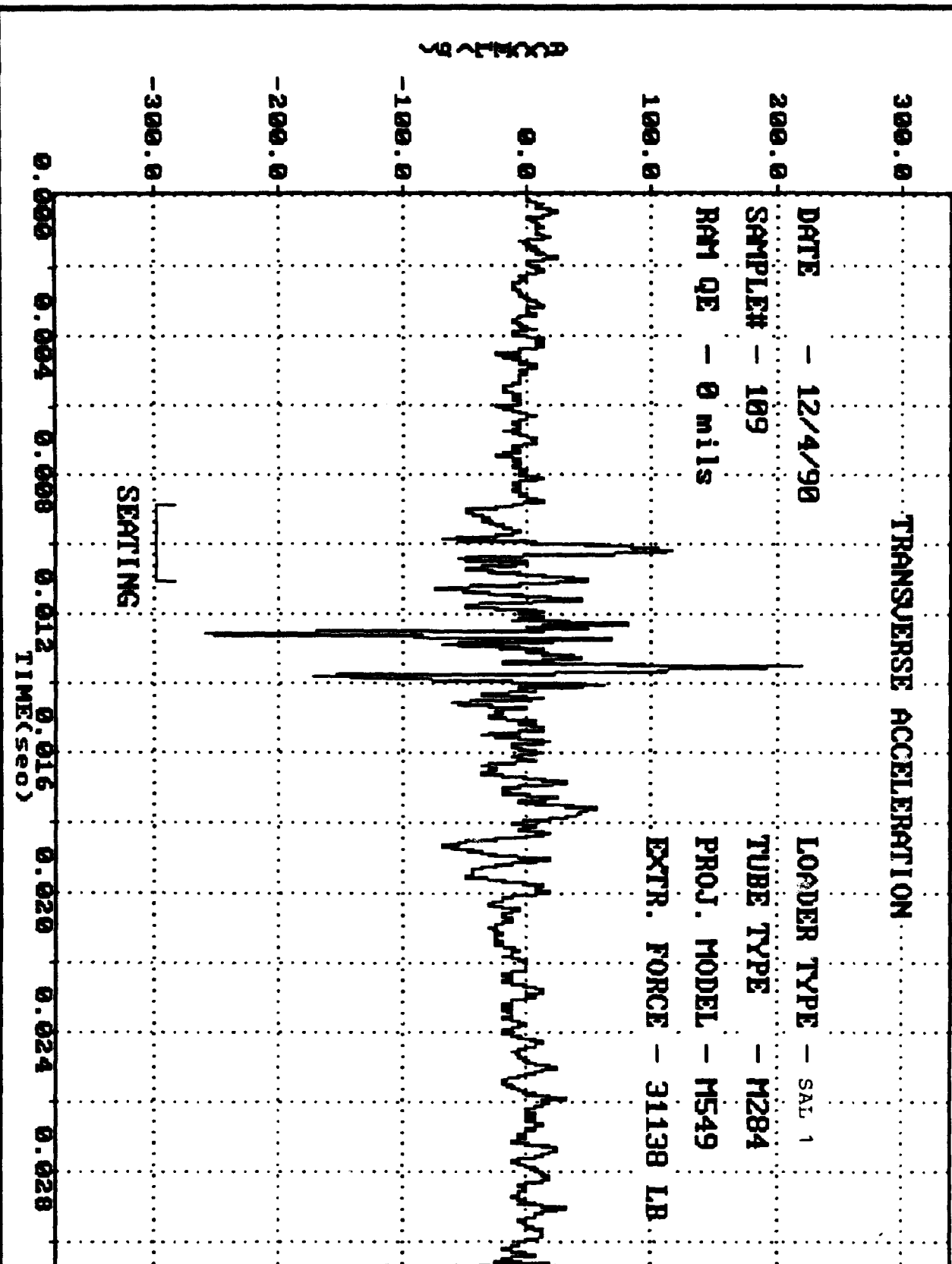
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FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

VERTICAL ACCELERATION

DATE - 12/4/90

LOADER TYPE - SAL 1

SAMPLE# - 109

TUBE TYPE - M284

RAM QE - 0 mls

PROJ. MODEL - M549

EXTR. FORCE - 31138 LB

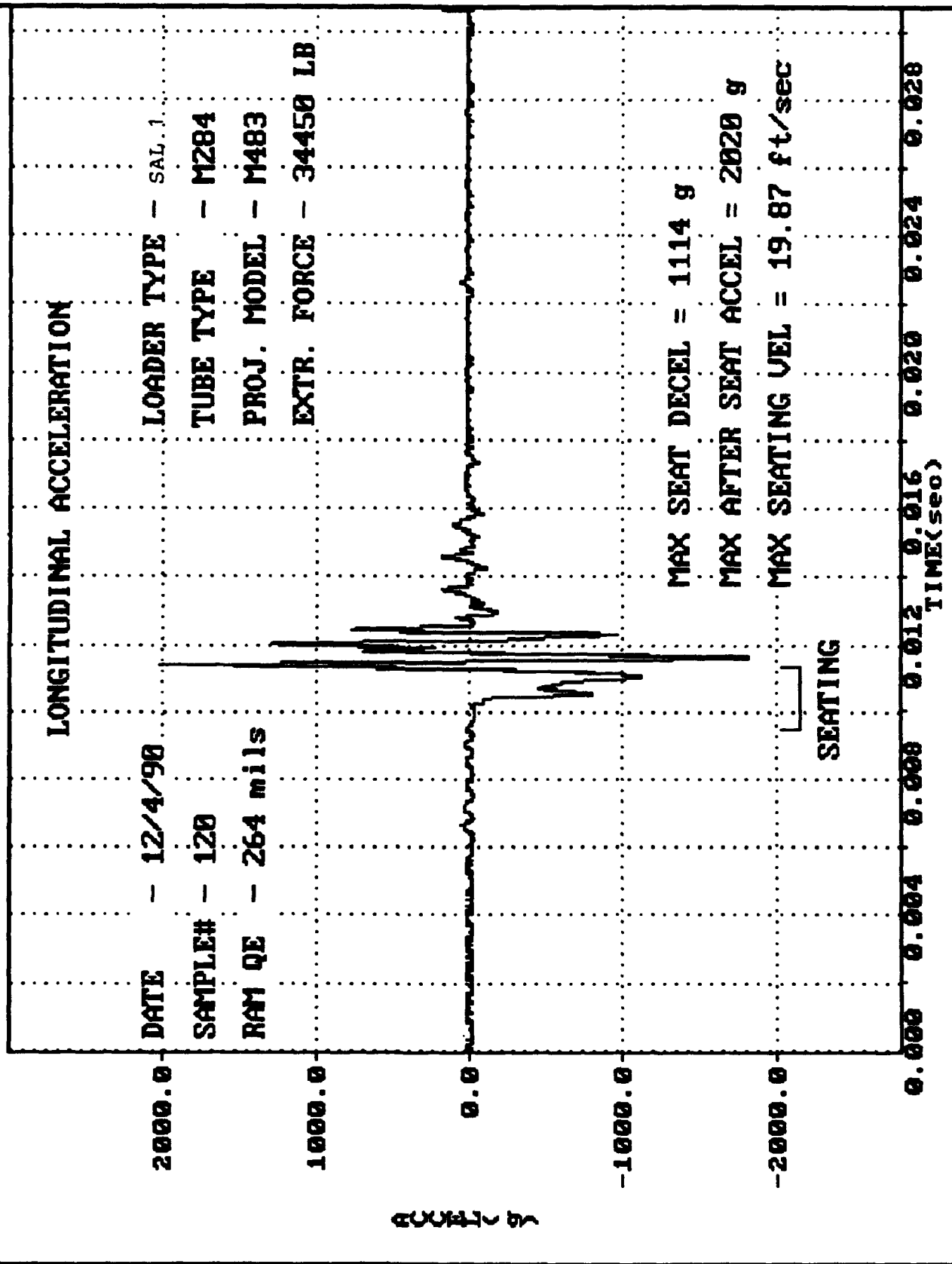
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-200.0
0.0

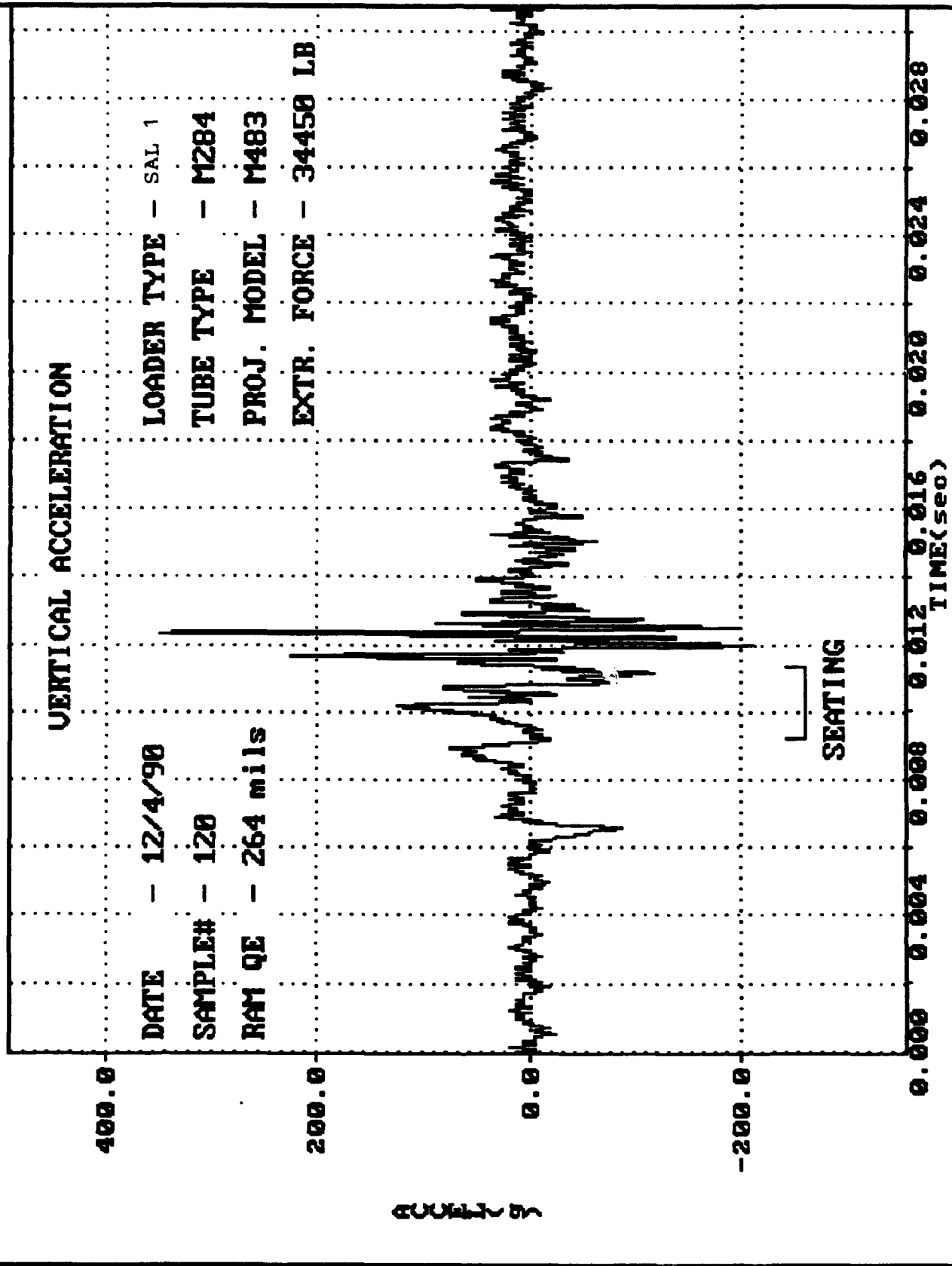
SEATING

0.000 0.004 0.008 0.012 0.016 0.020 0.024 0.028
TIME(sec)

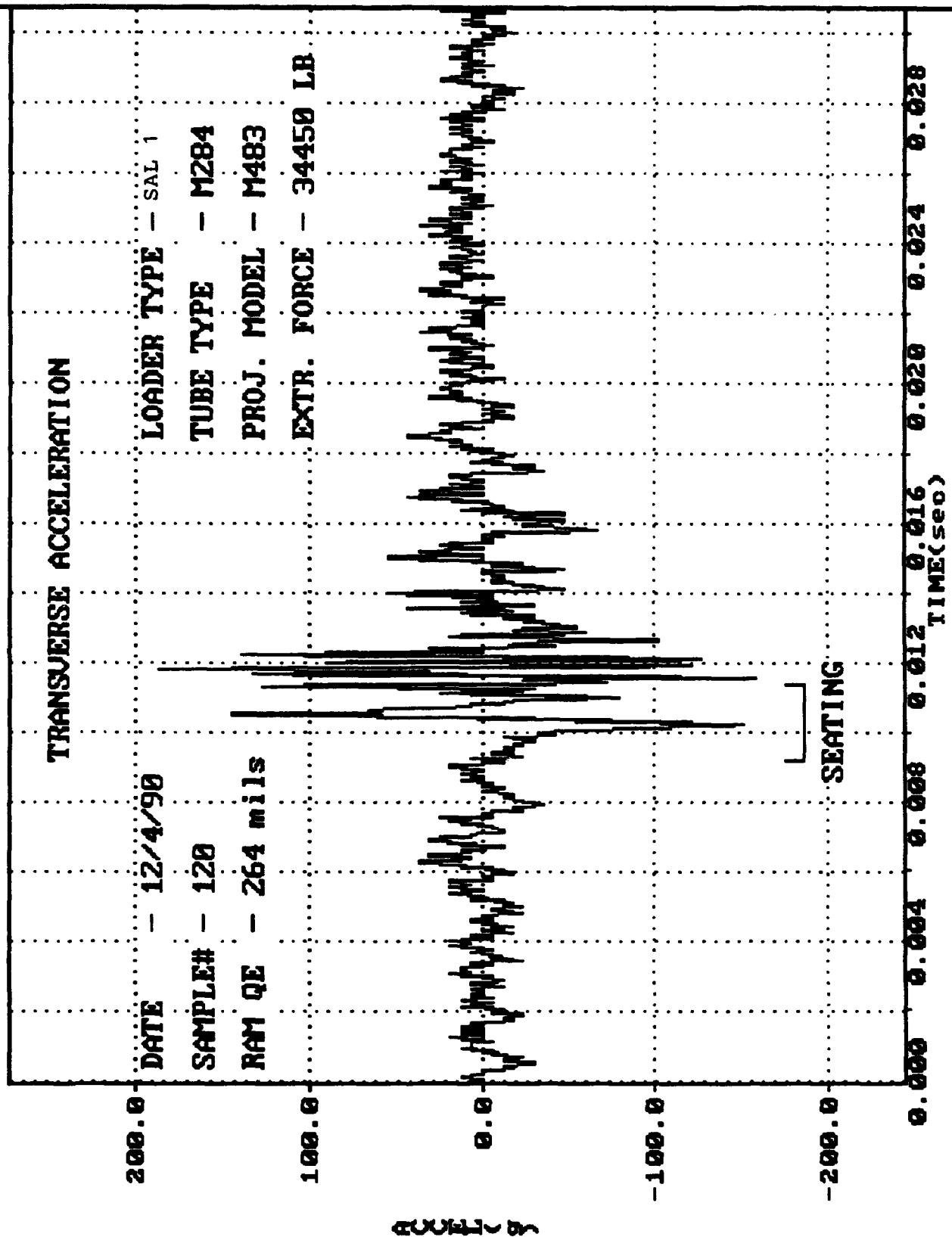
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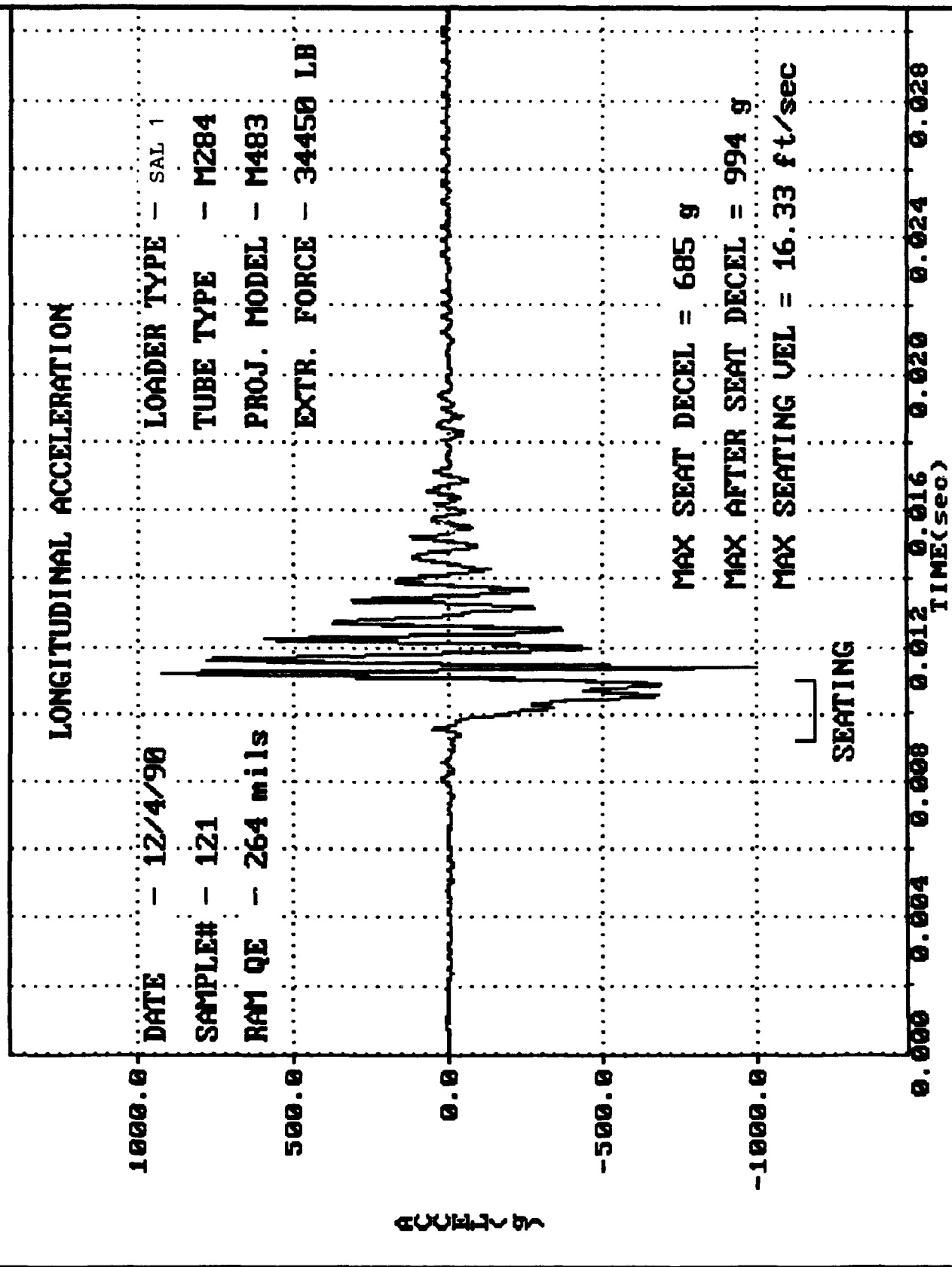
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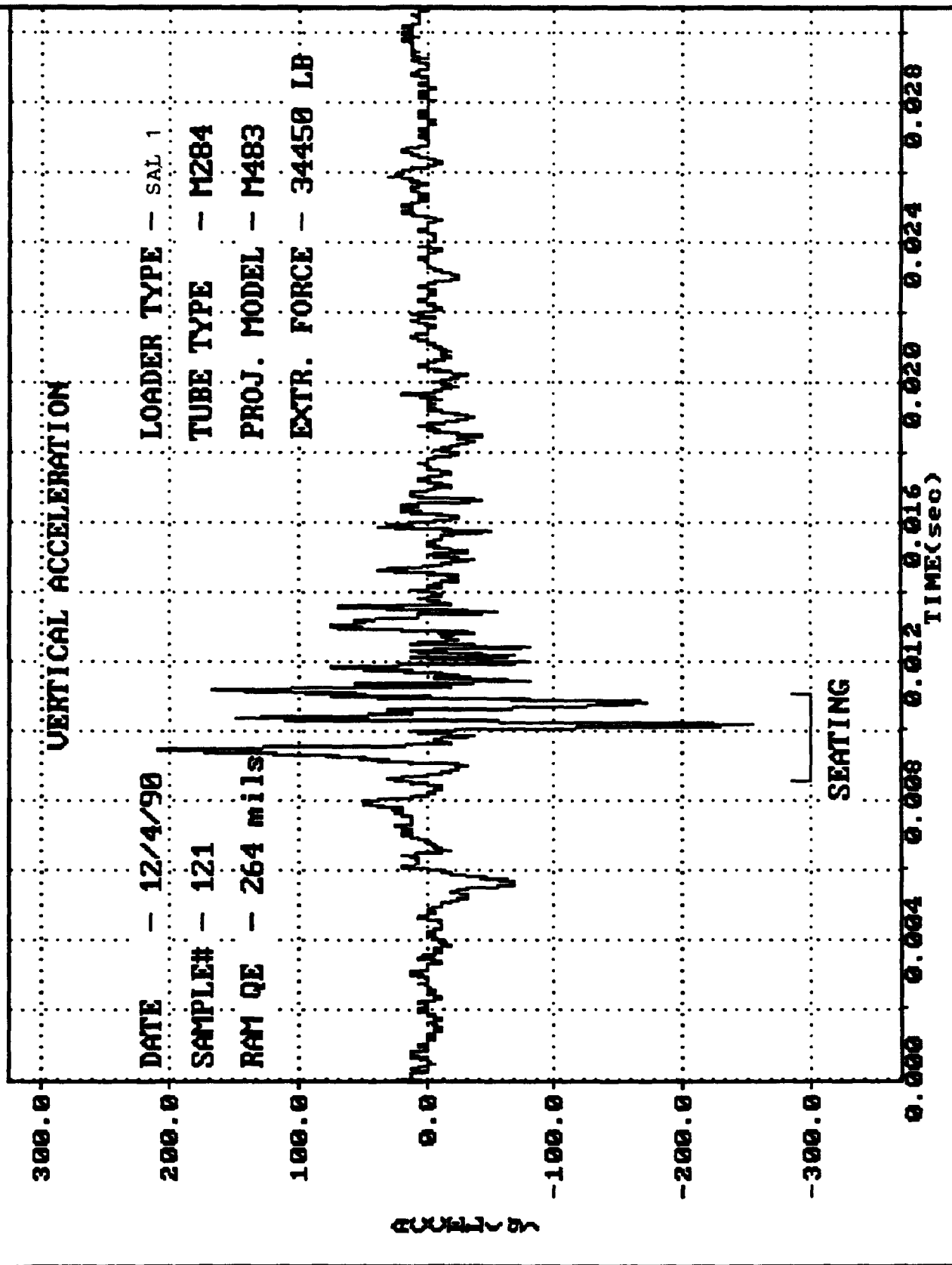
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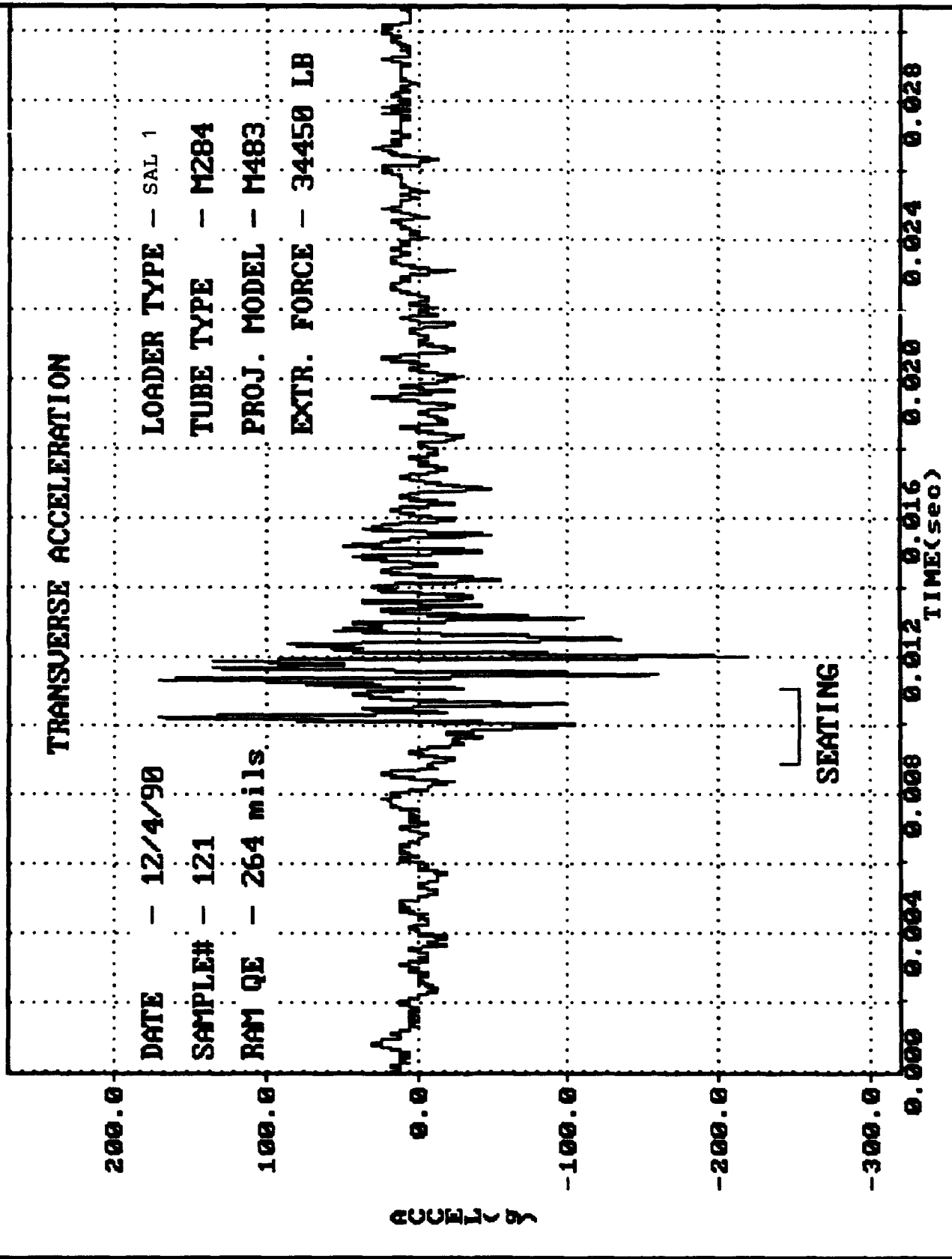
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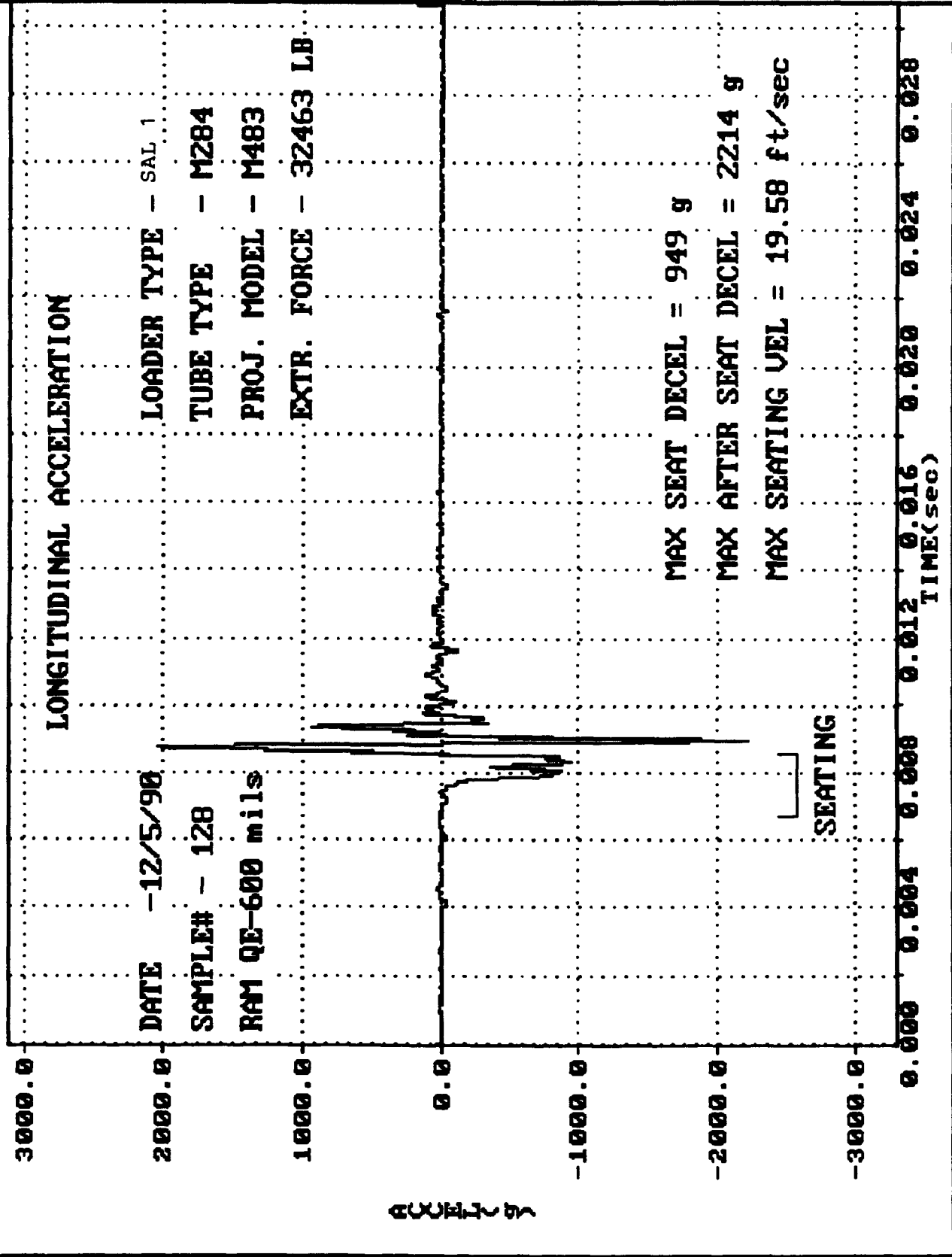
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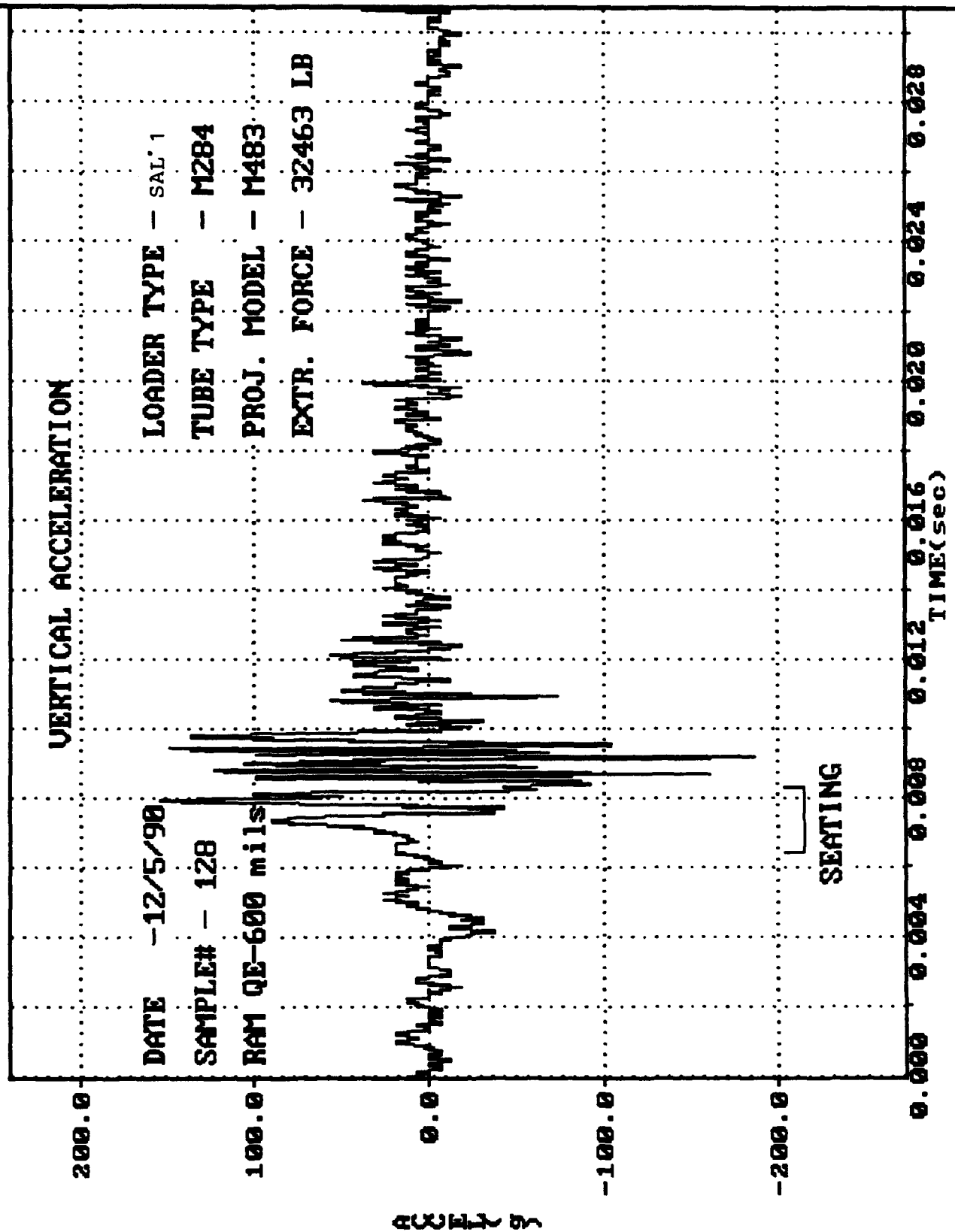
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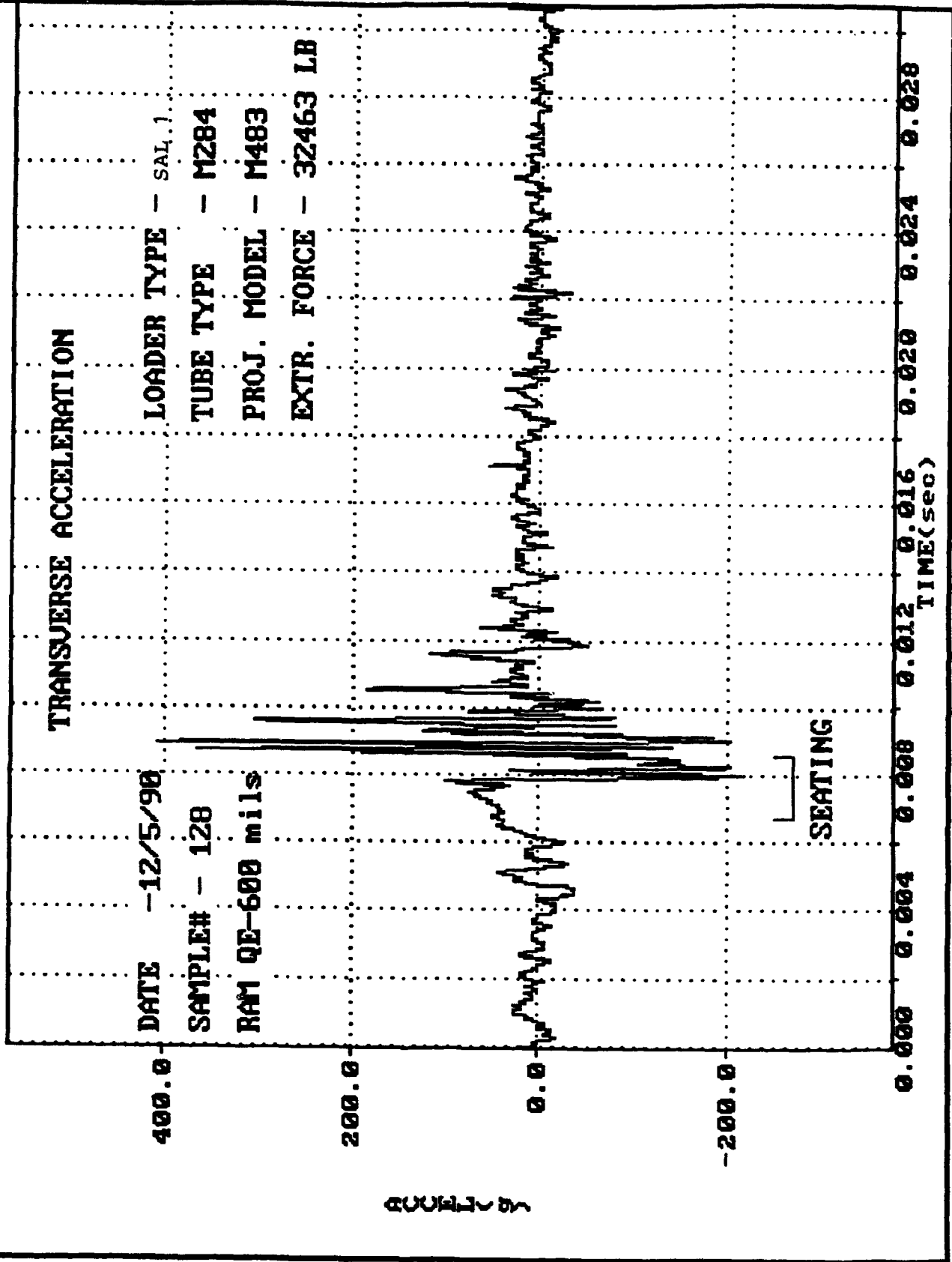
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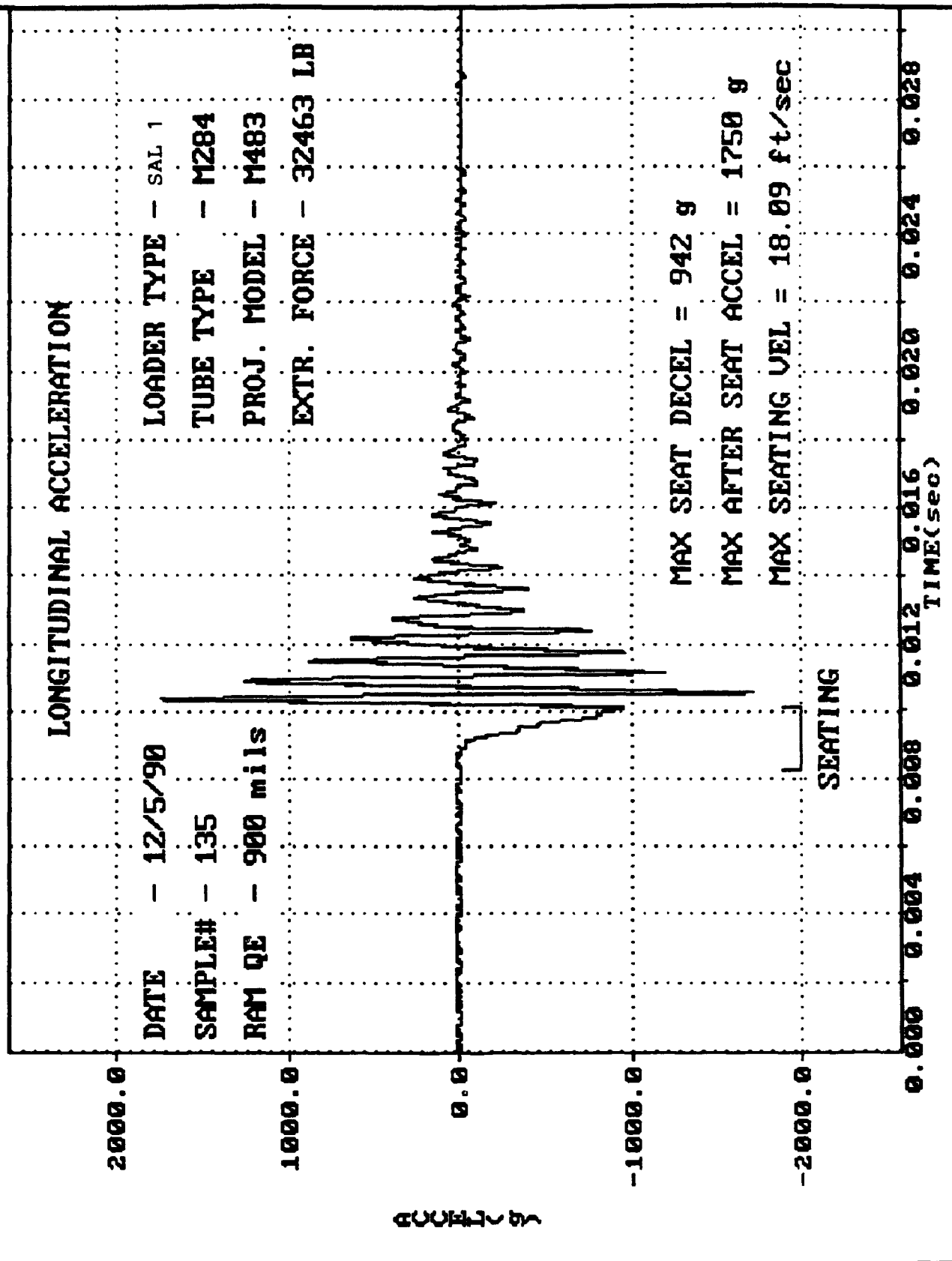
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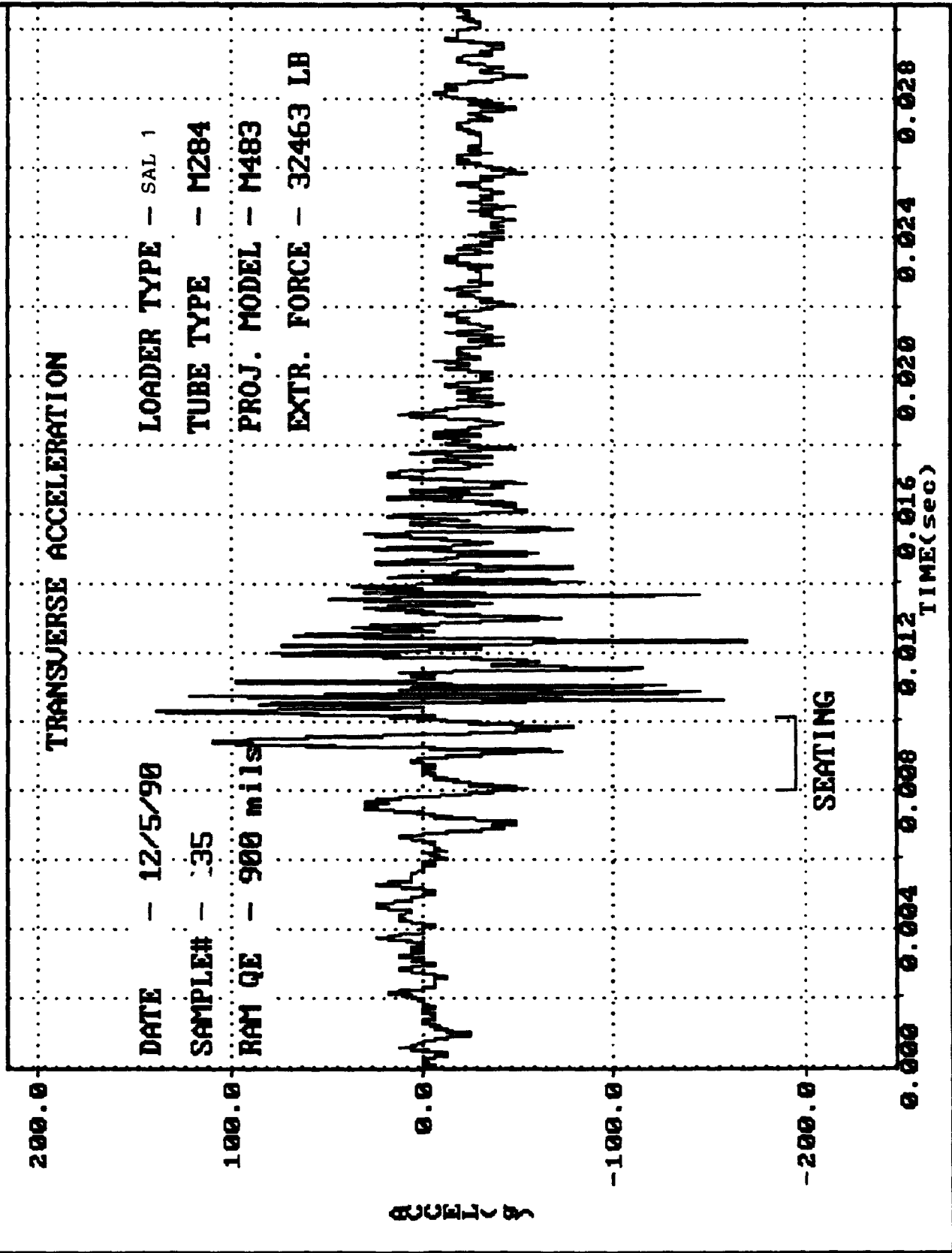
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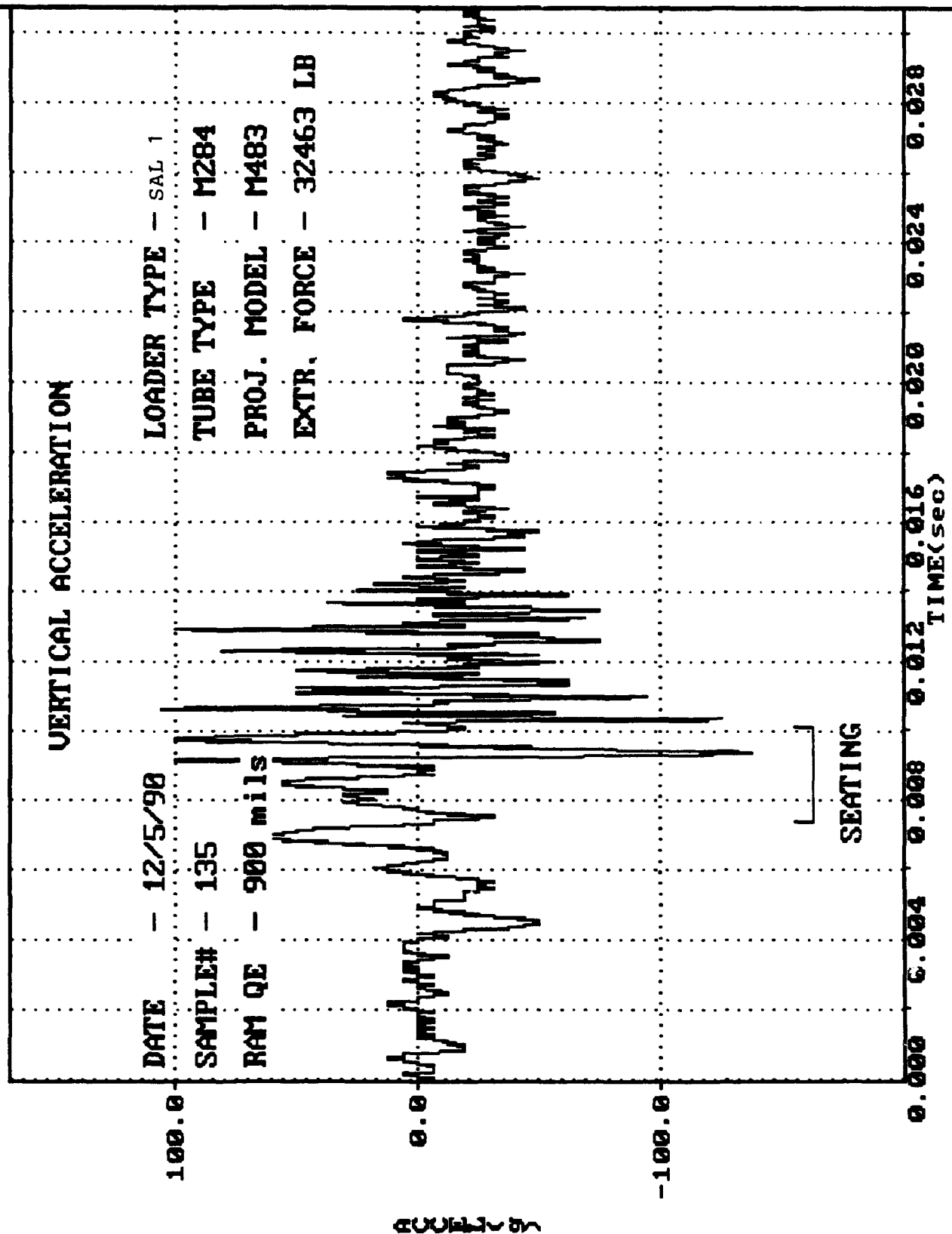
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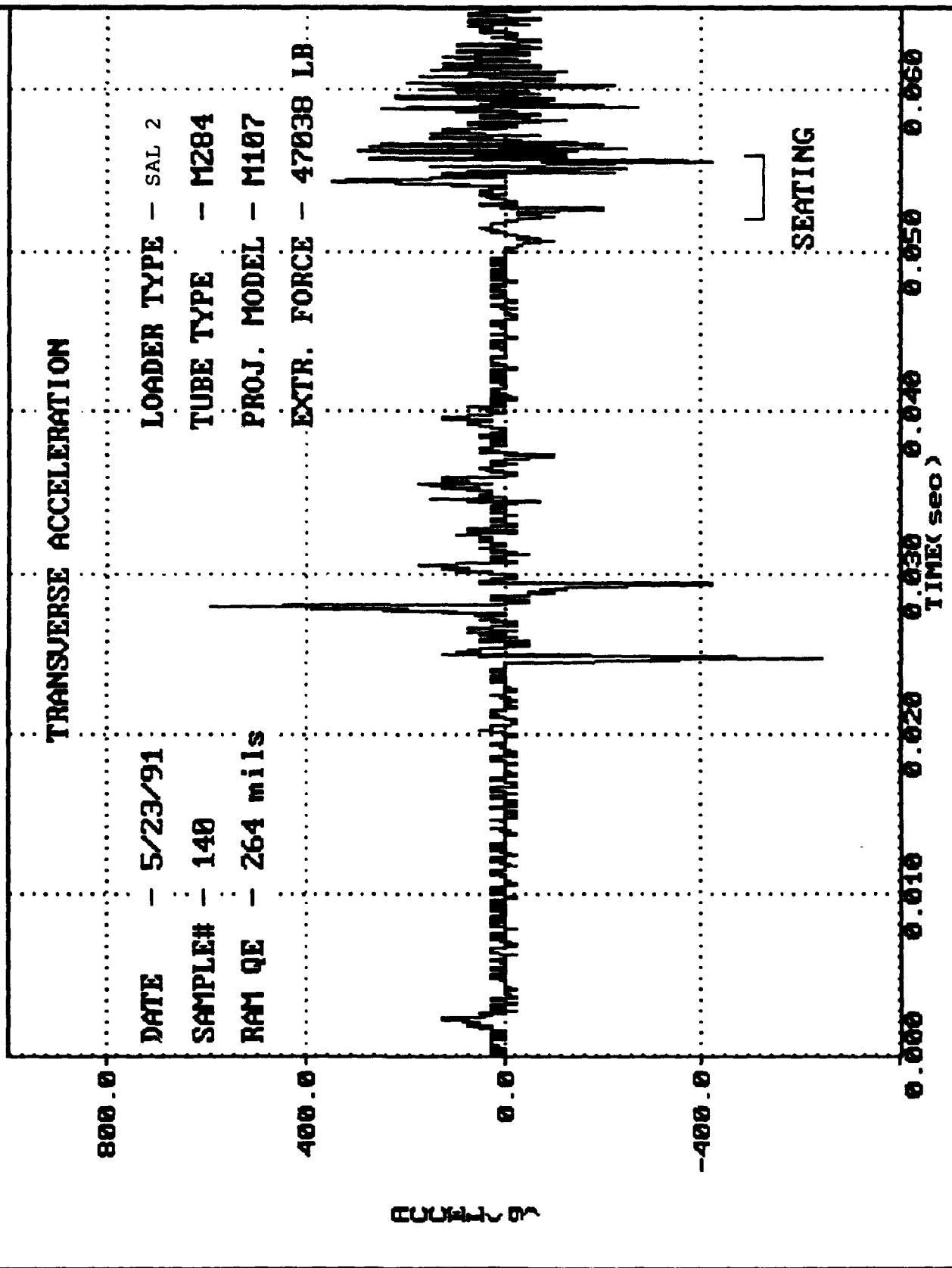
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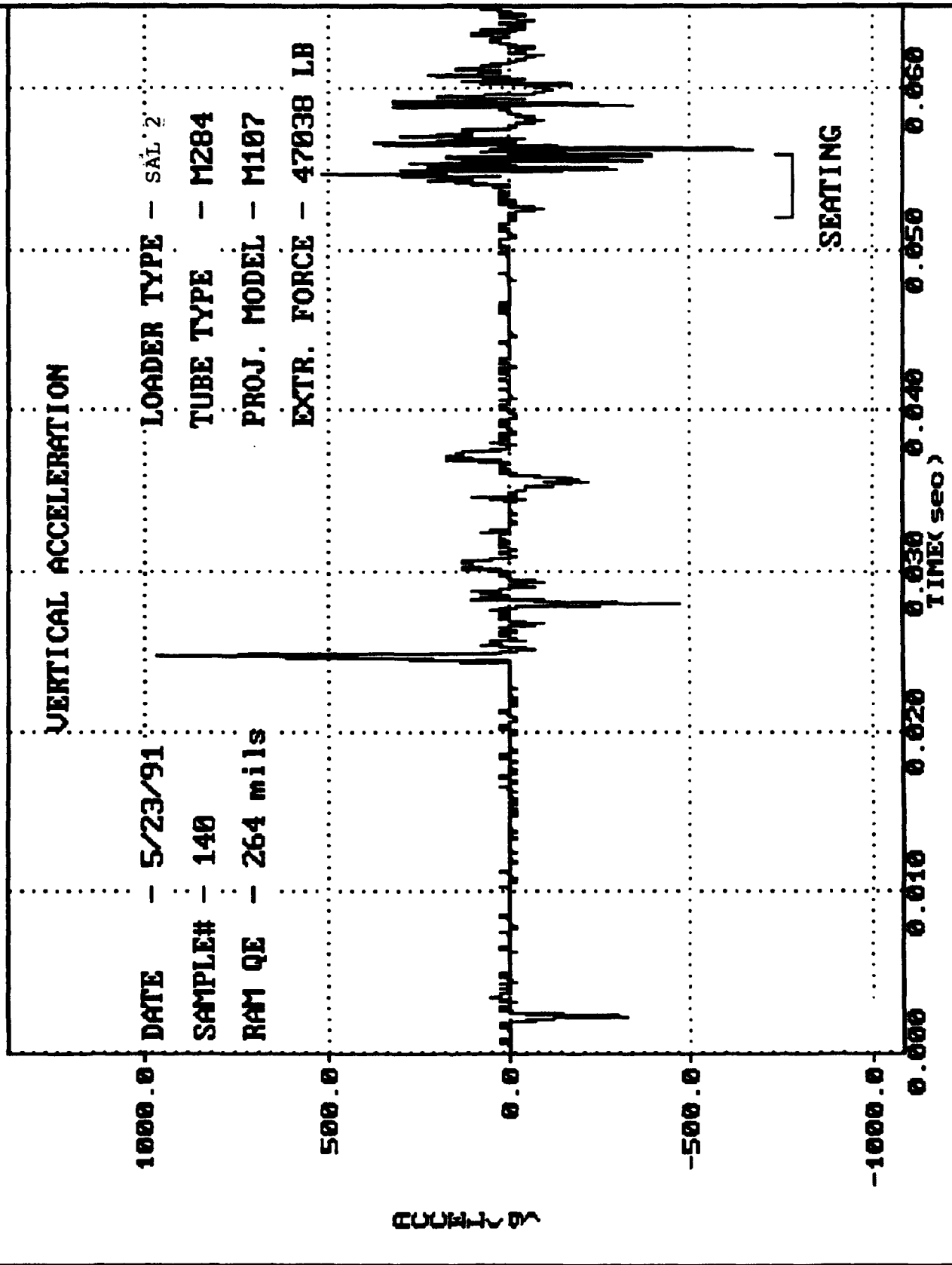
APPENDIX C

KW RAMS

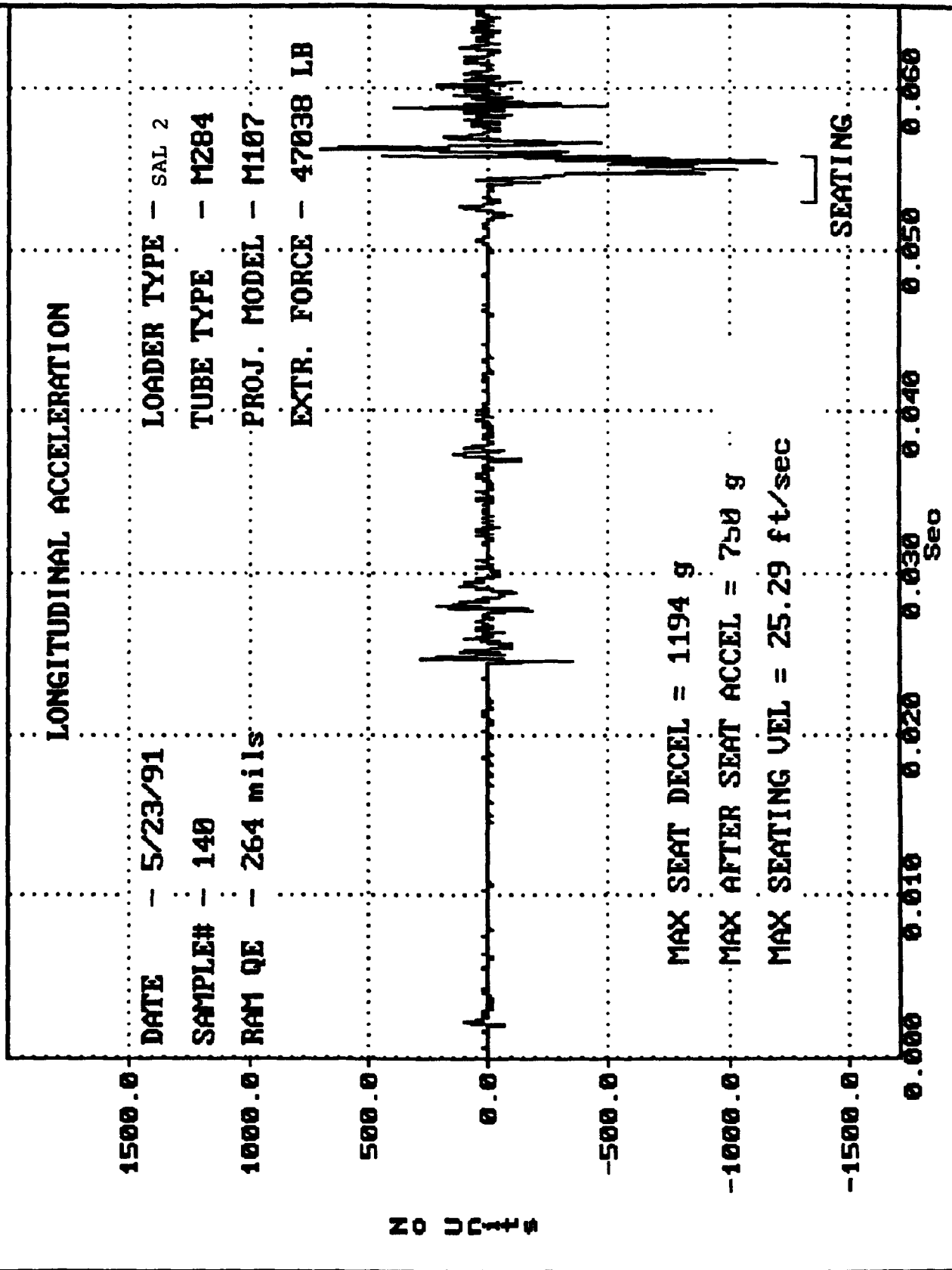
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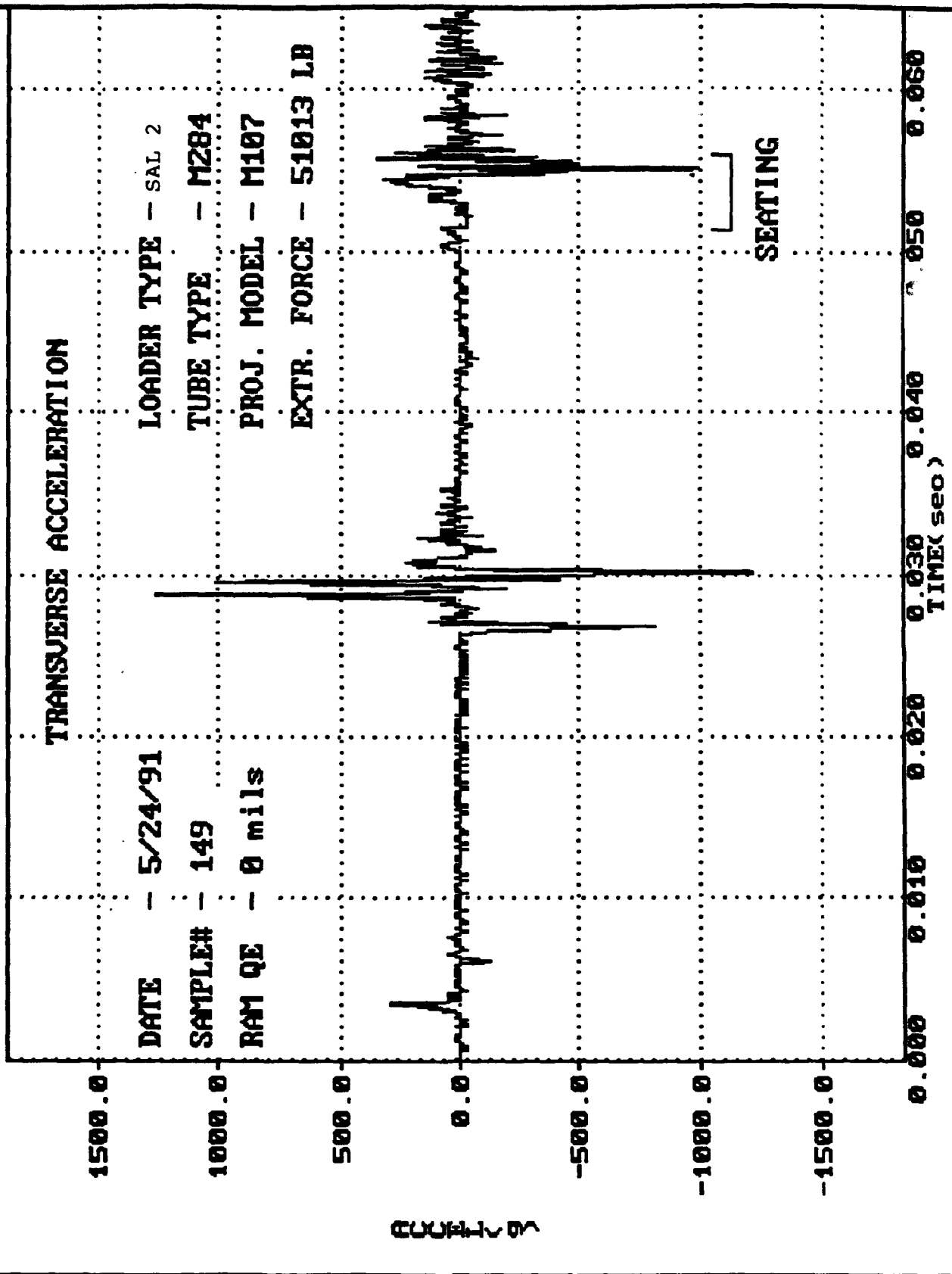
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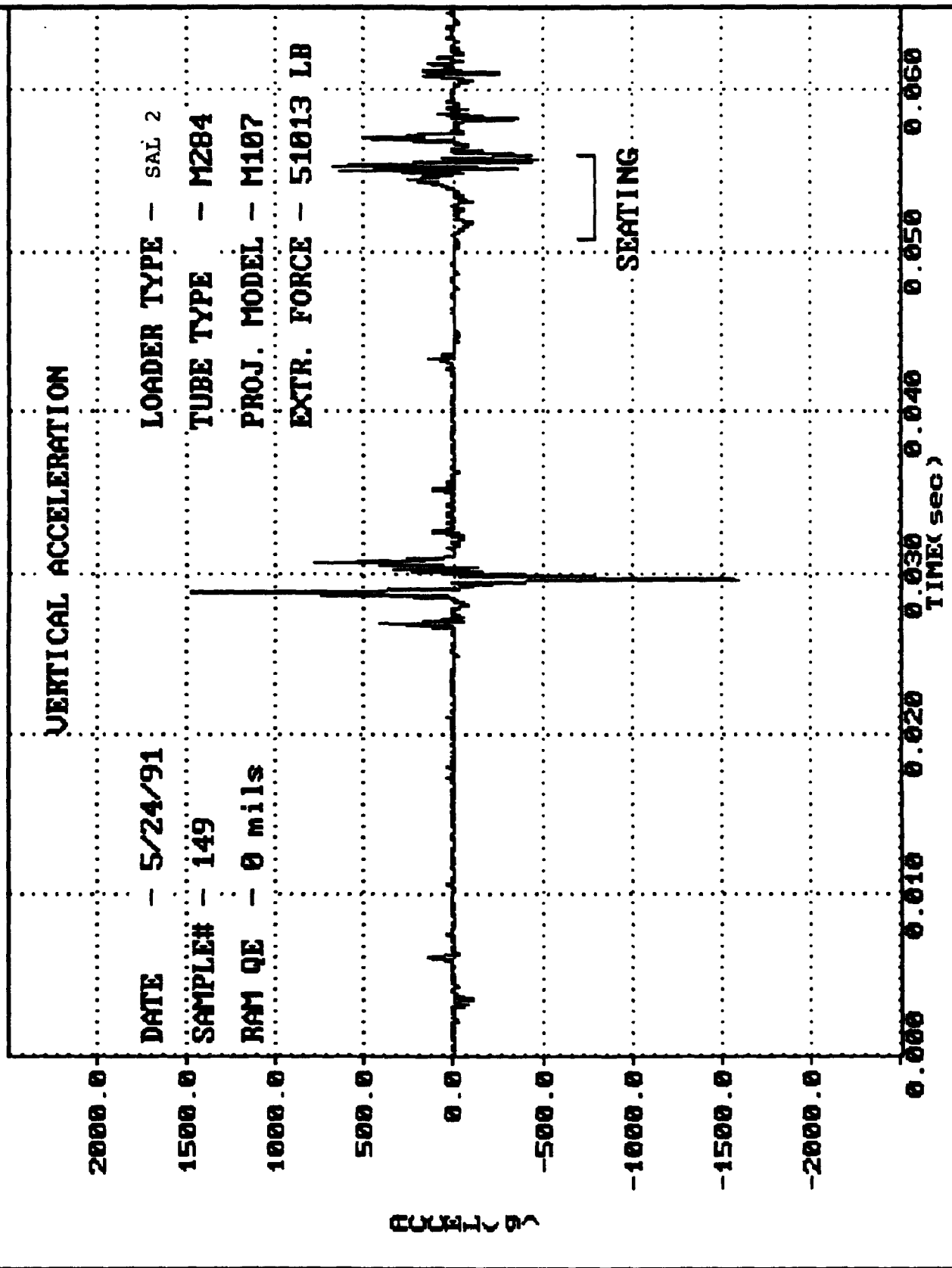
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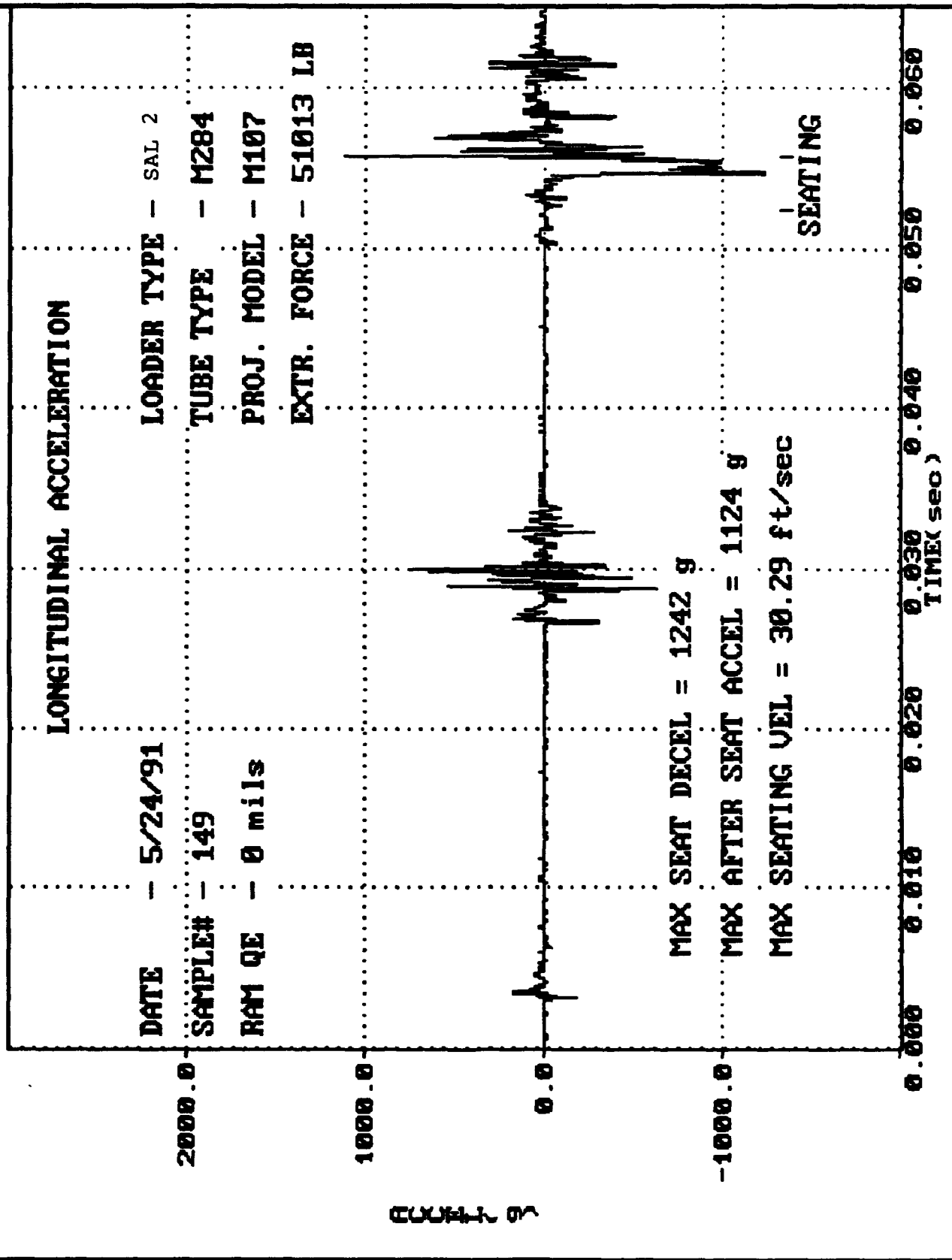
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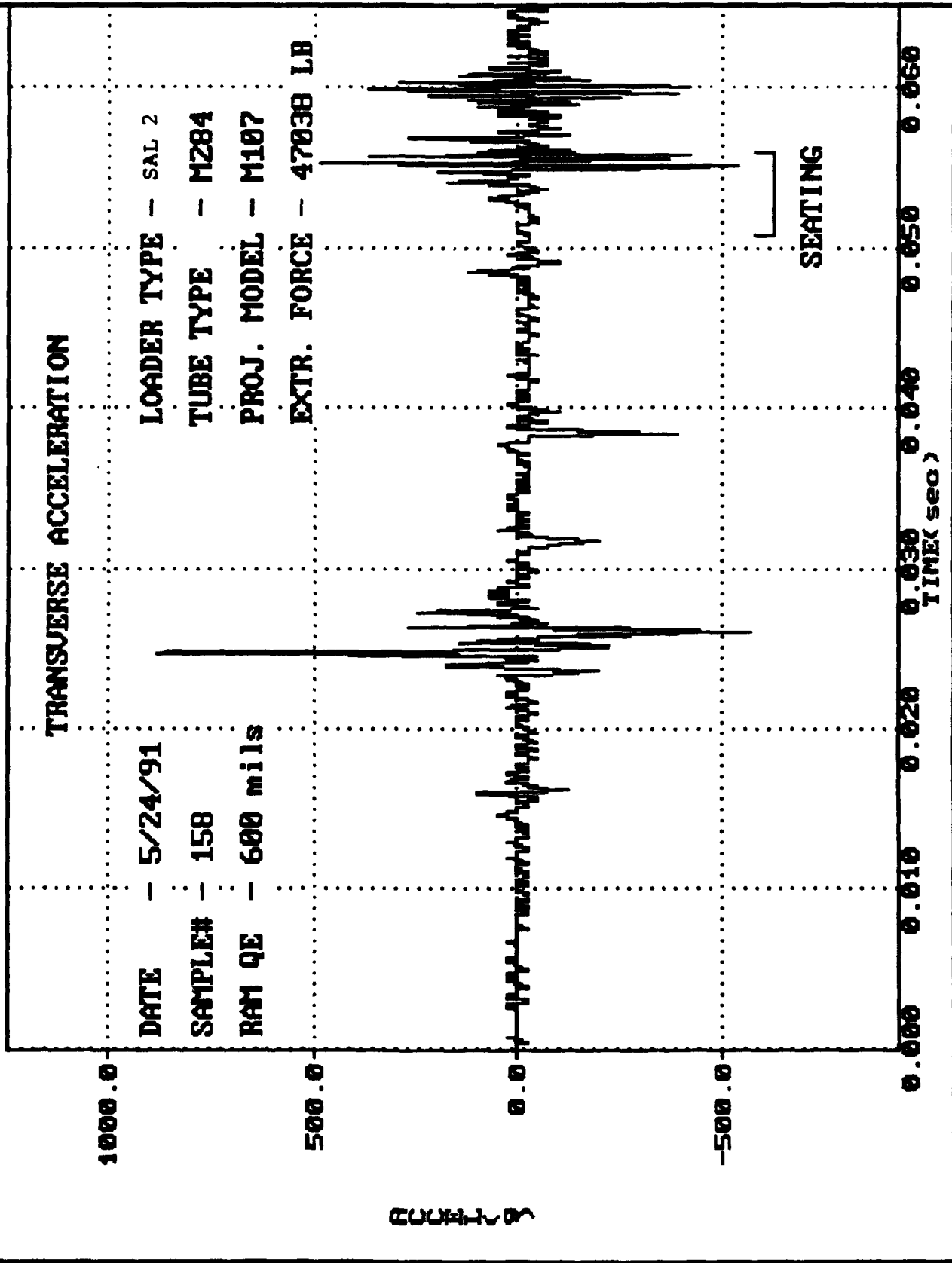
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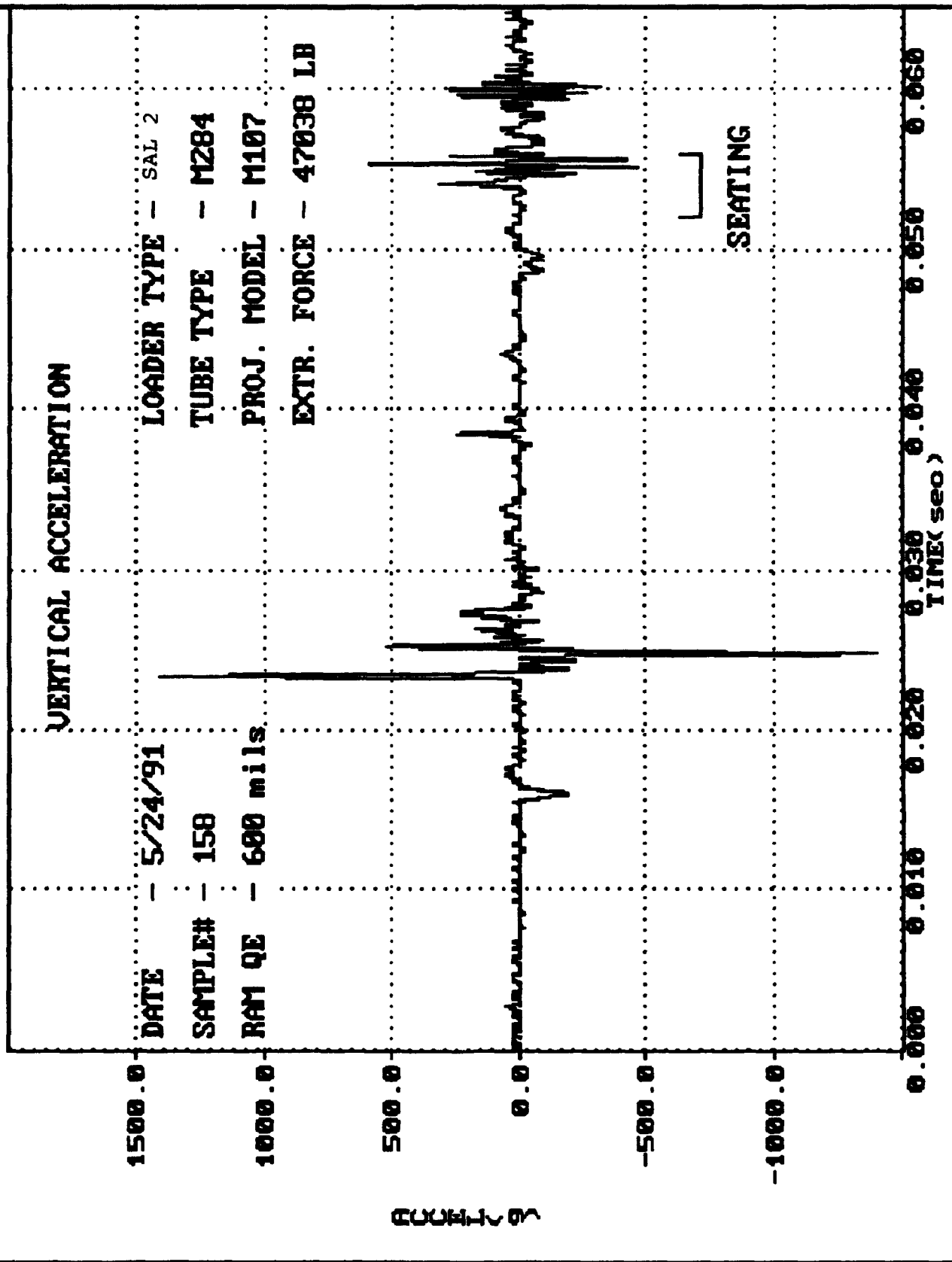
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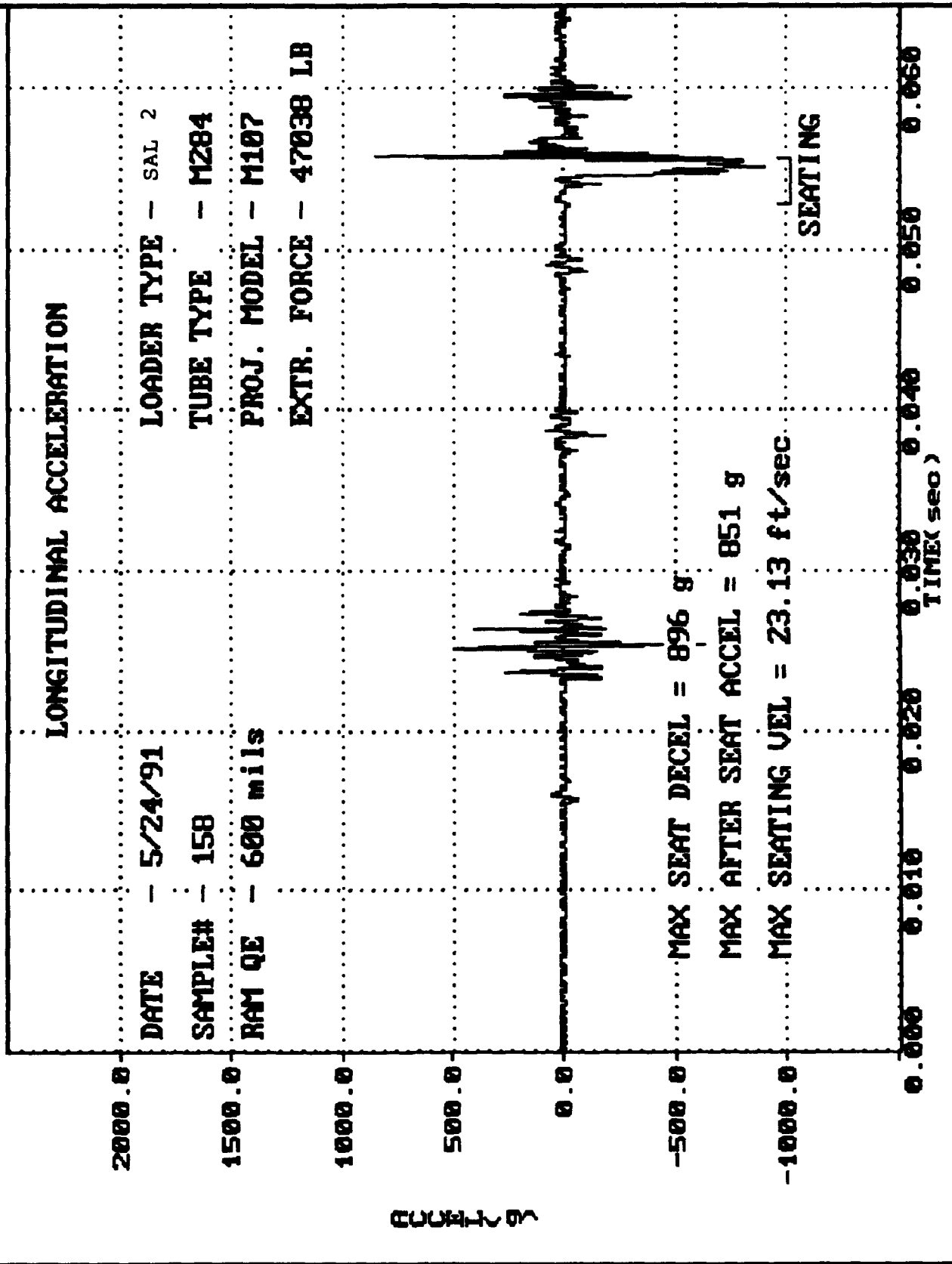
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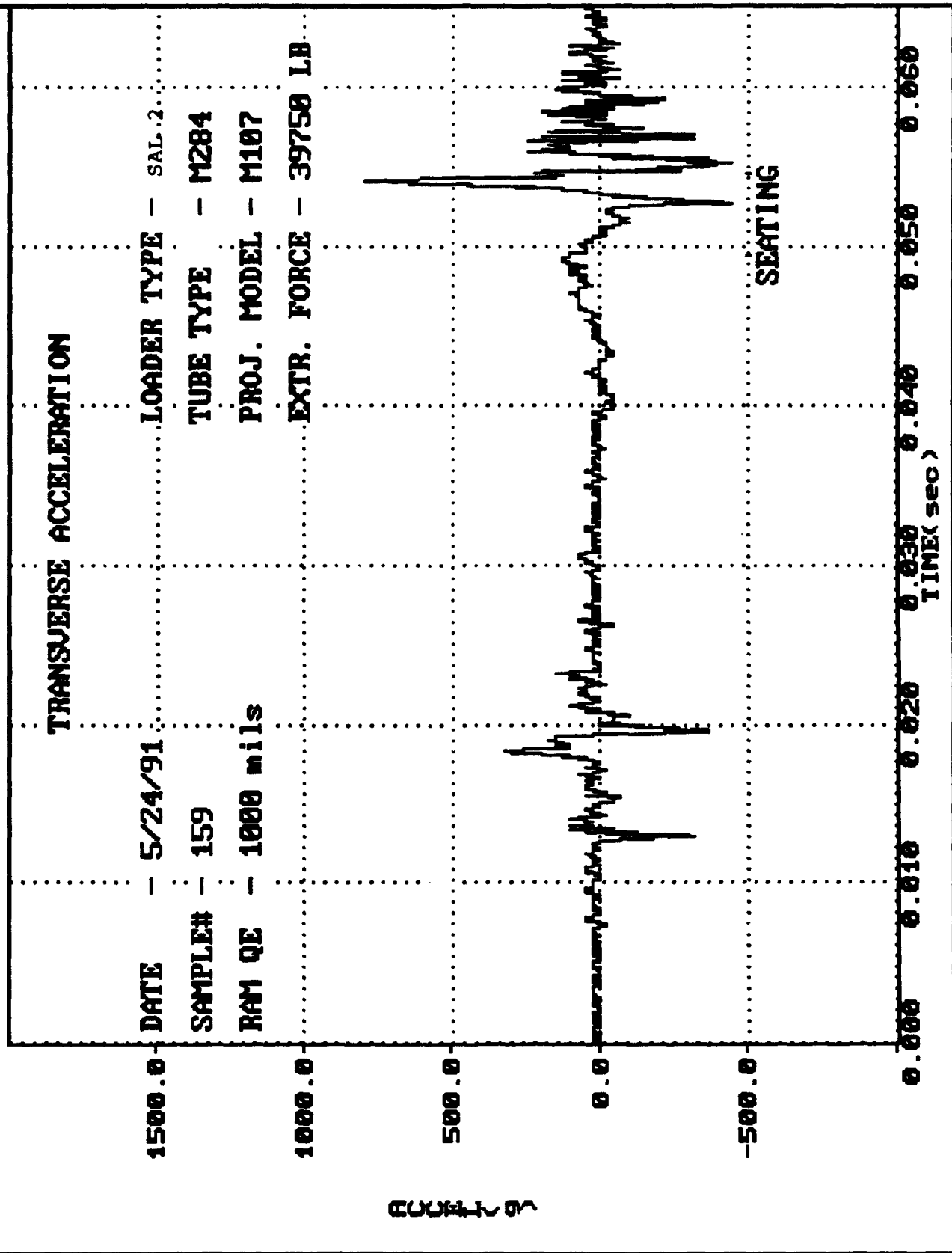
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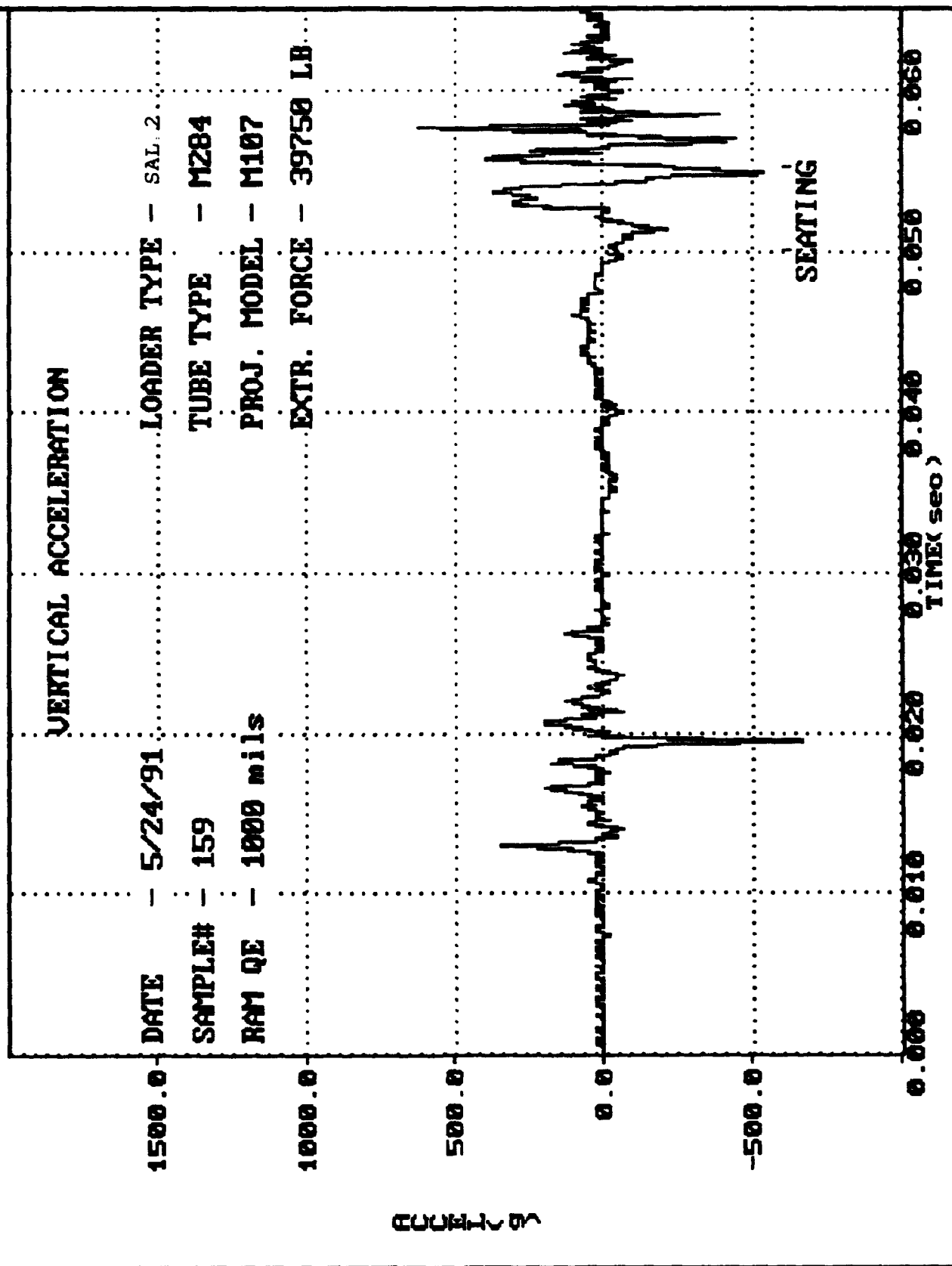
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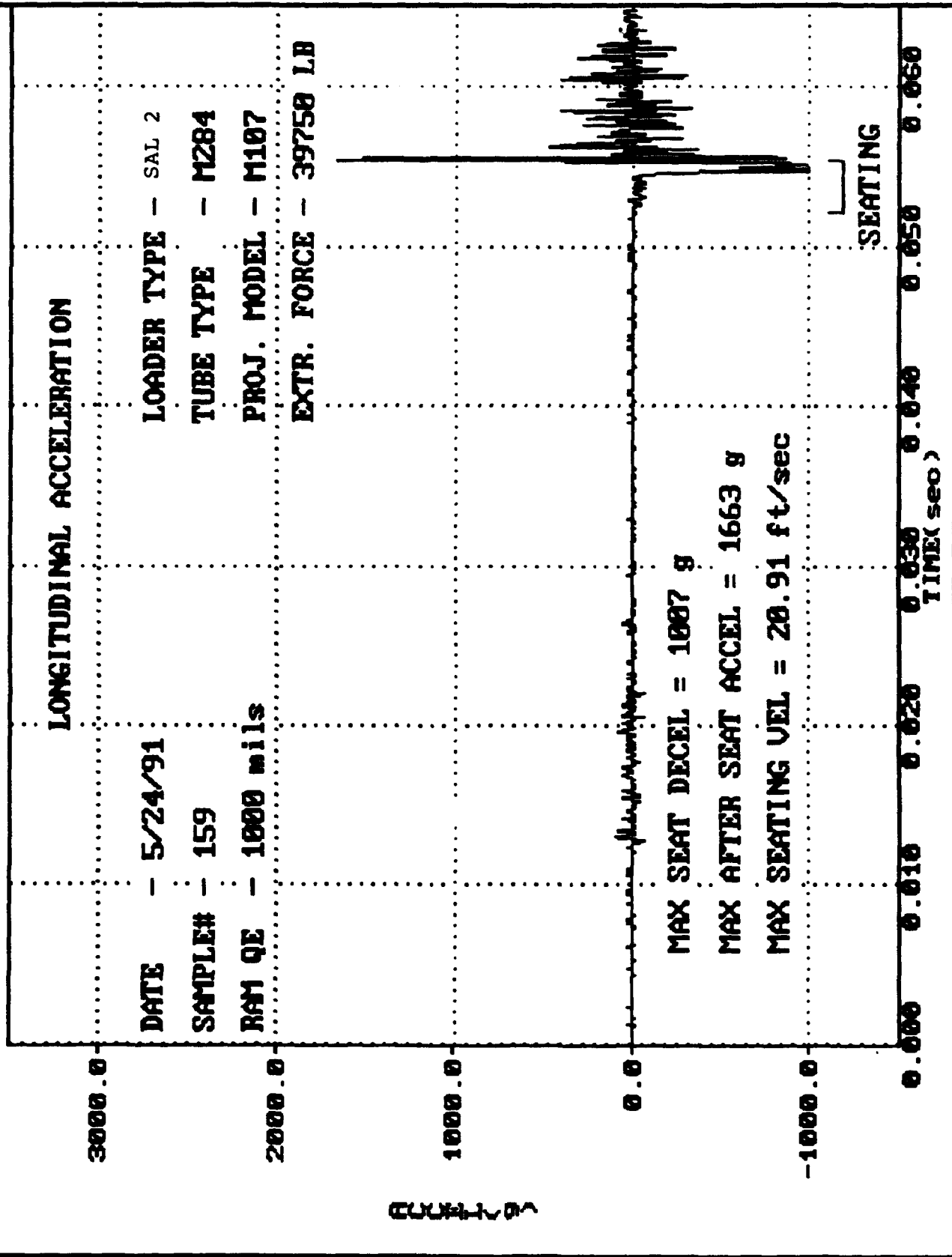
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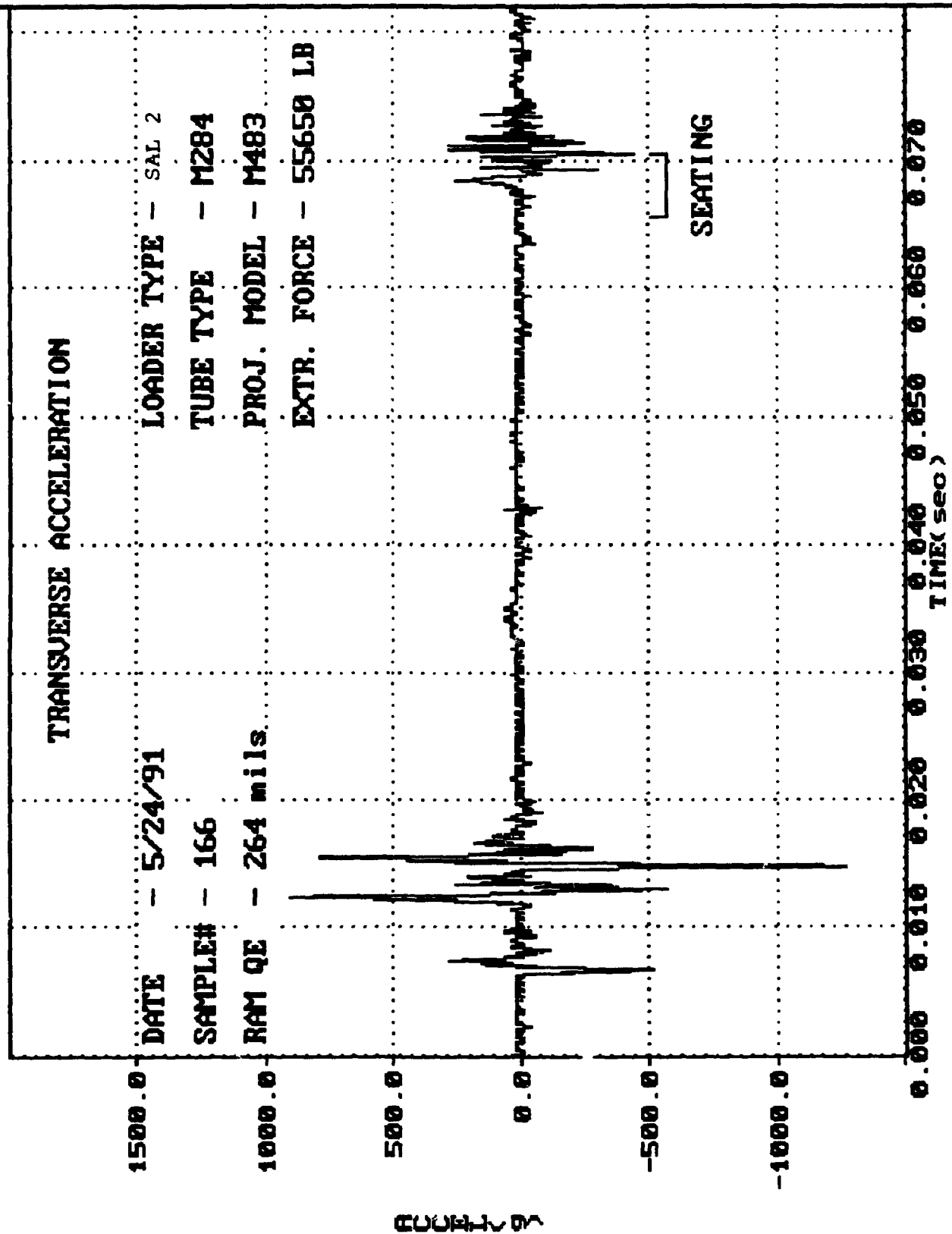
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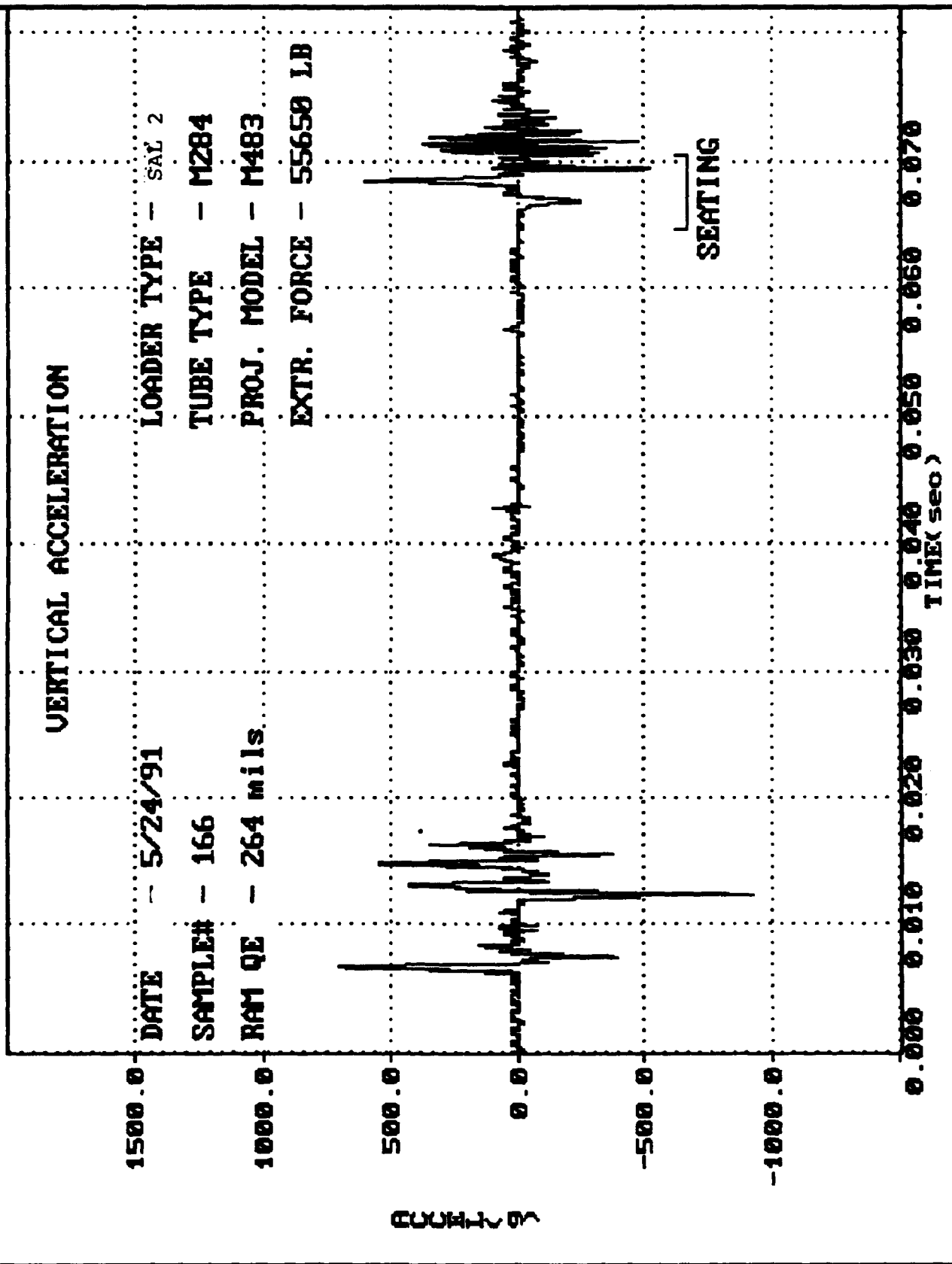
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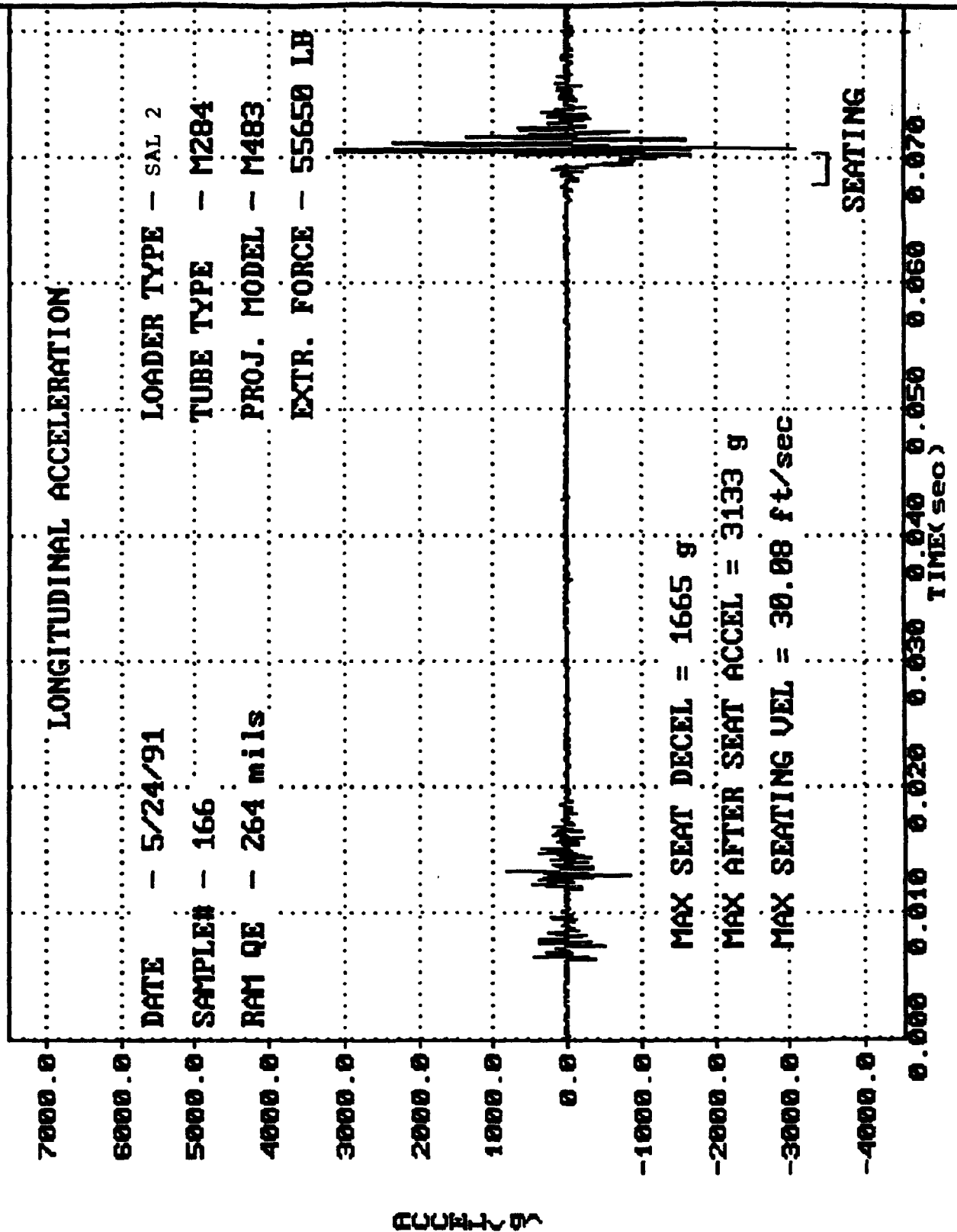
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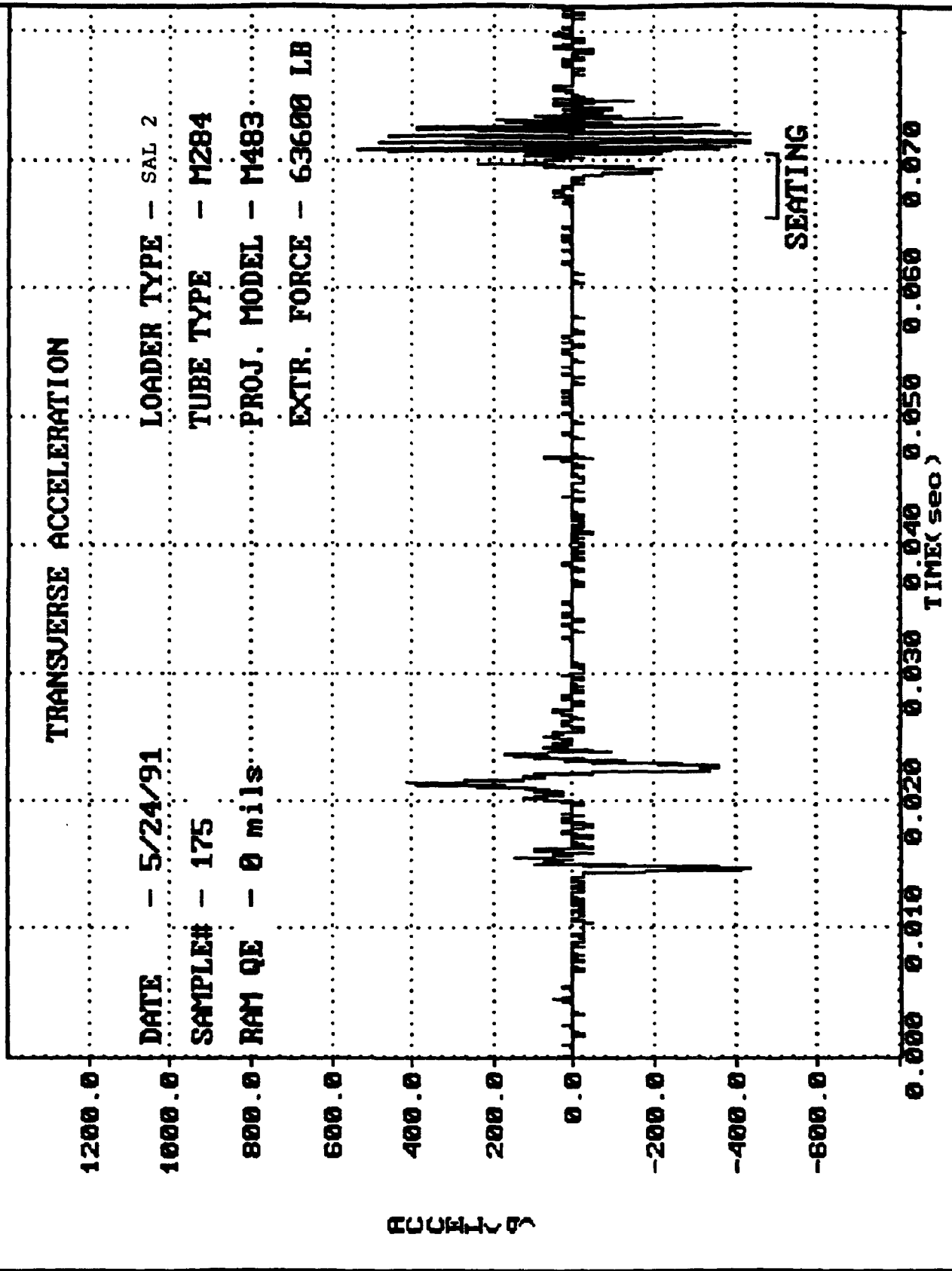
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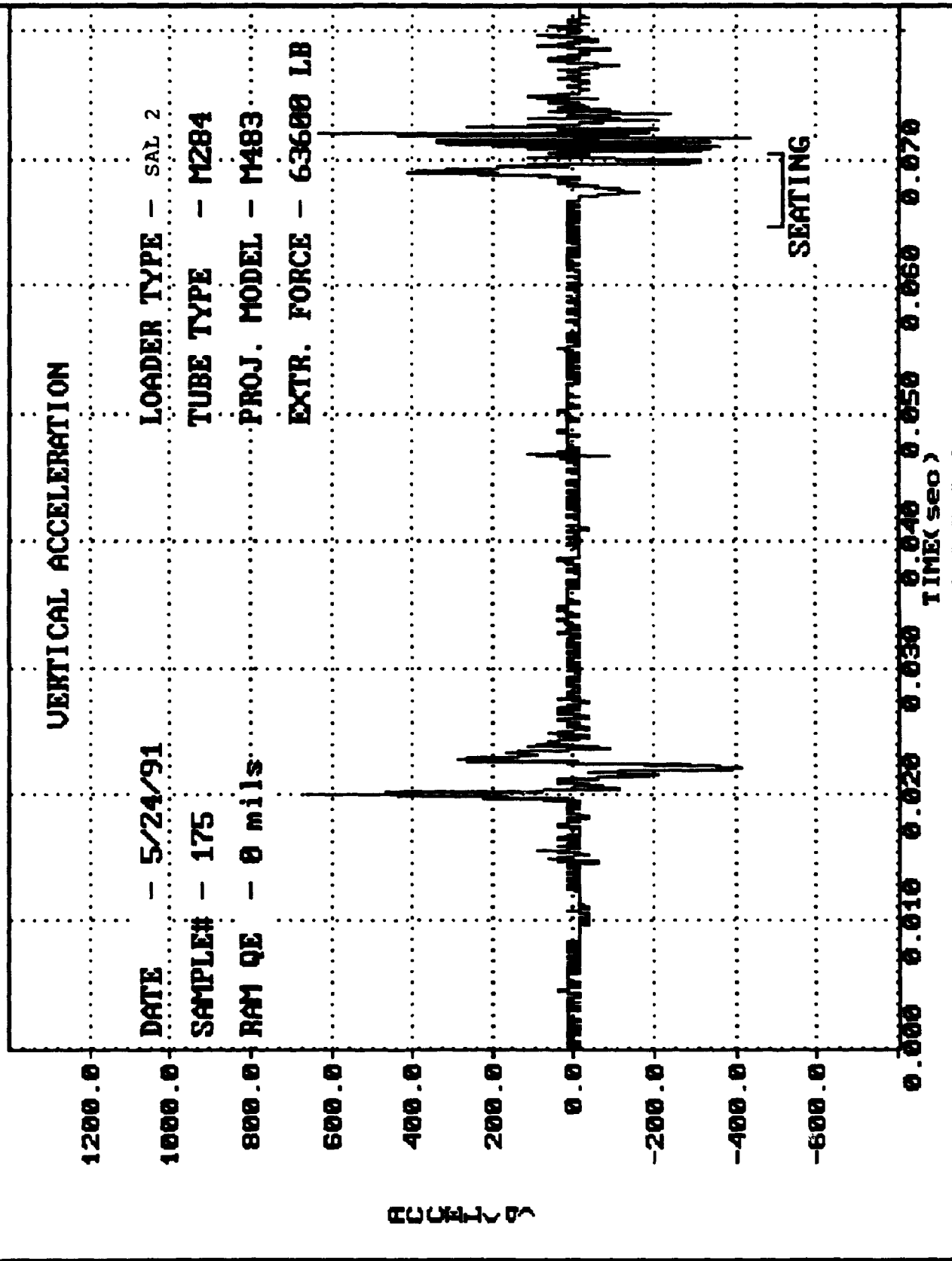
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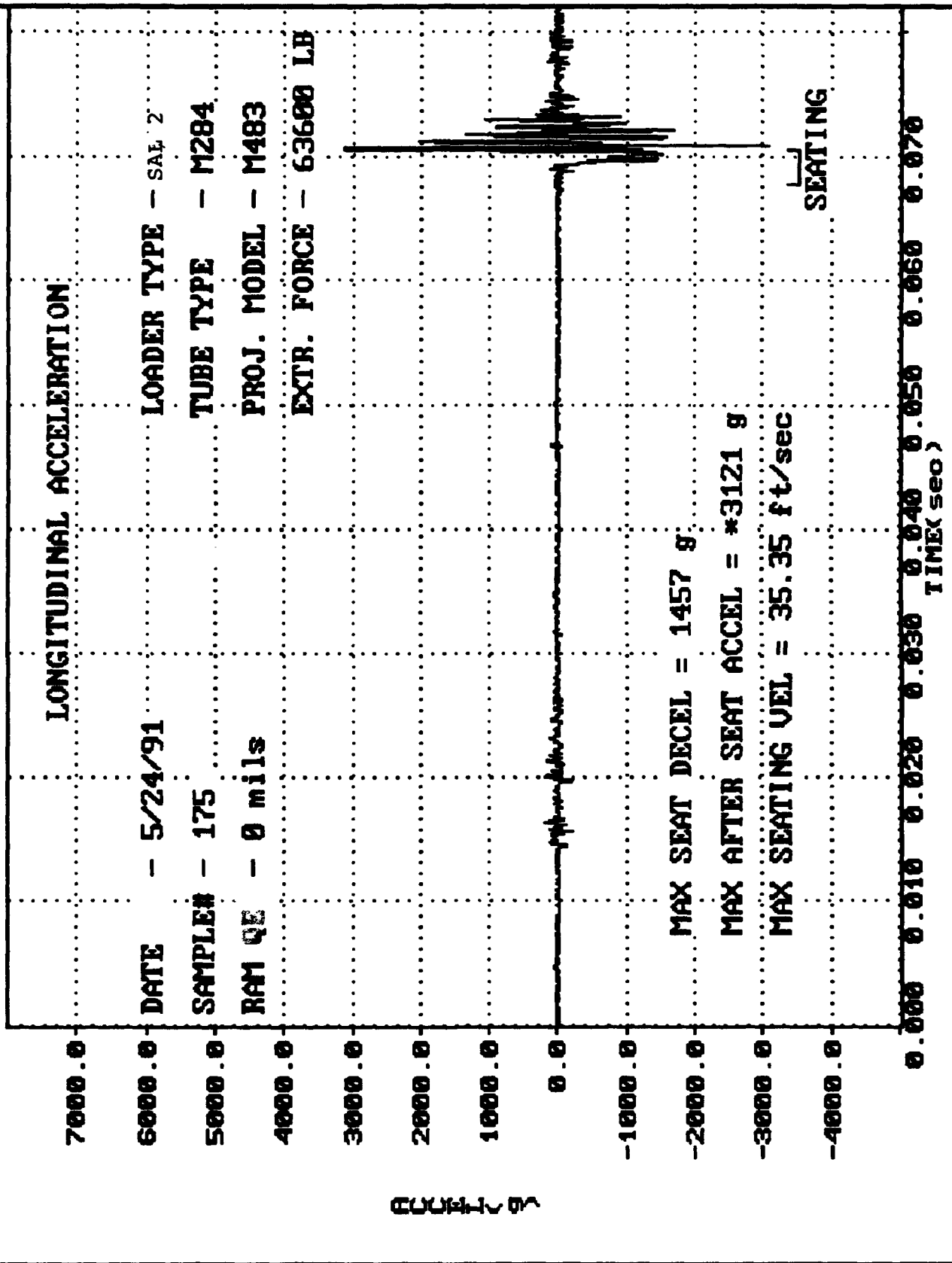
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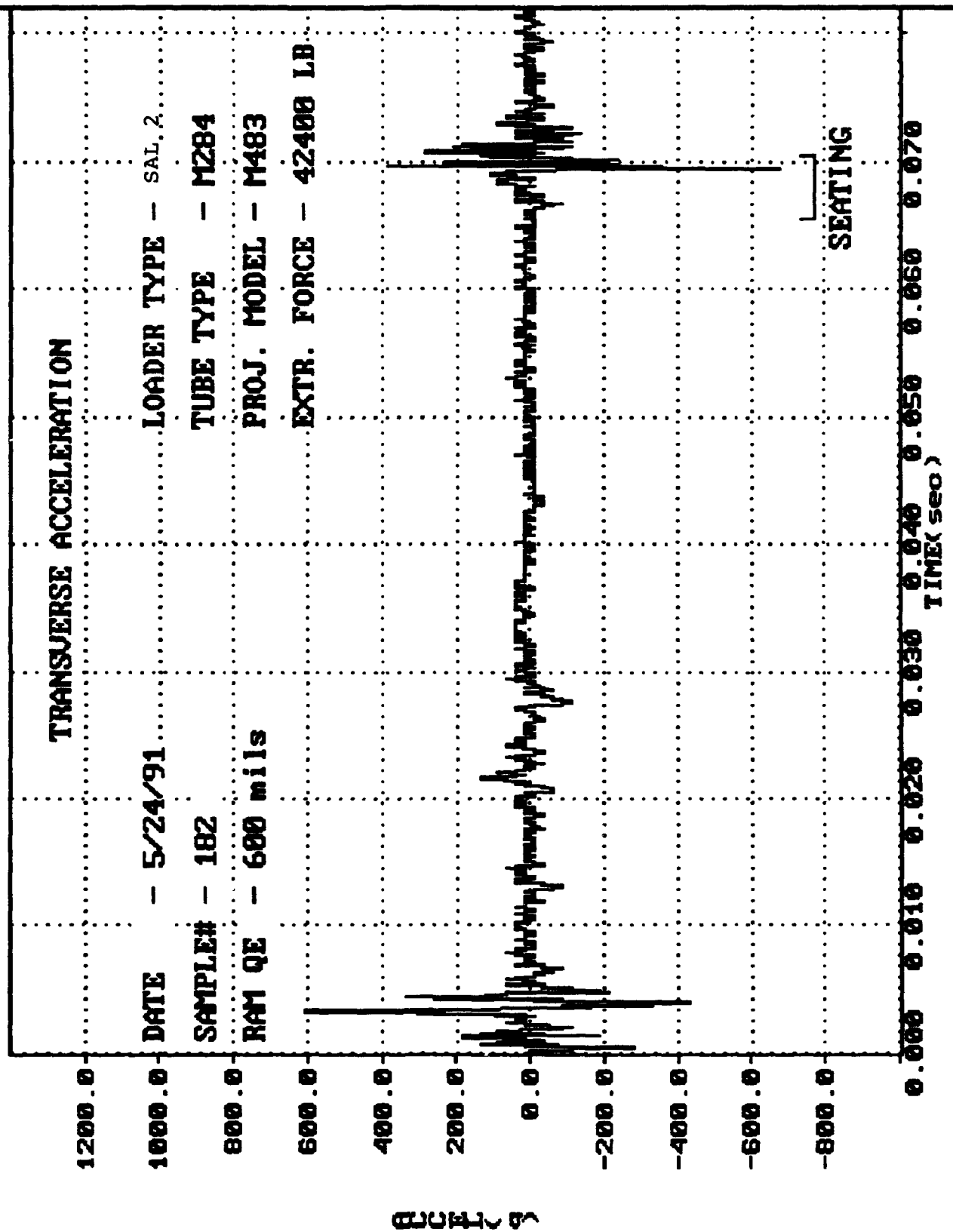
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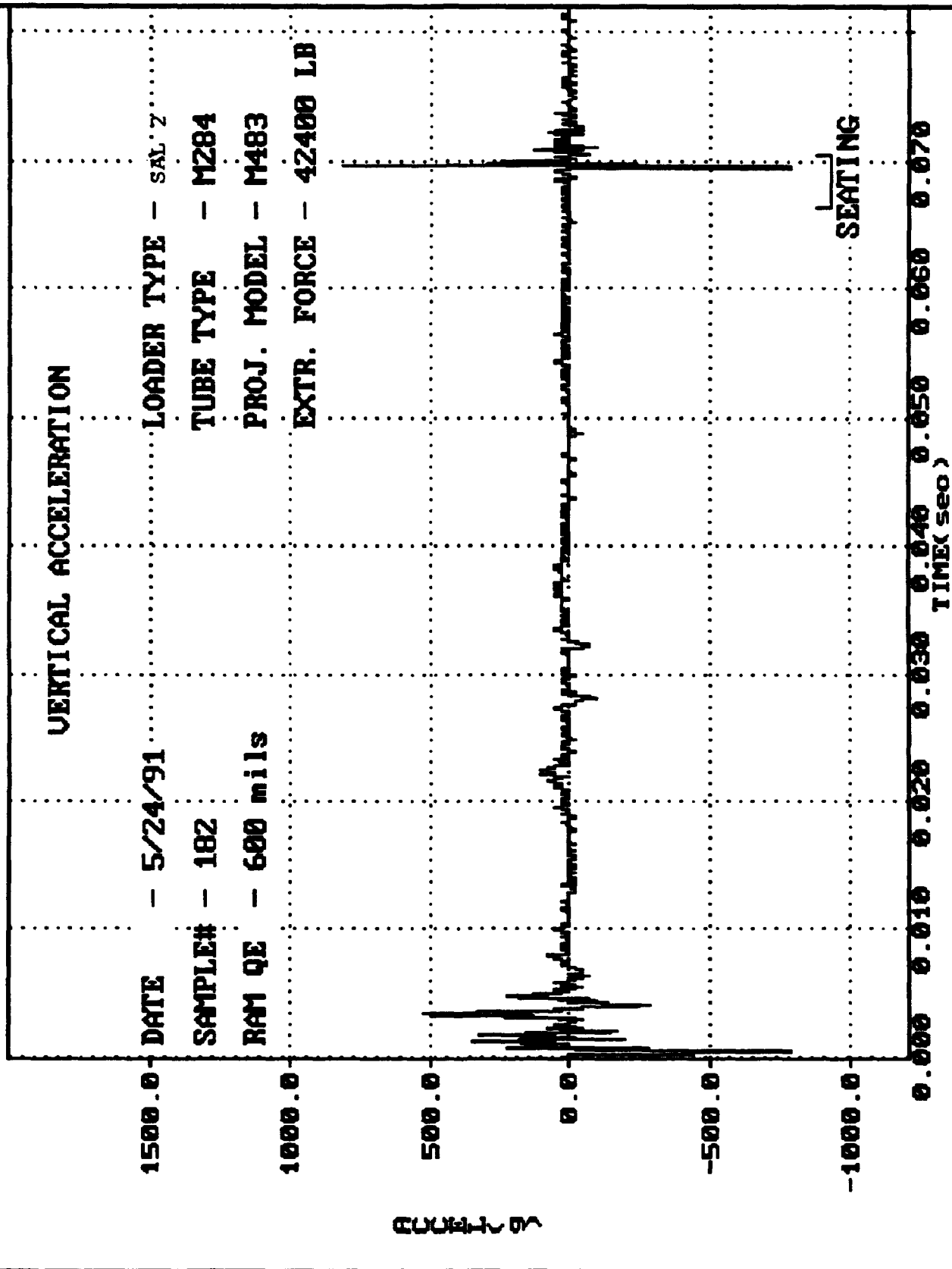
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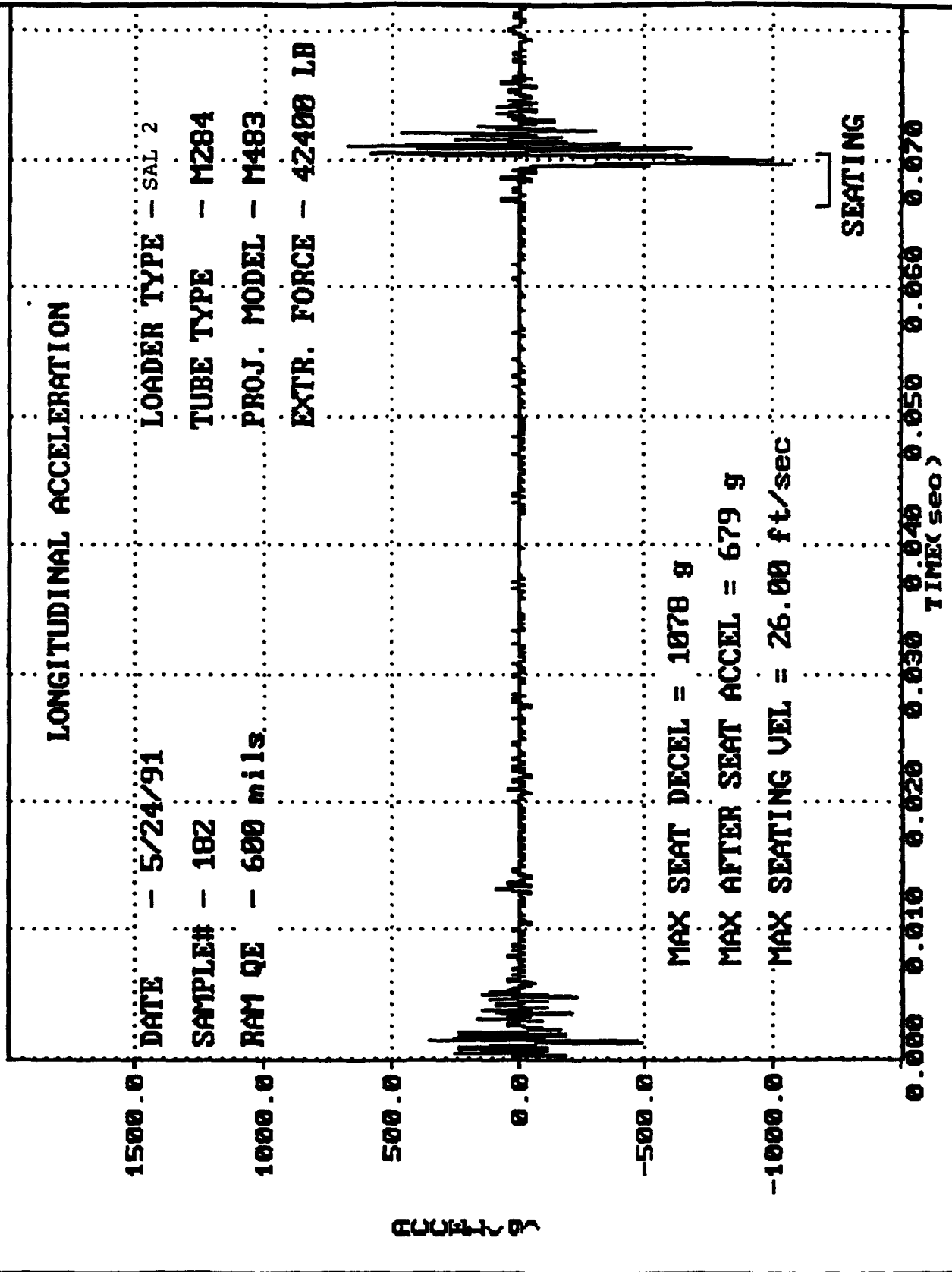
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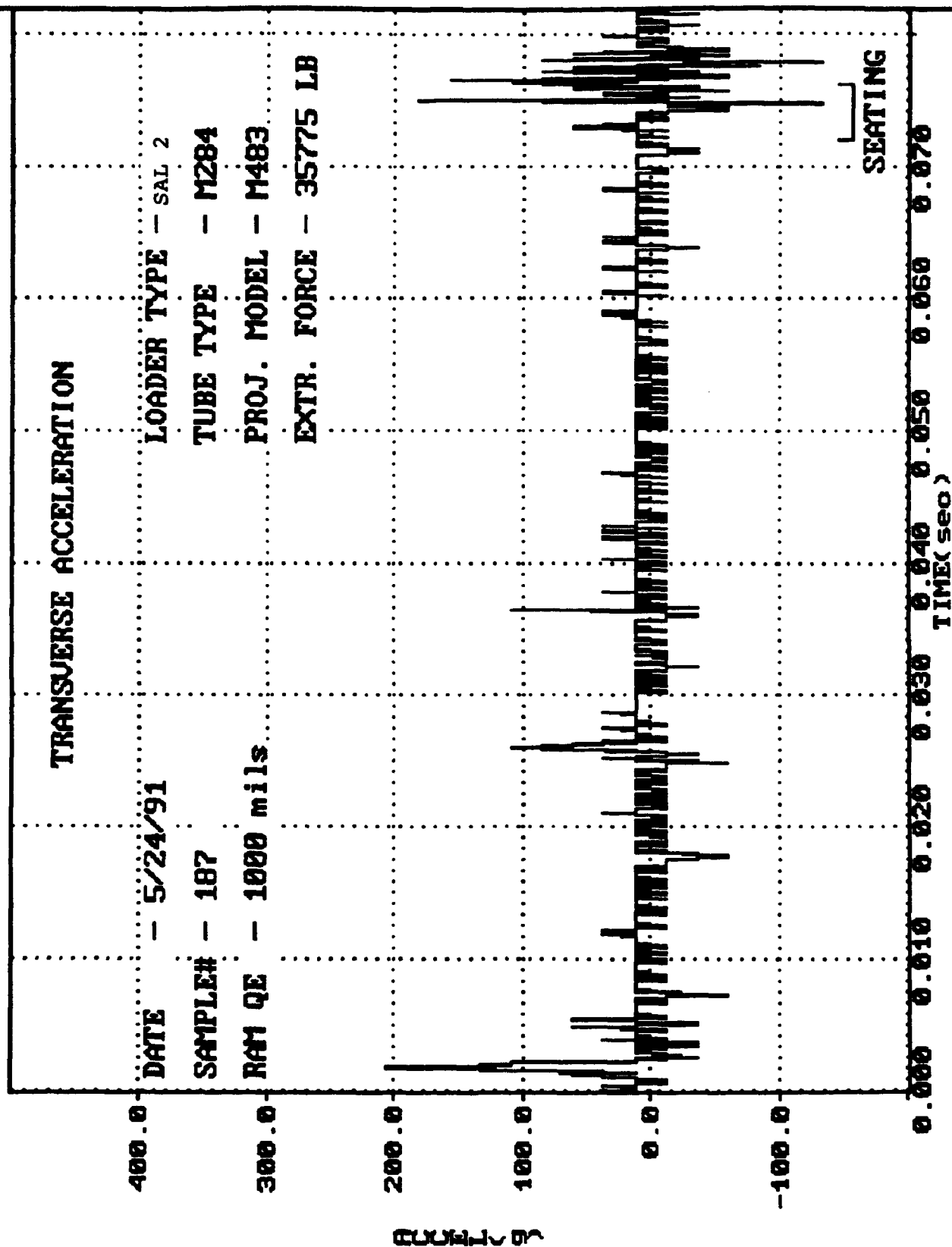
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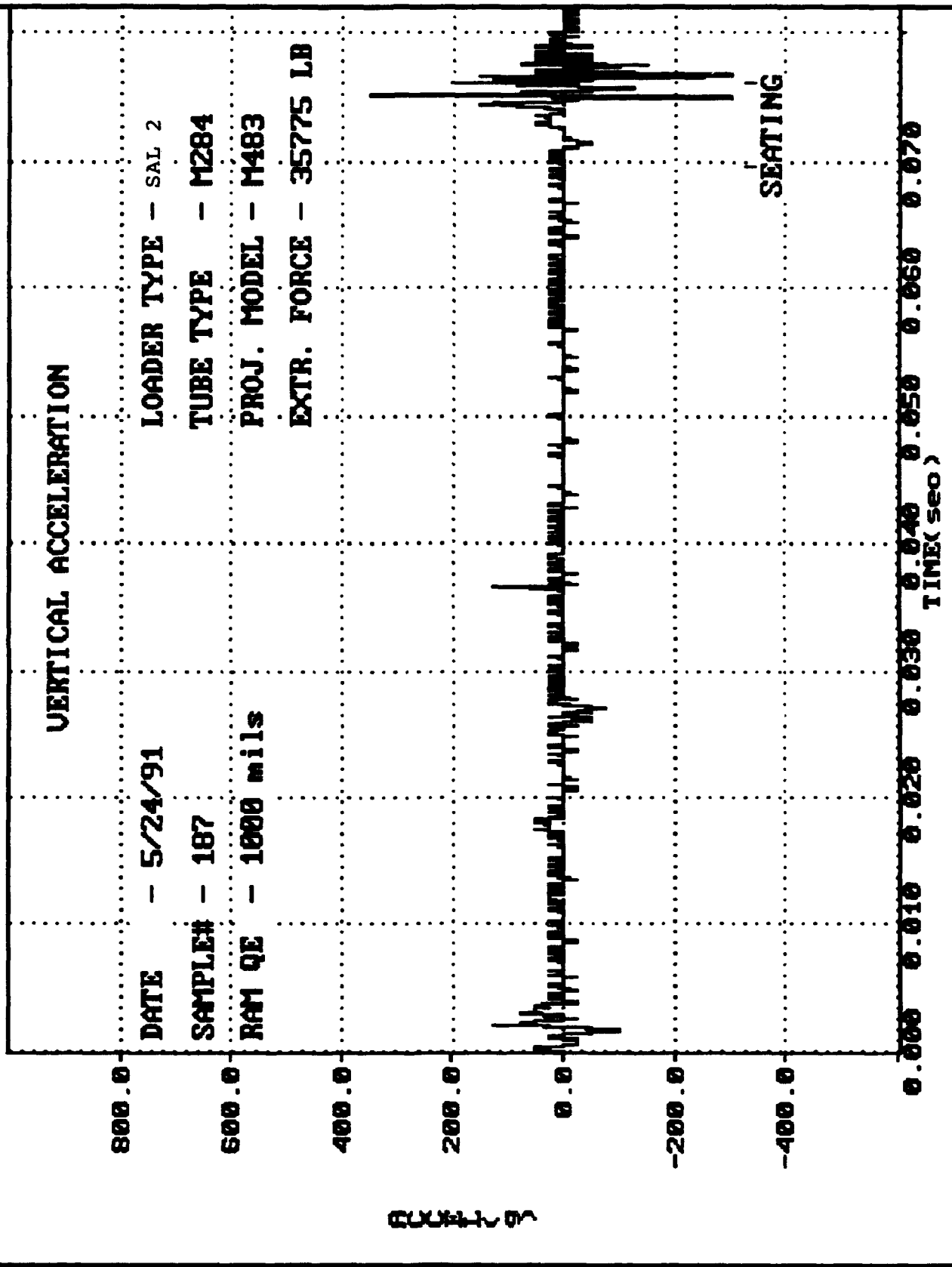
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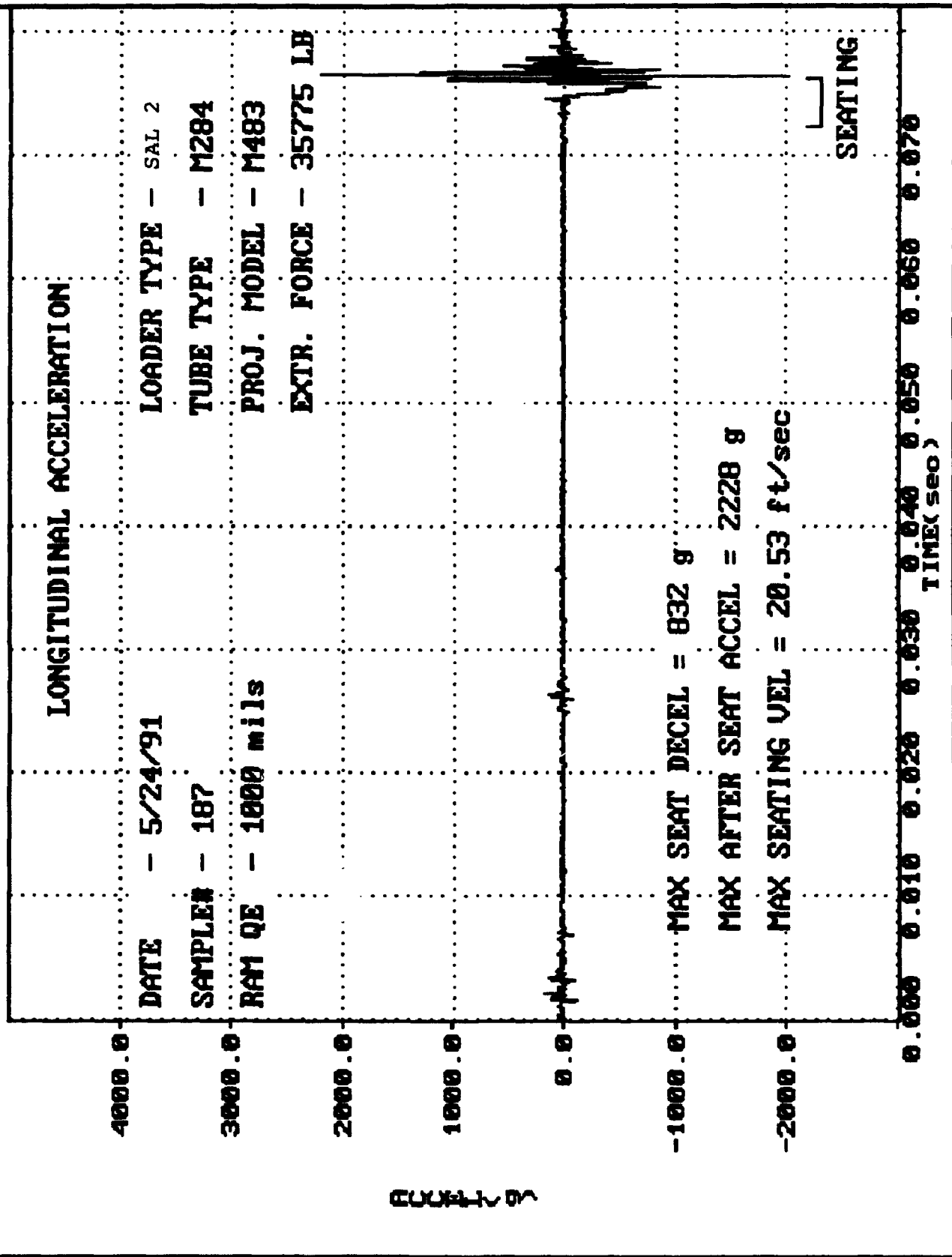
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FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

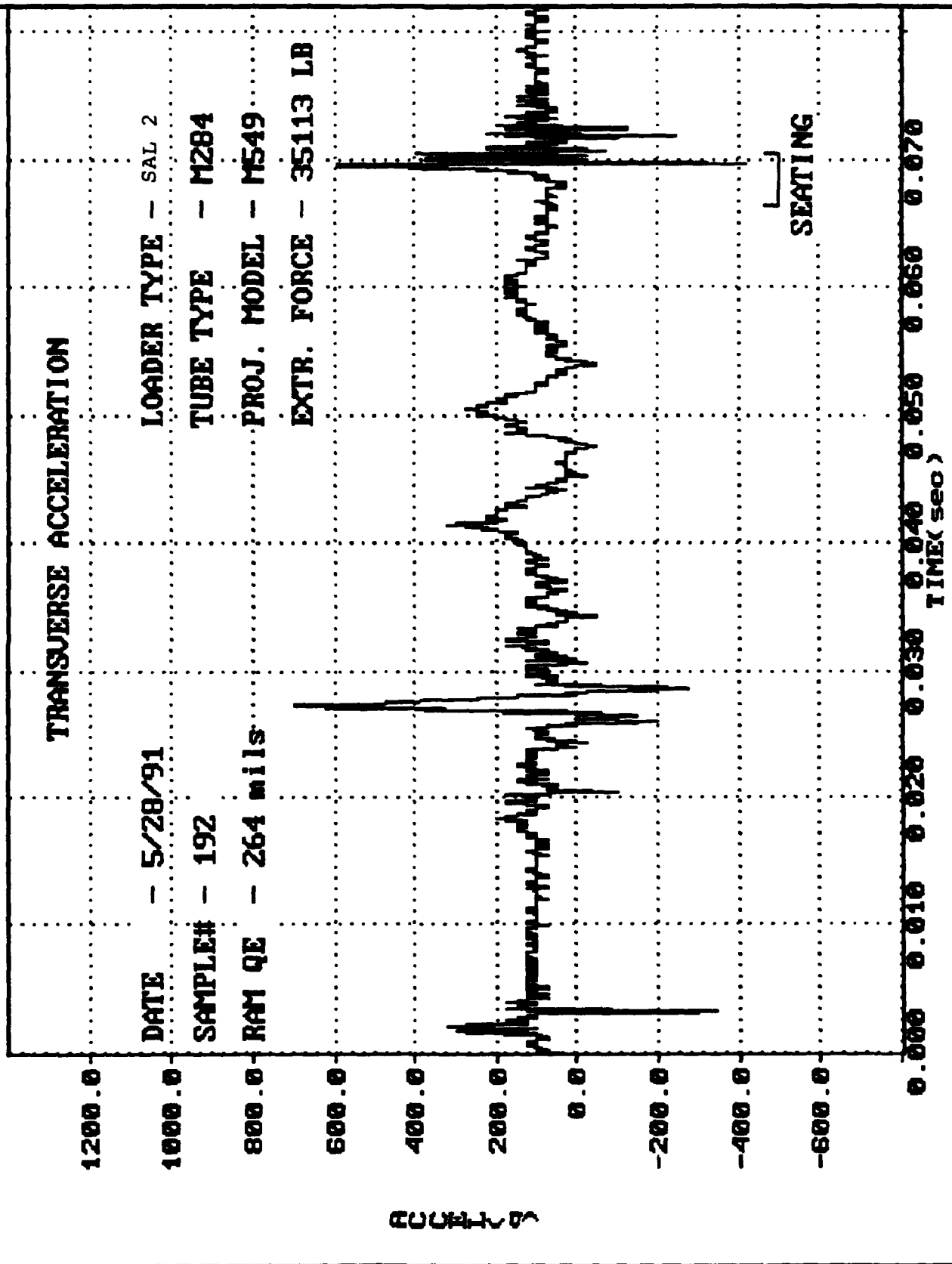


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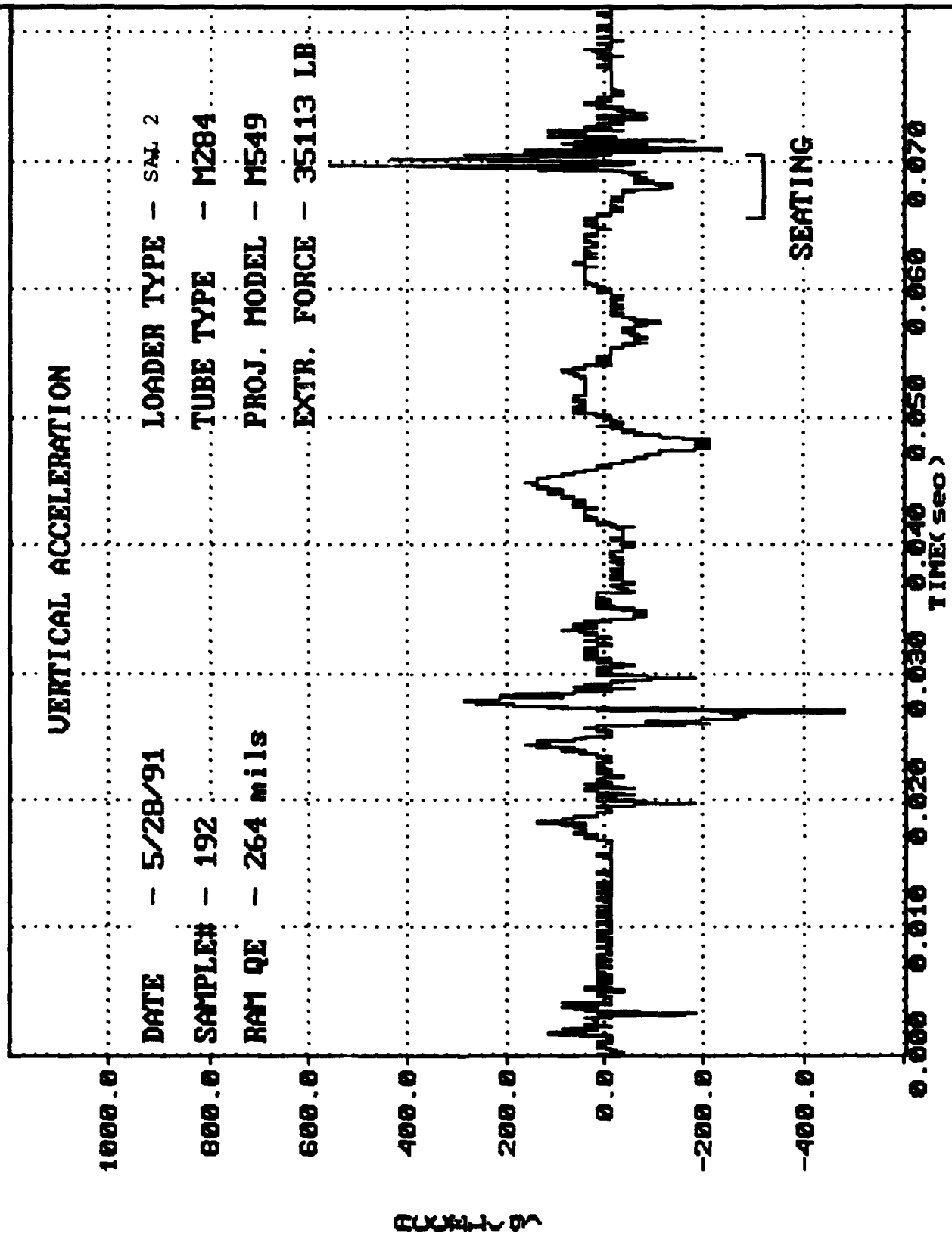


BUCKLE 3

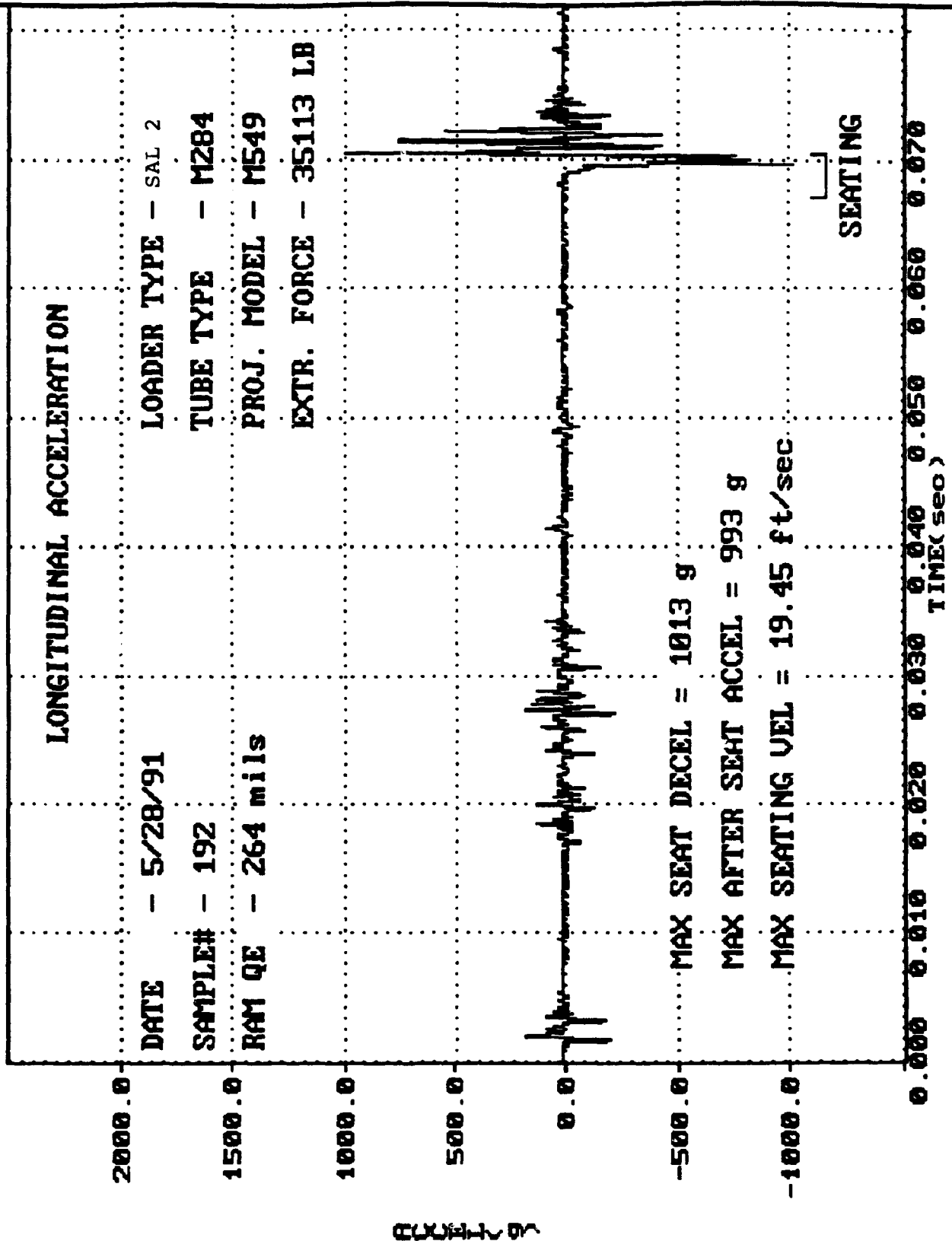
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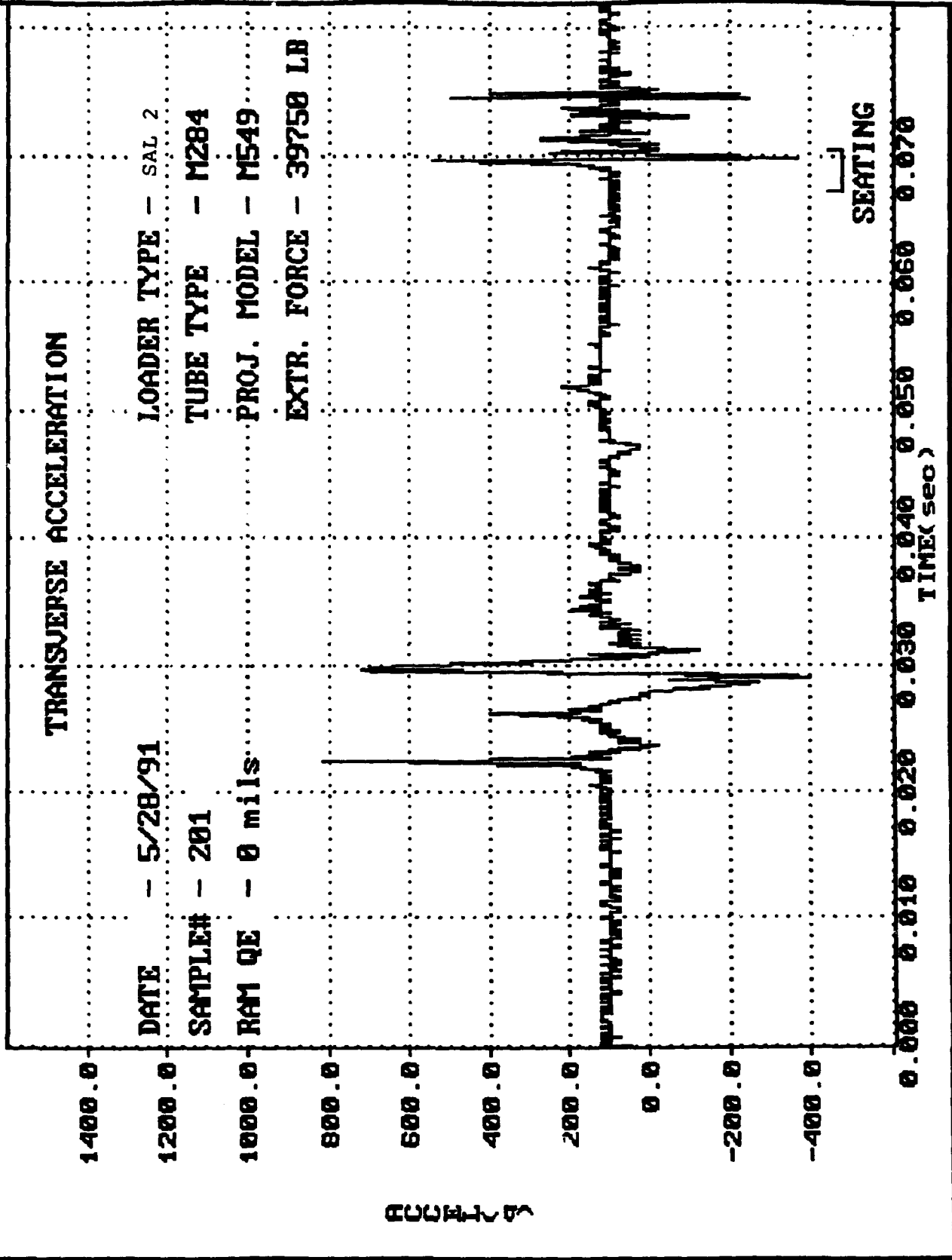
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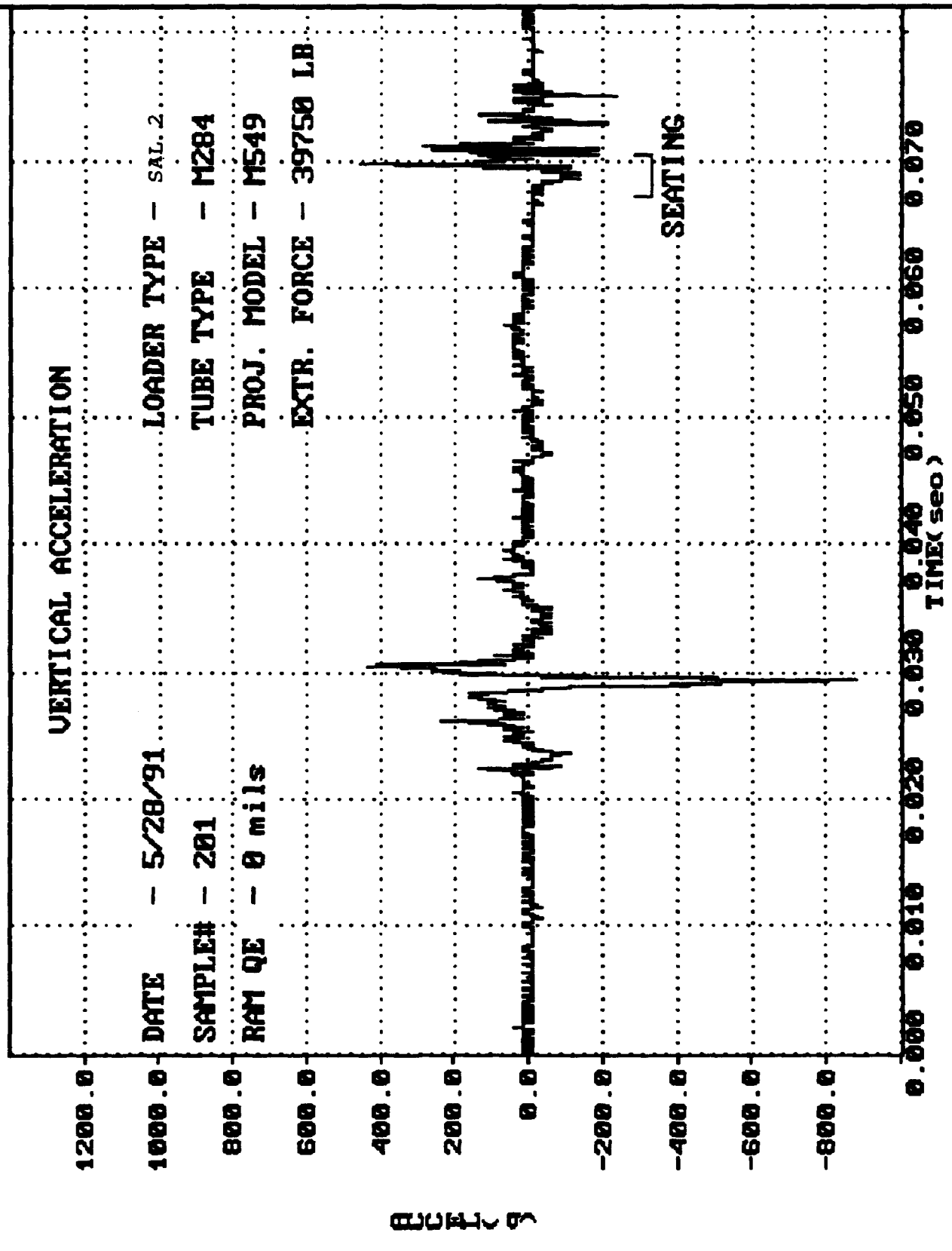
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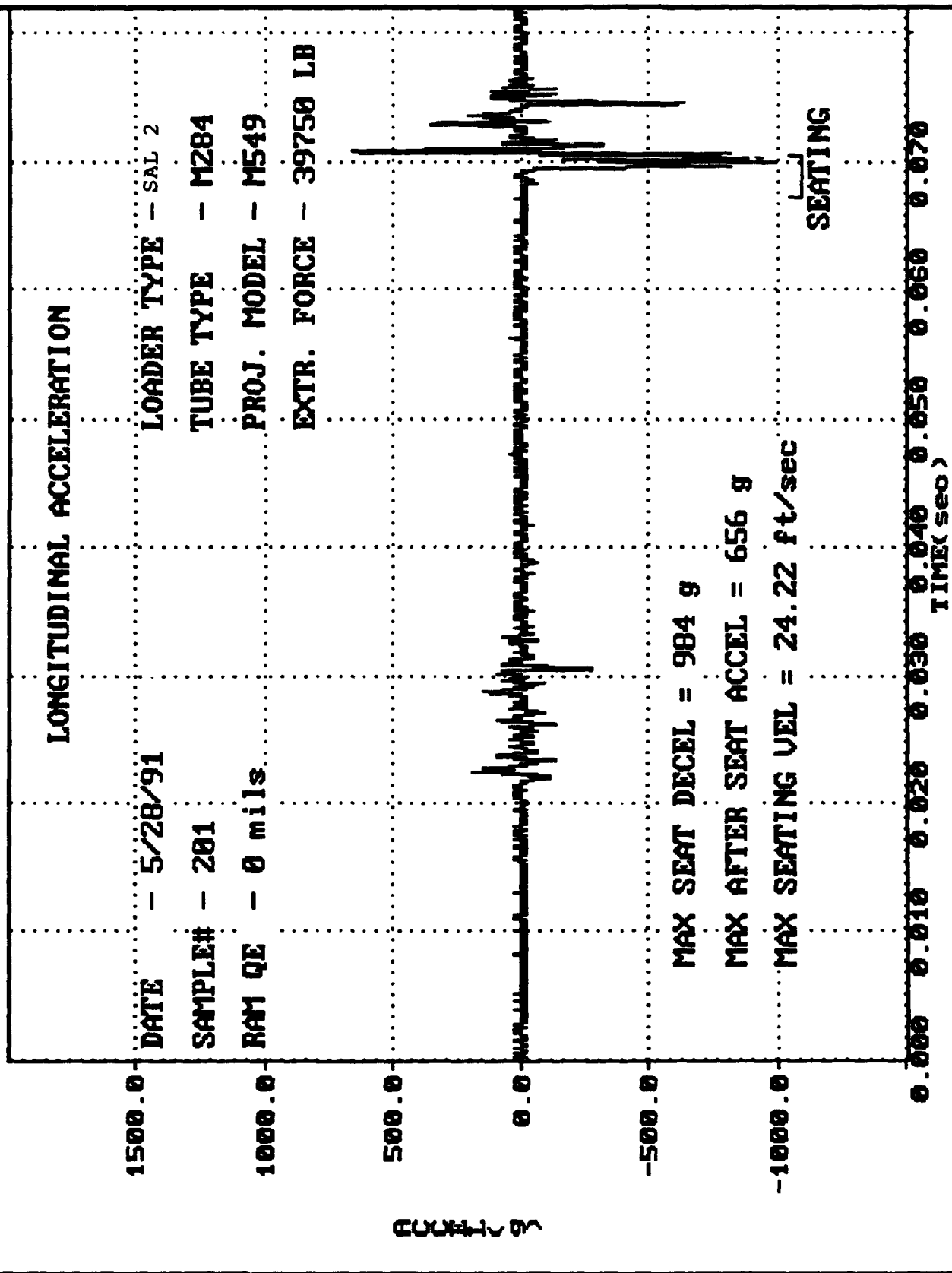
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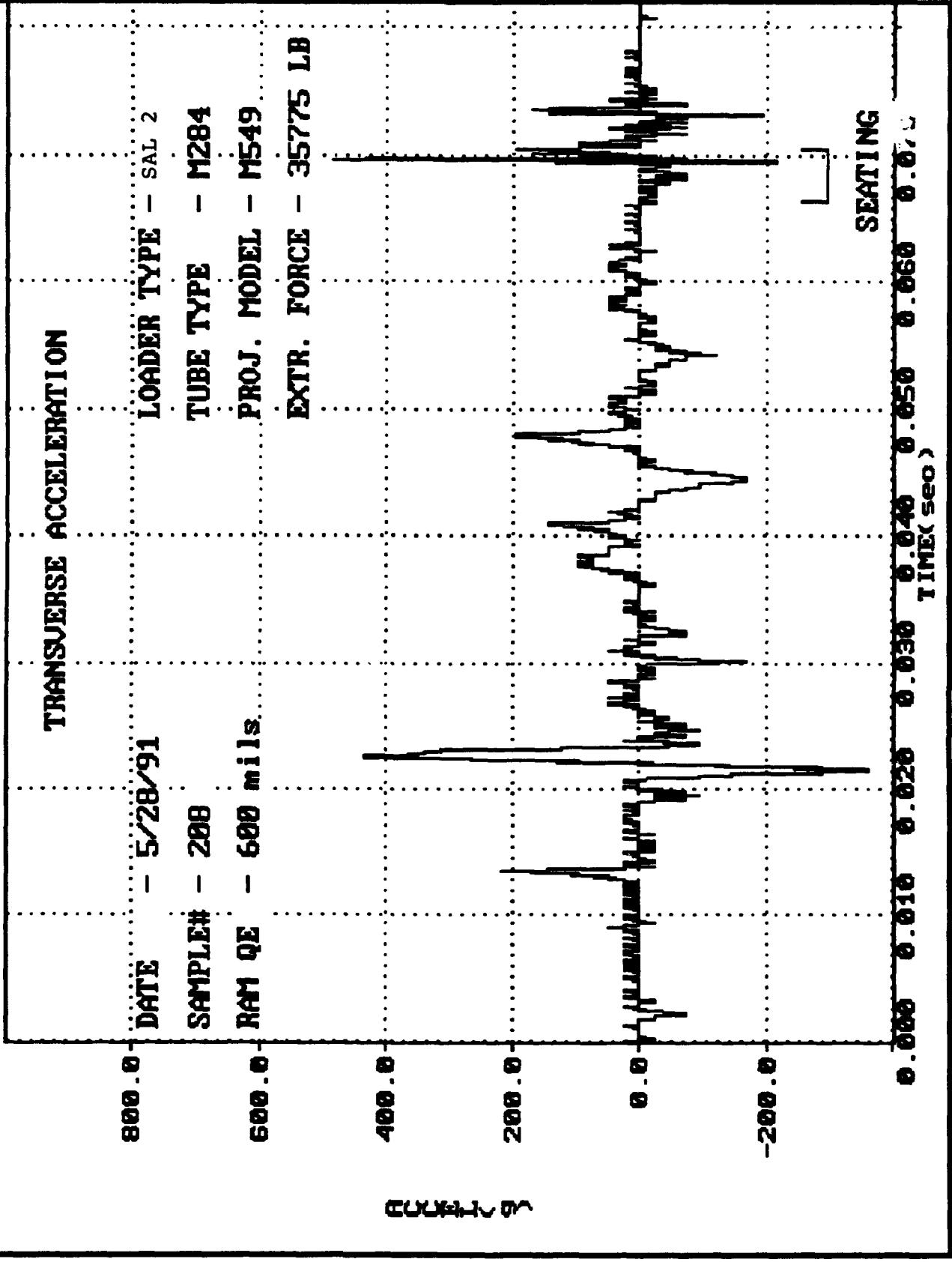
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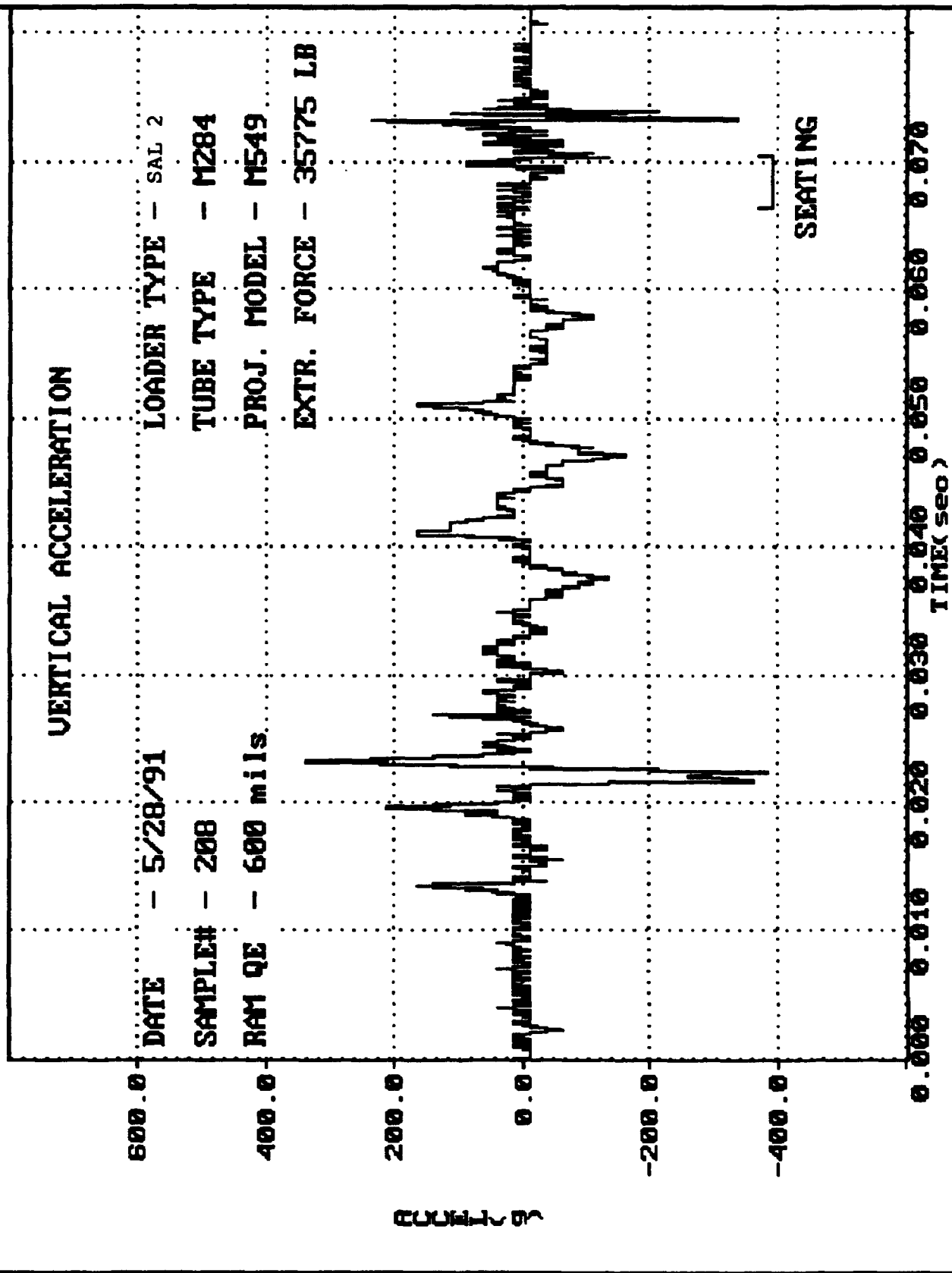
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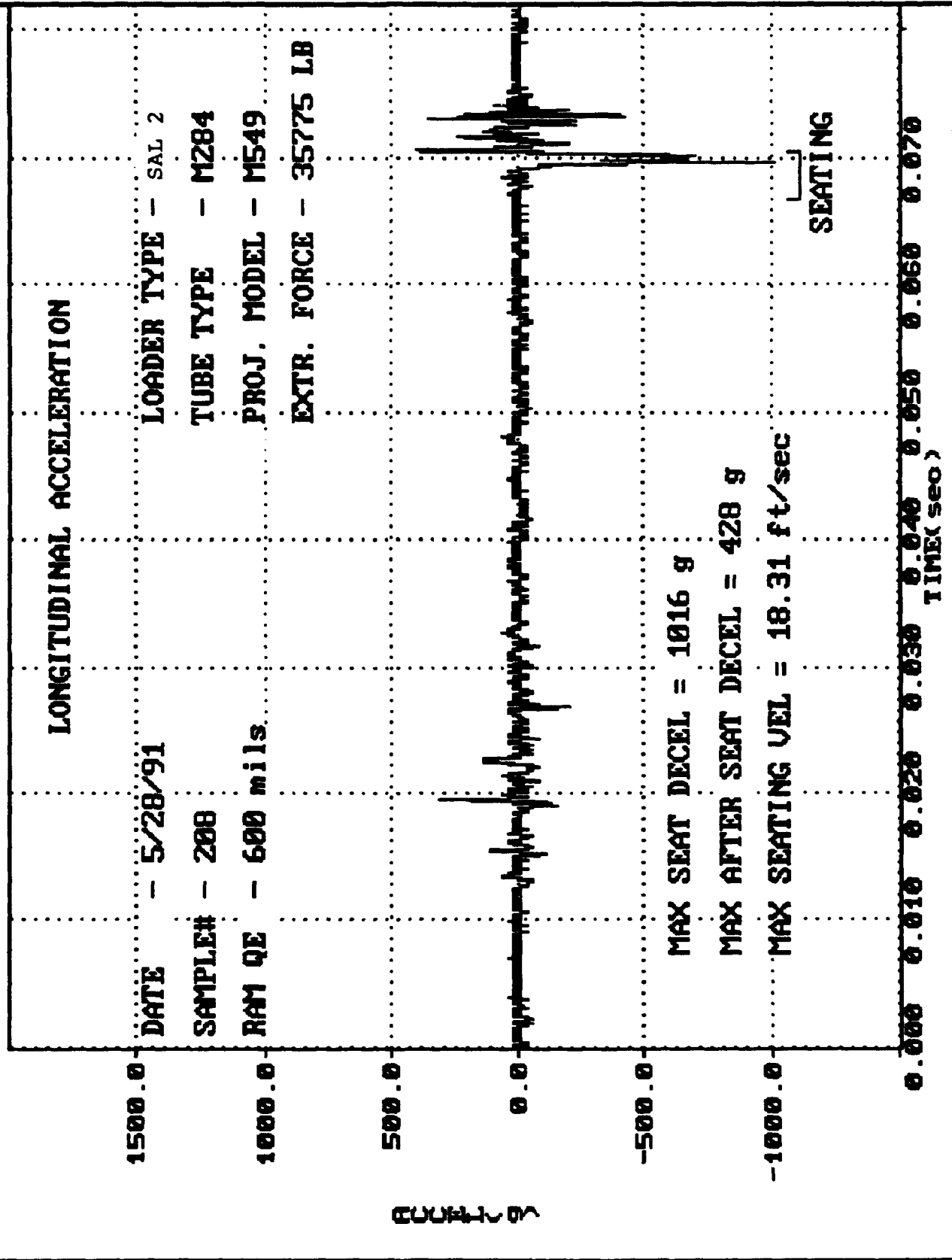
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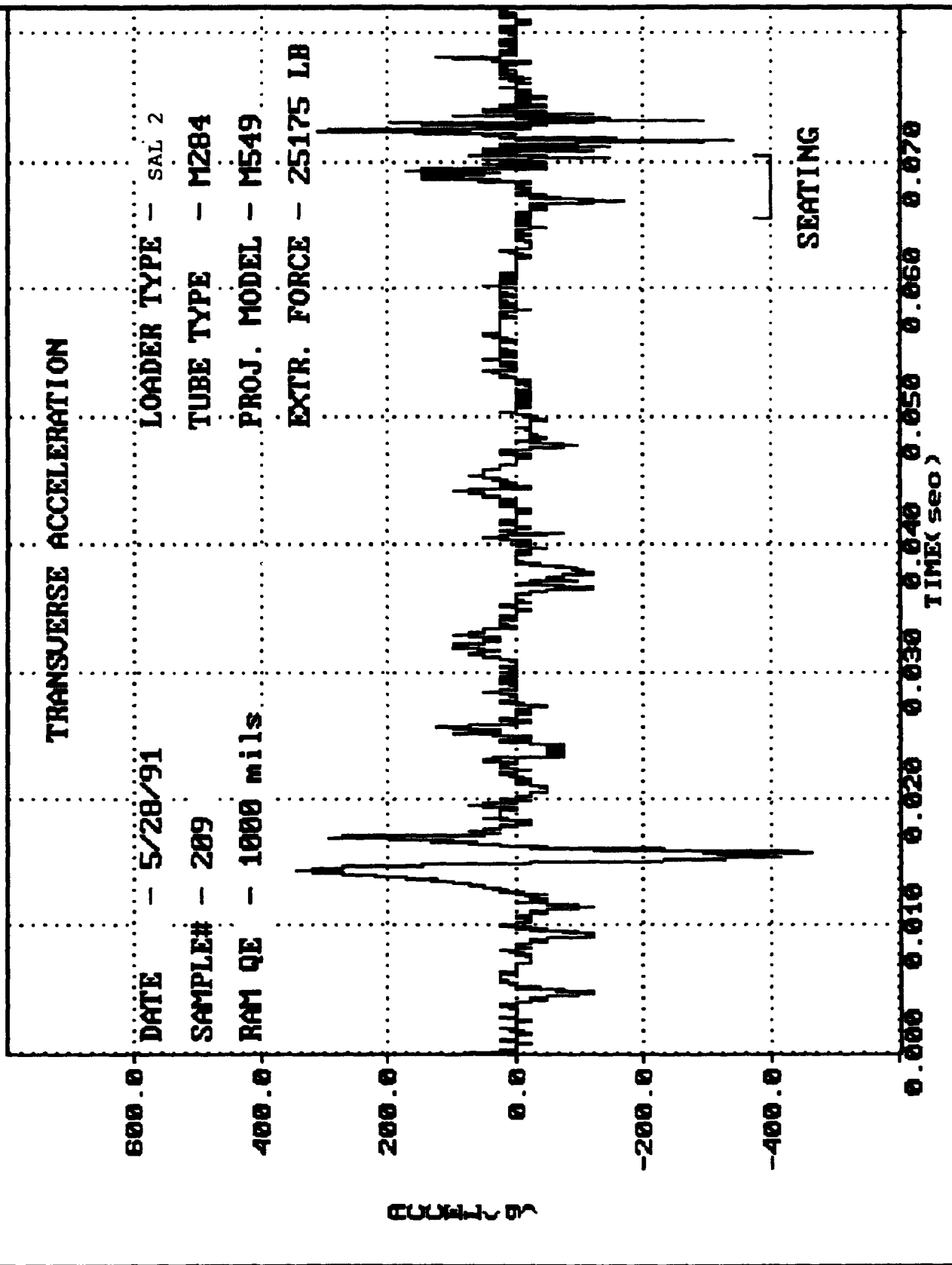
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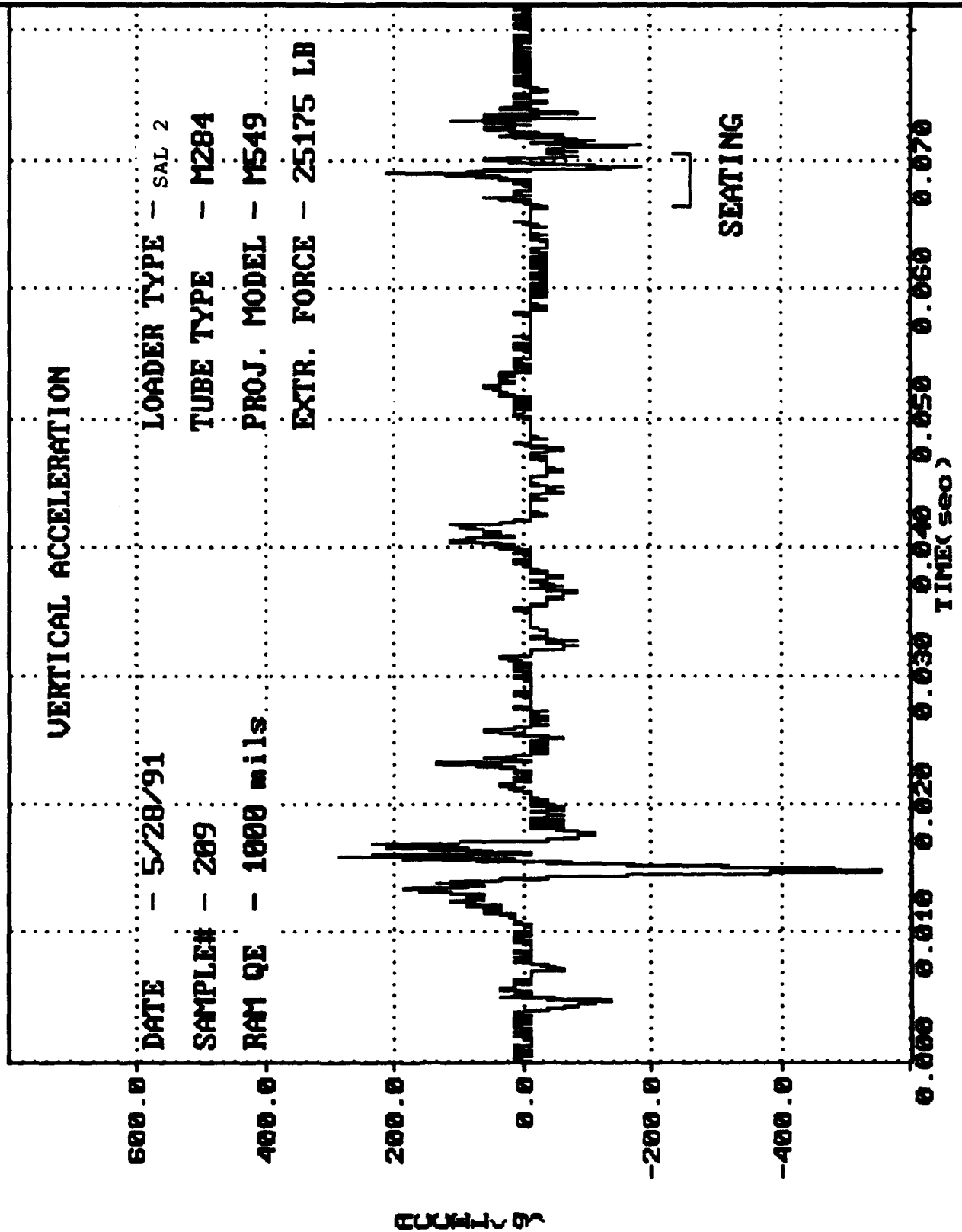
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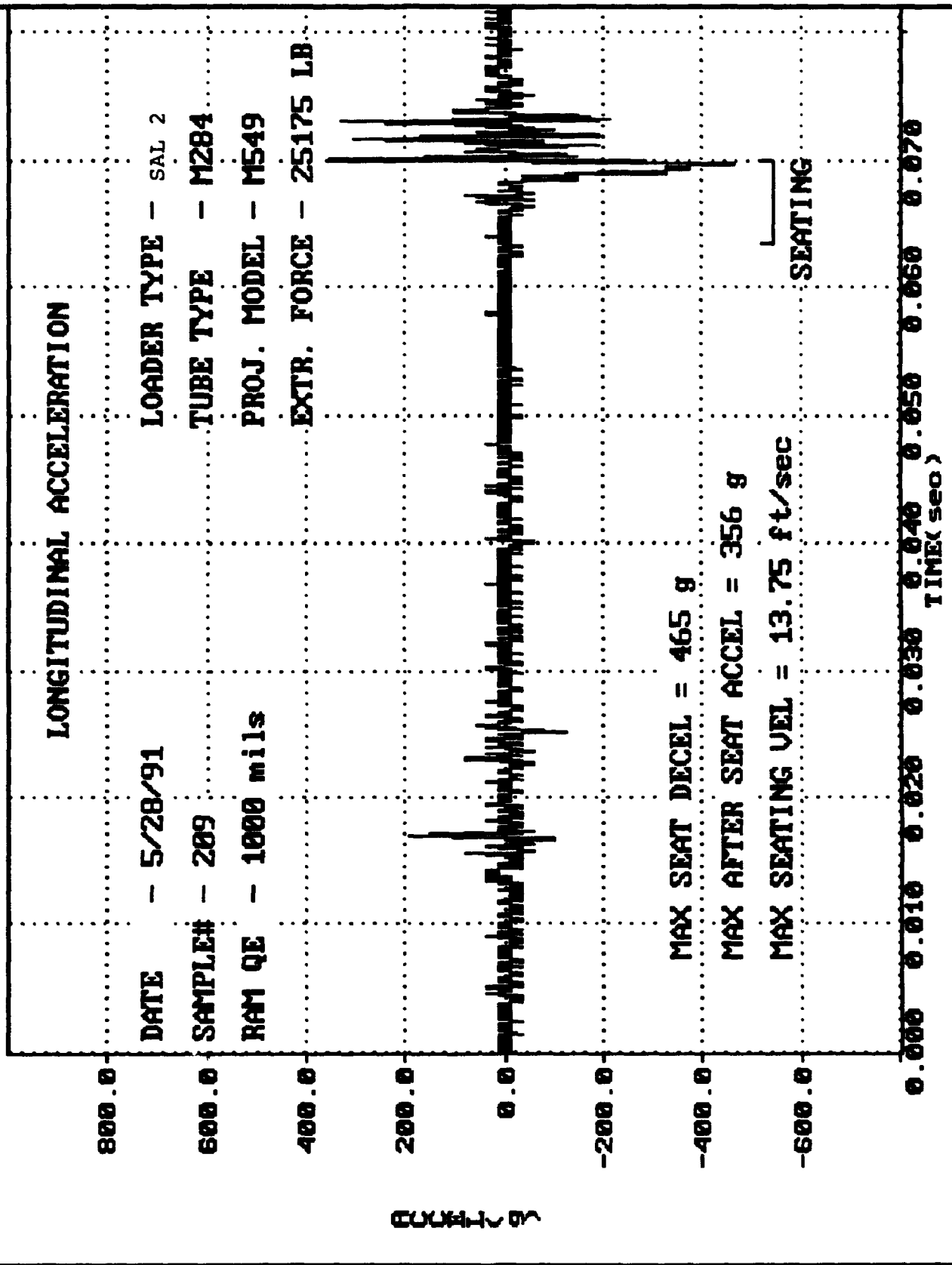
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FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



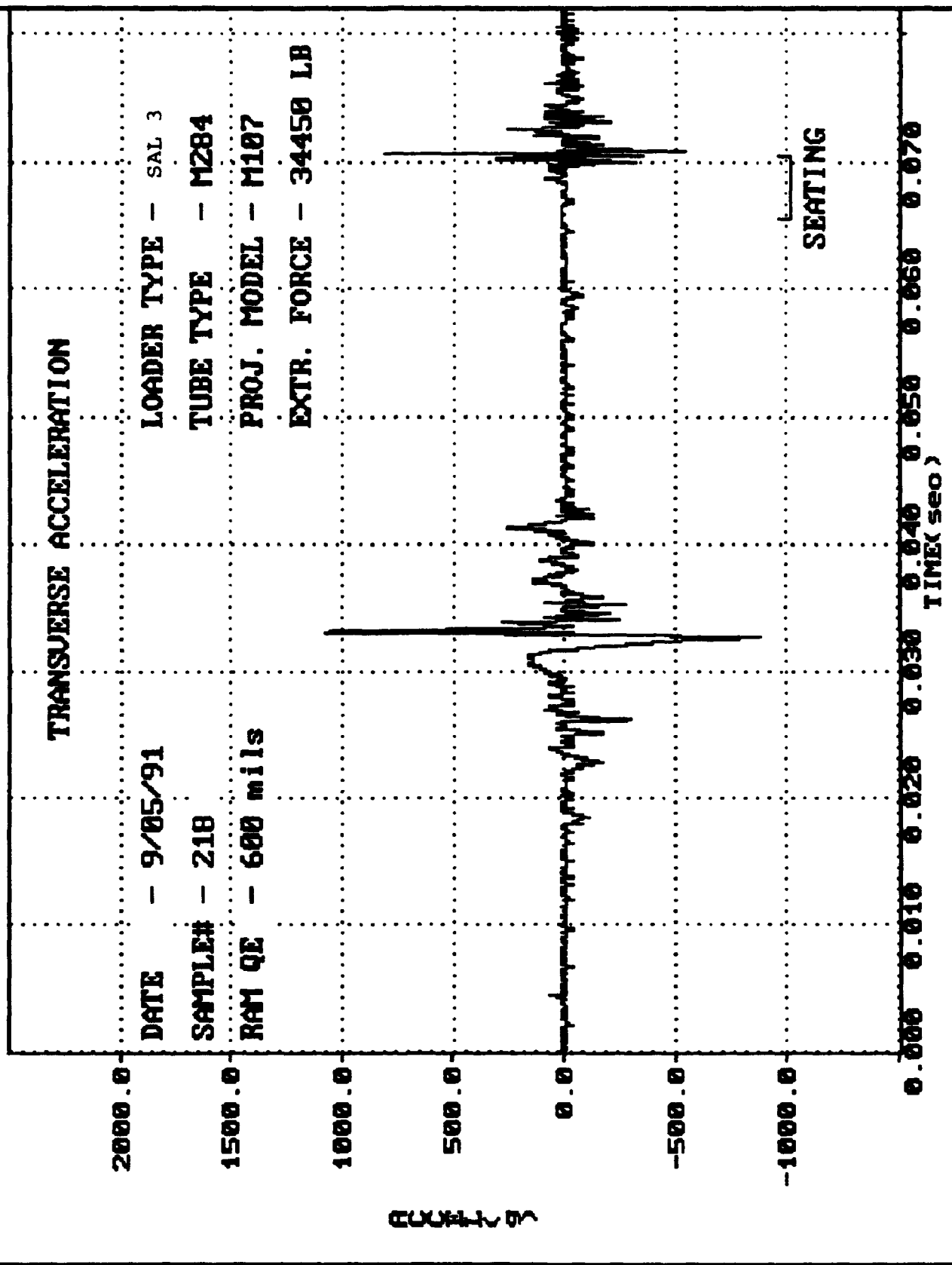
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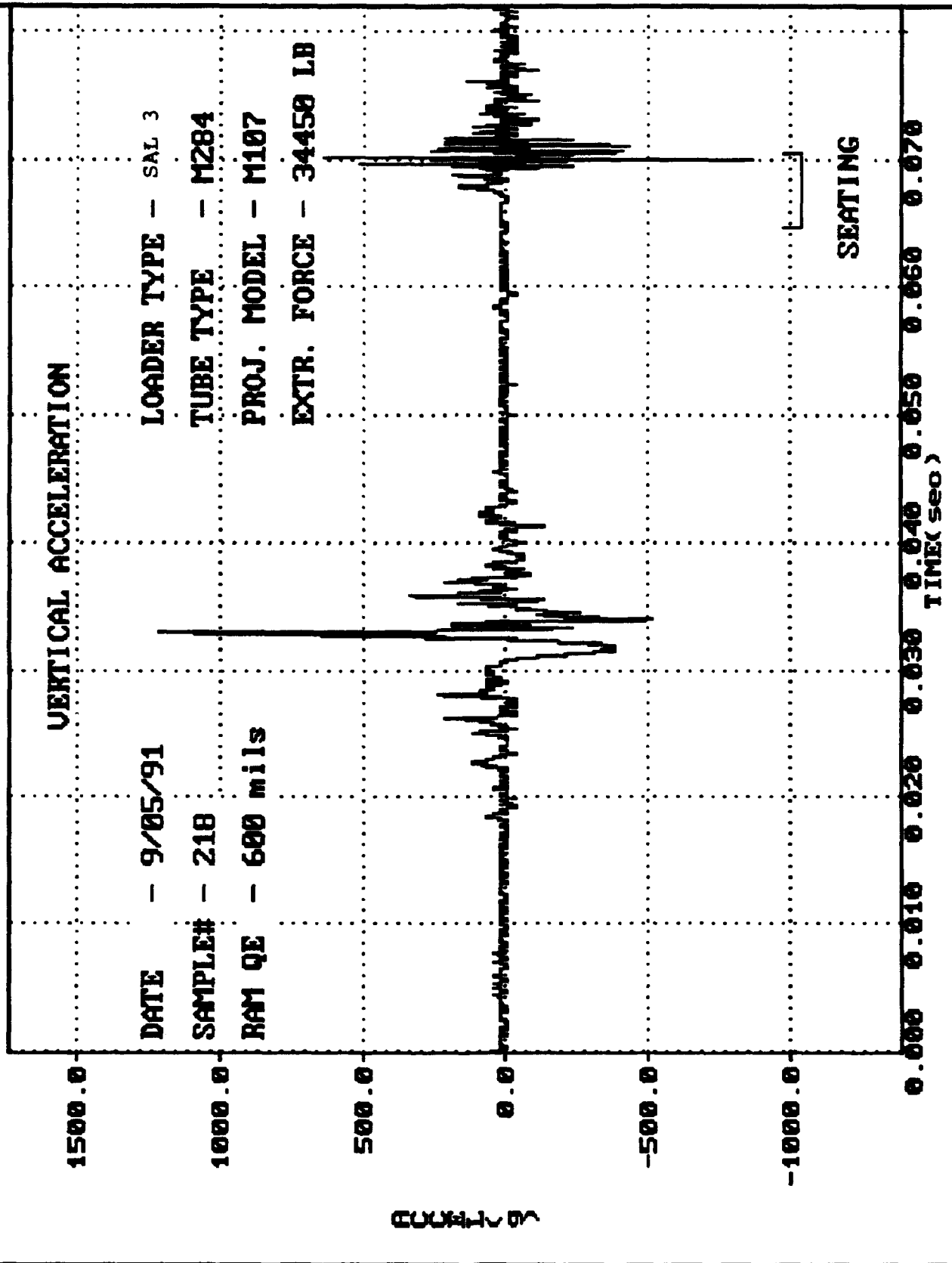
APPENDIX D

IT RAMS

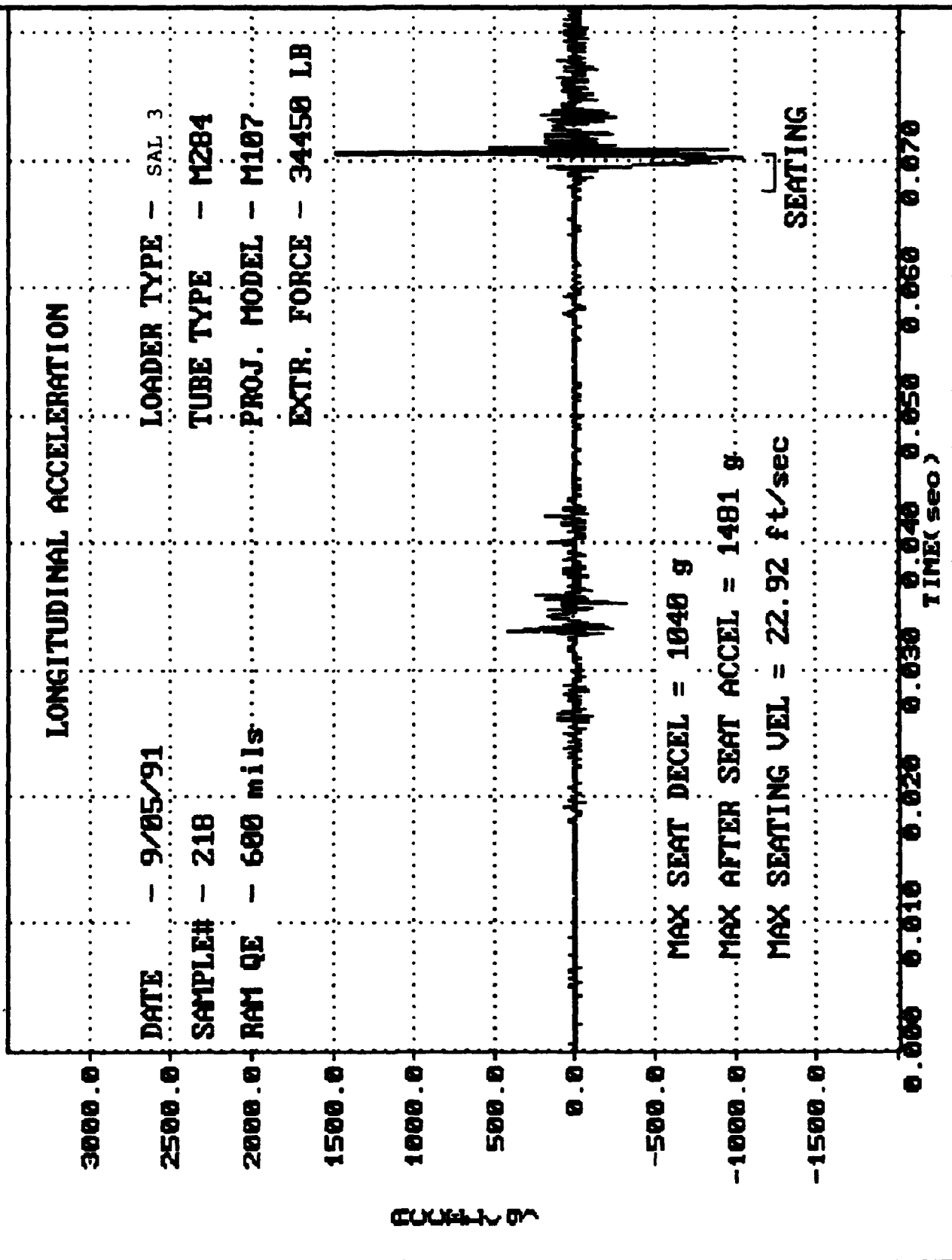
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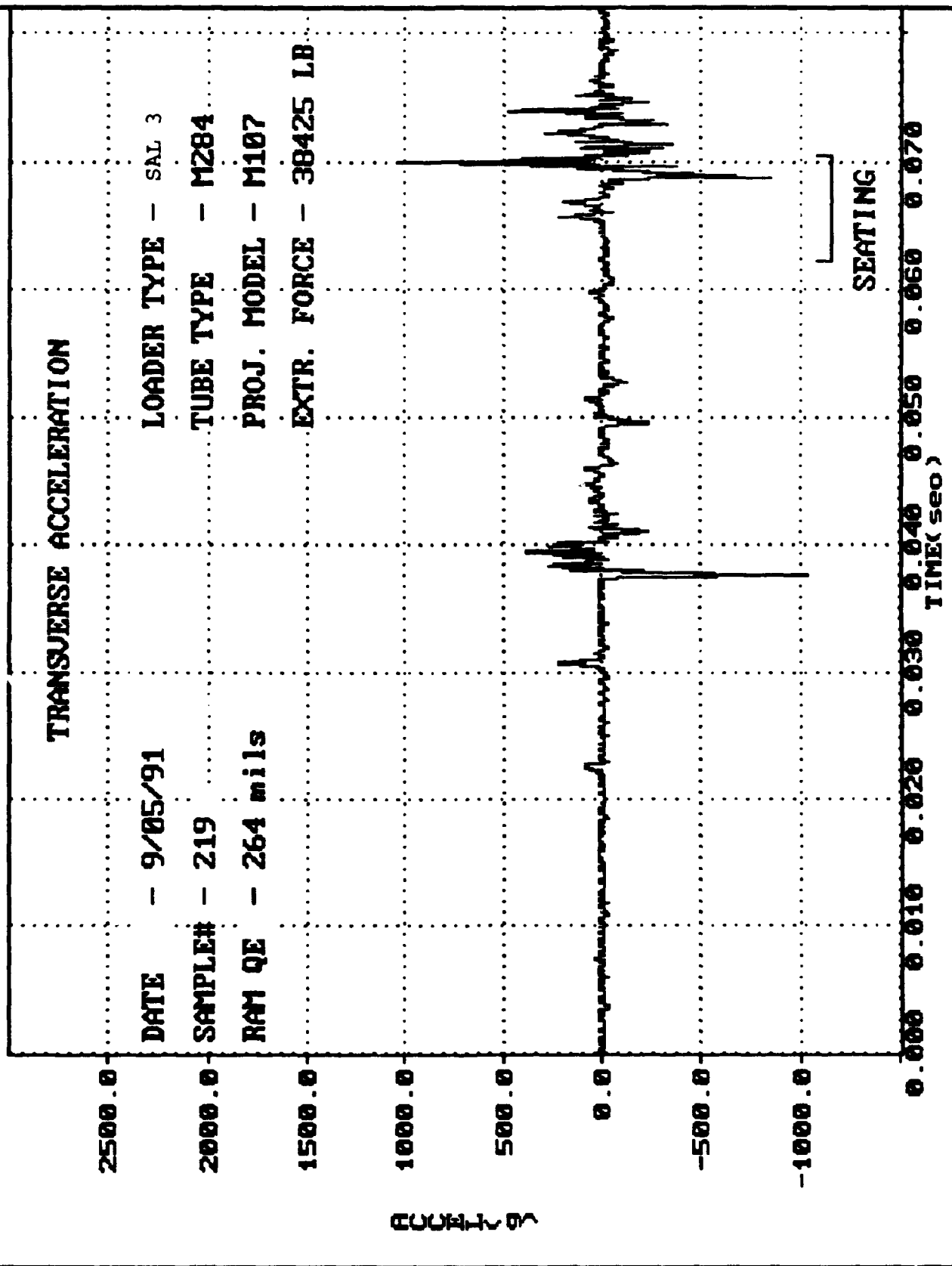
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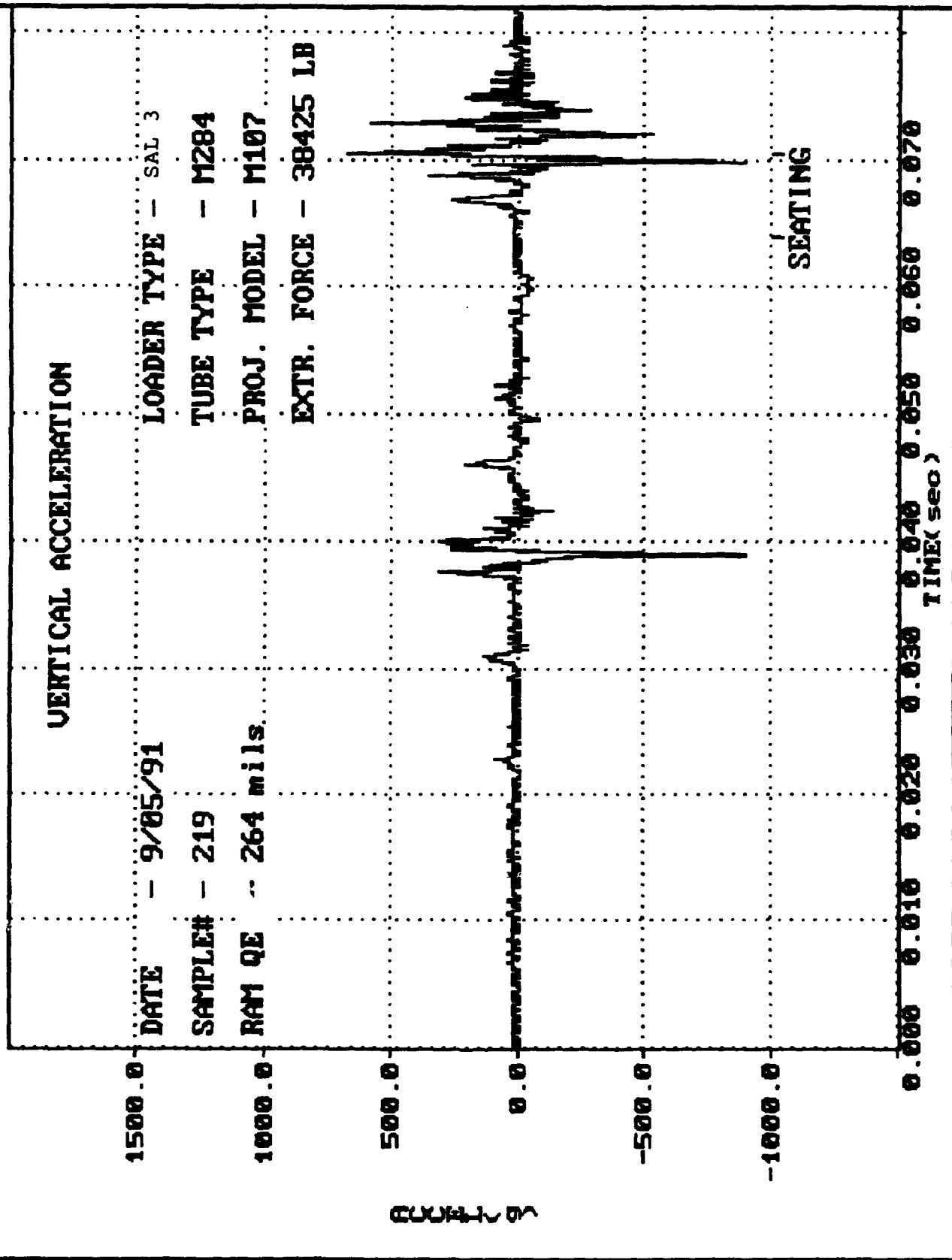
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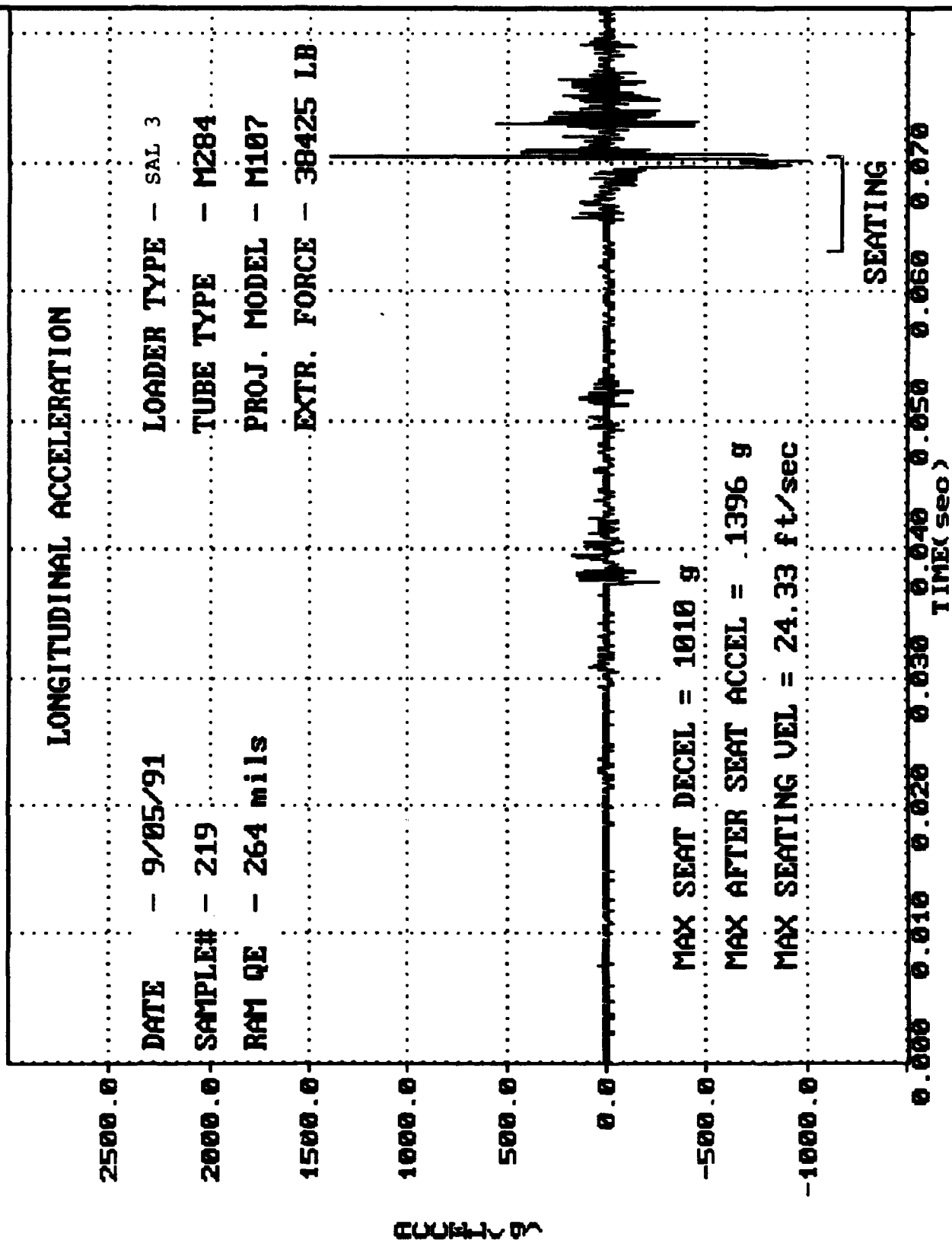
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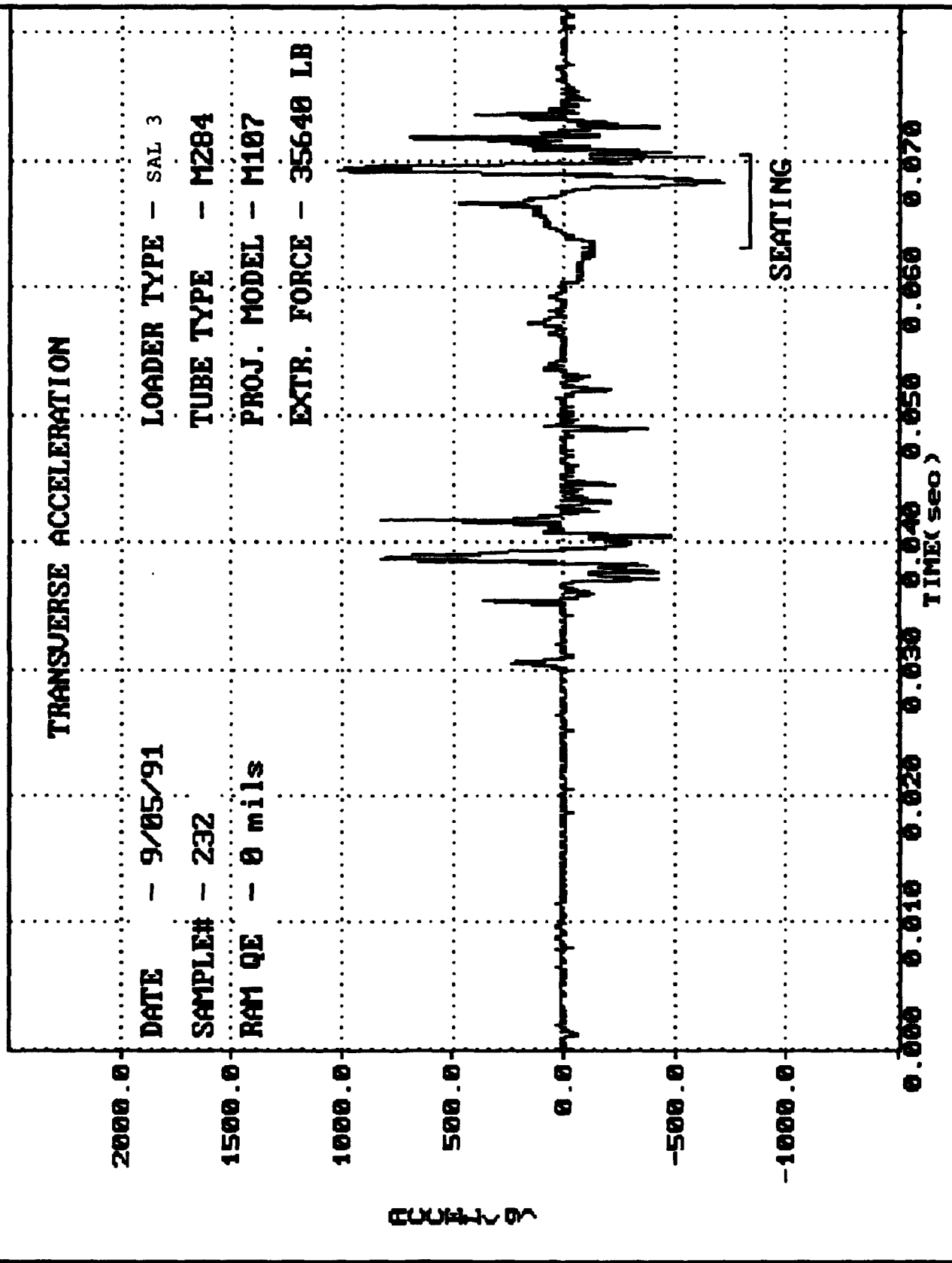
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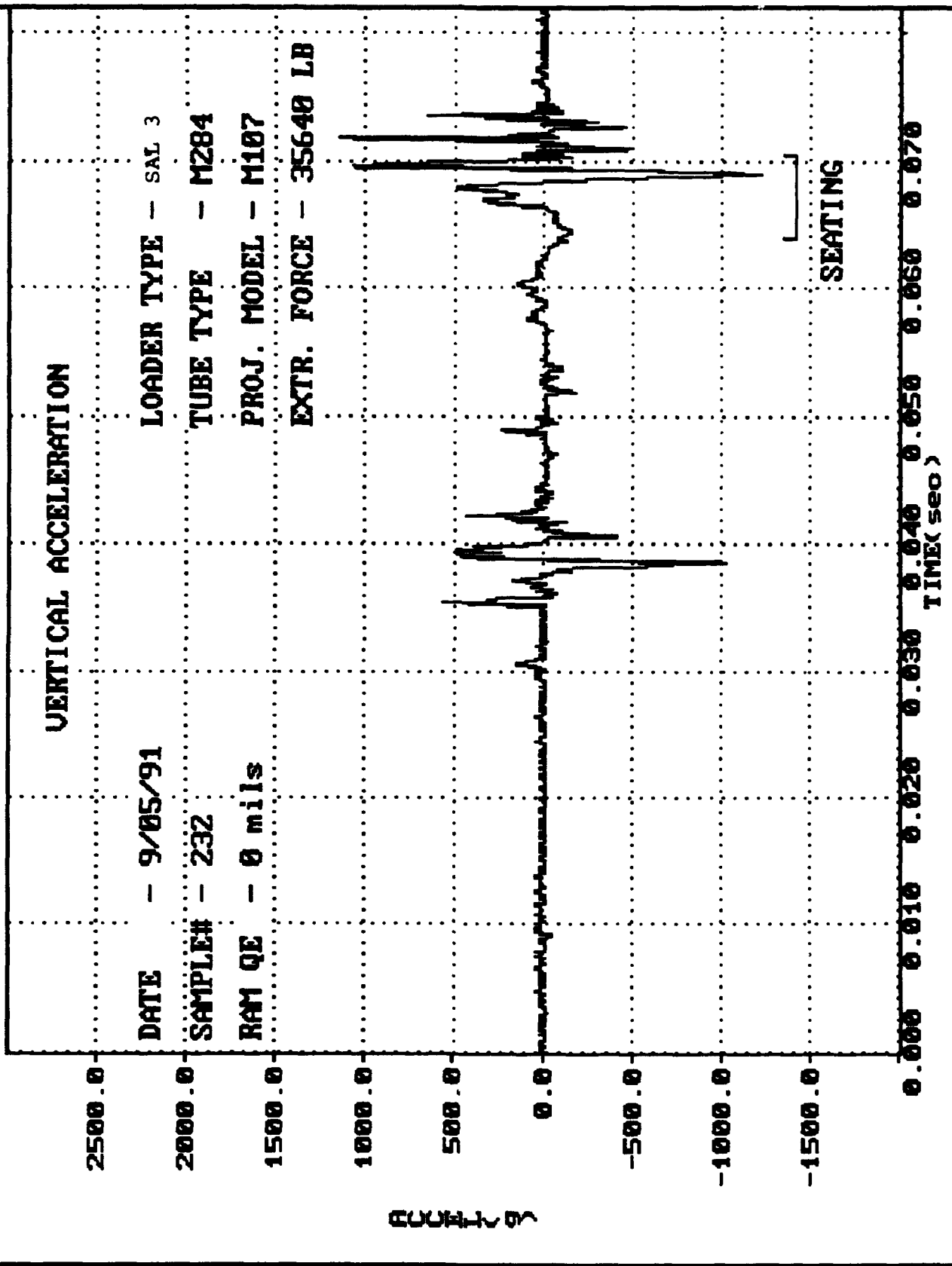
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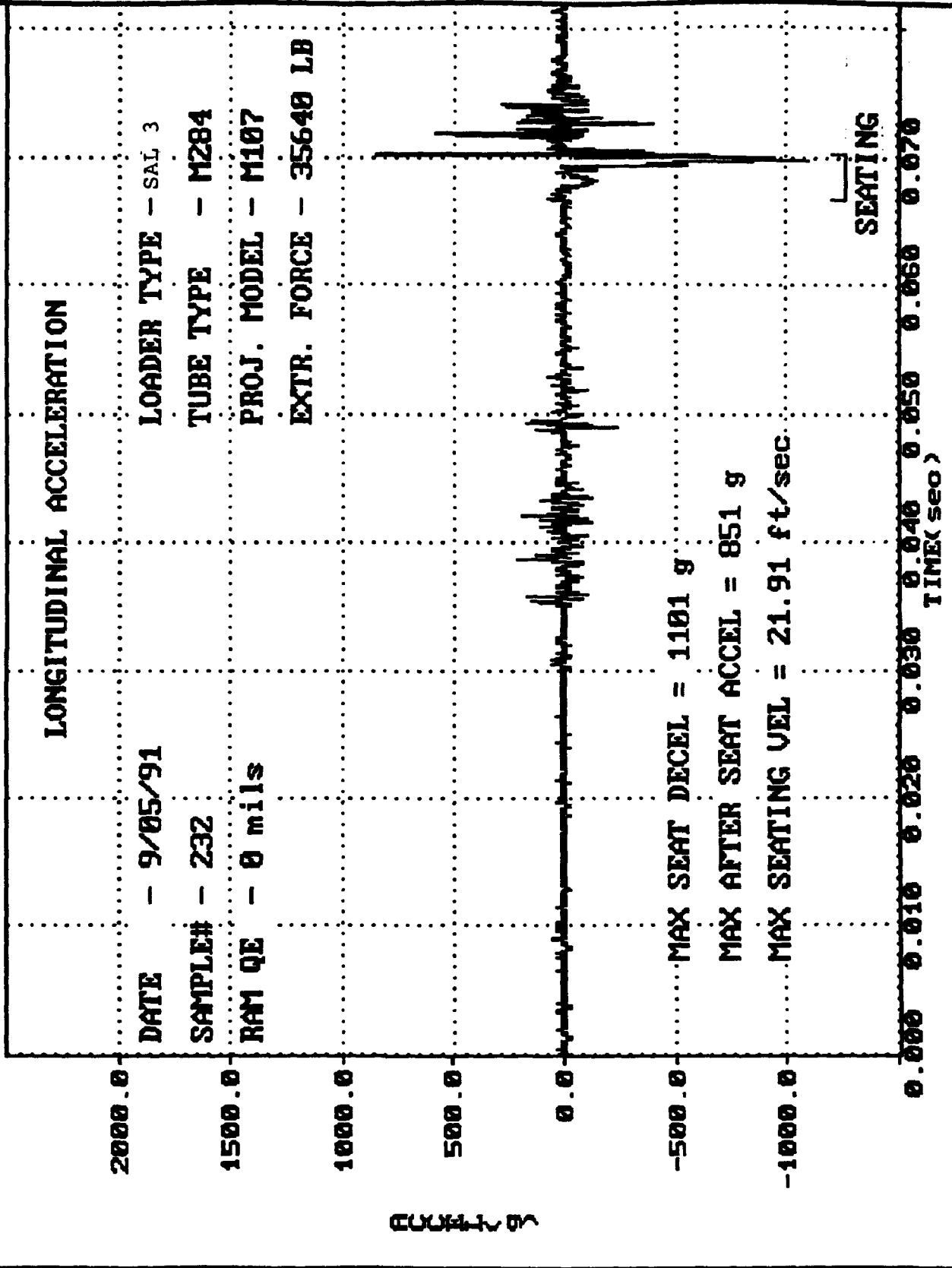
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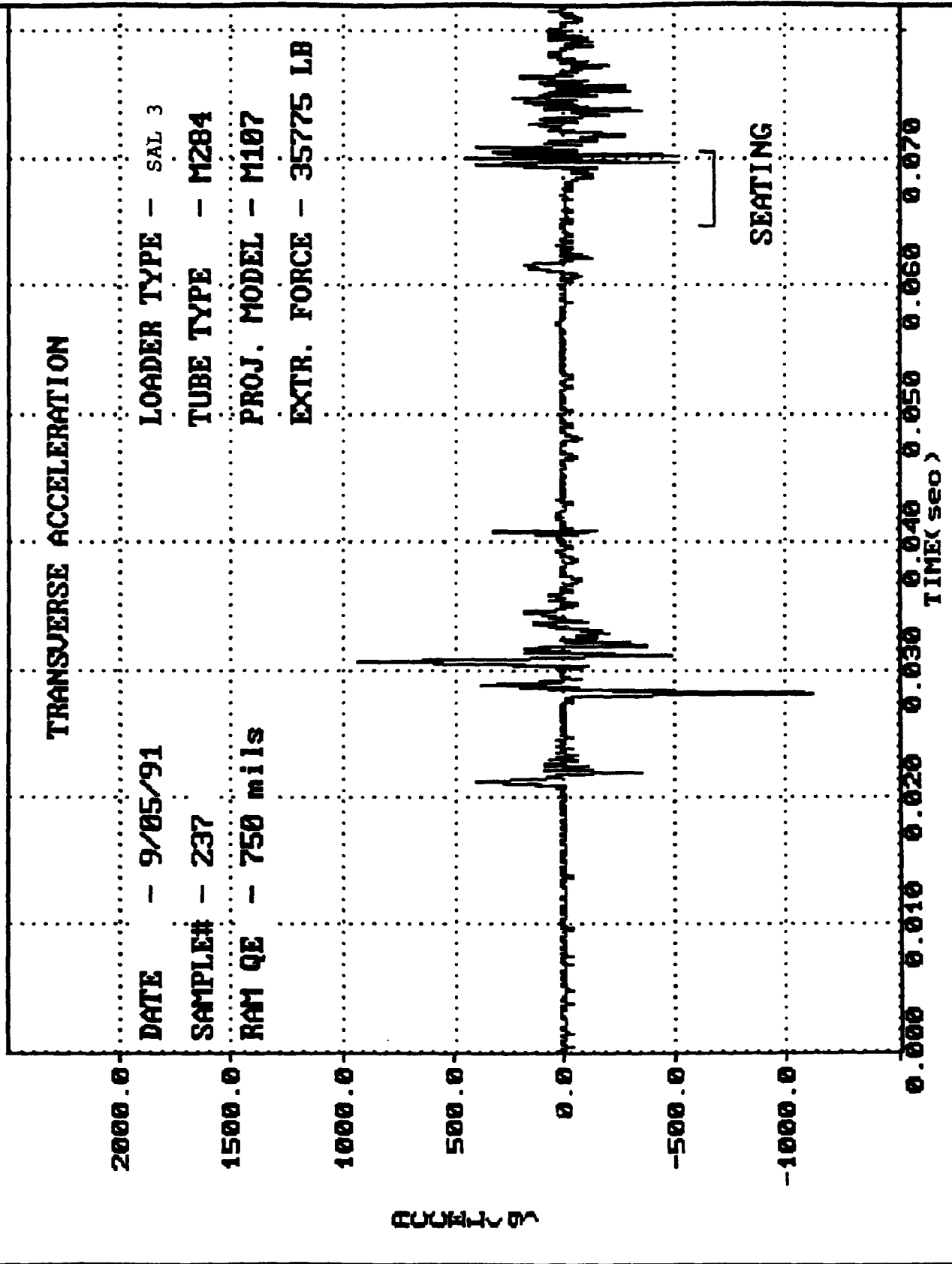
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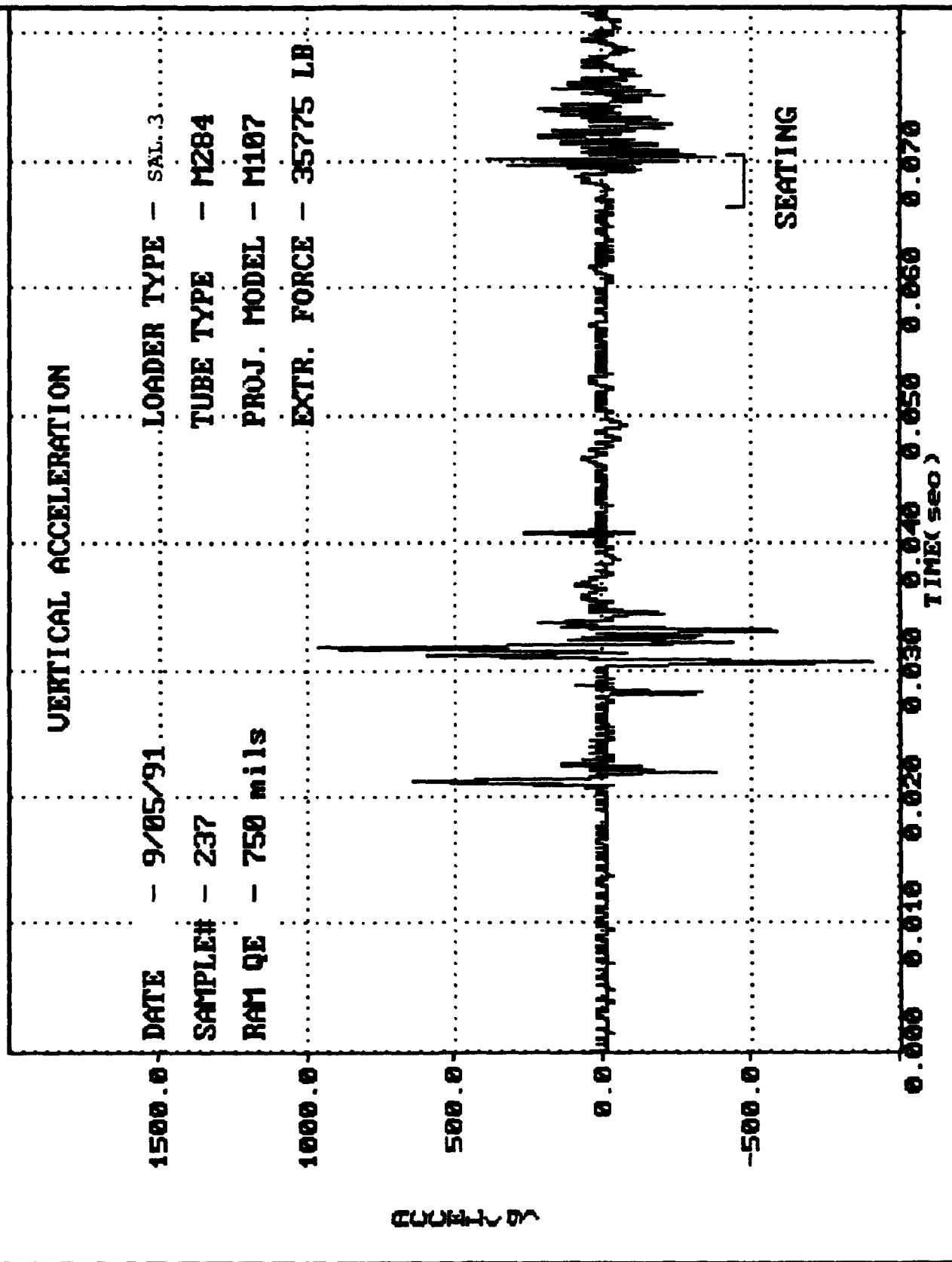
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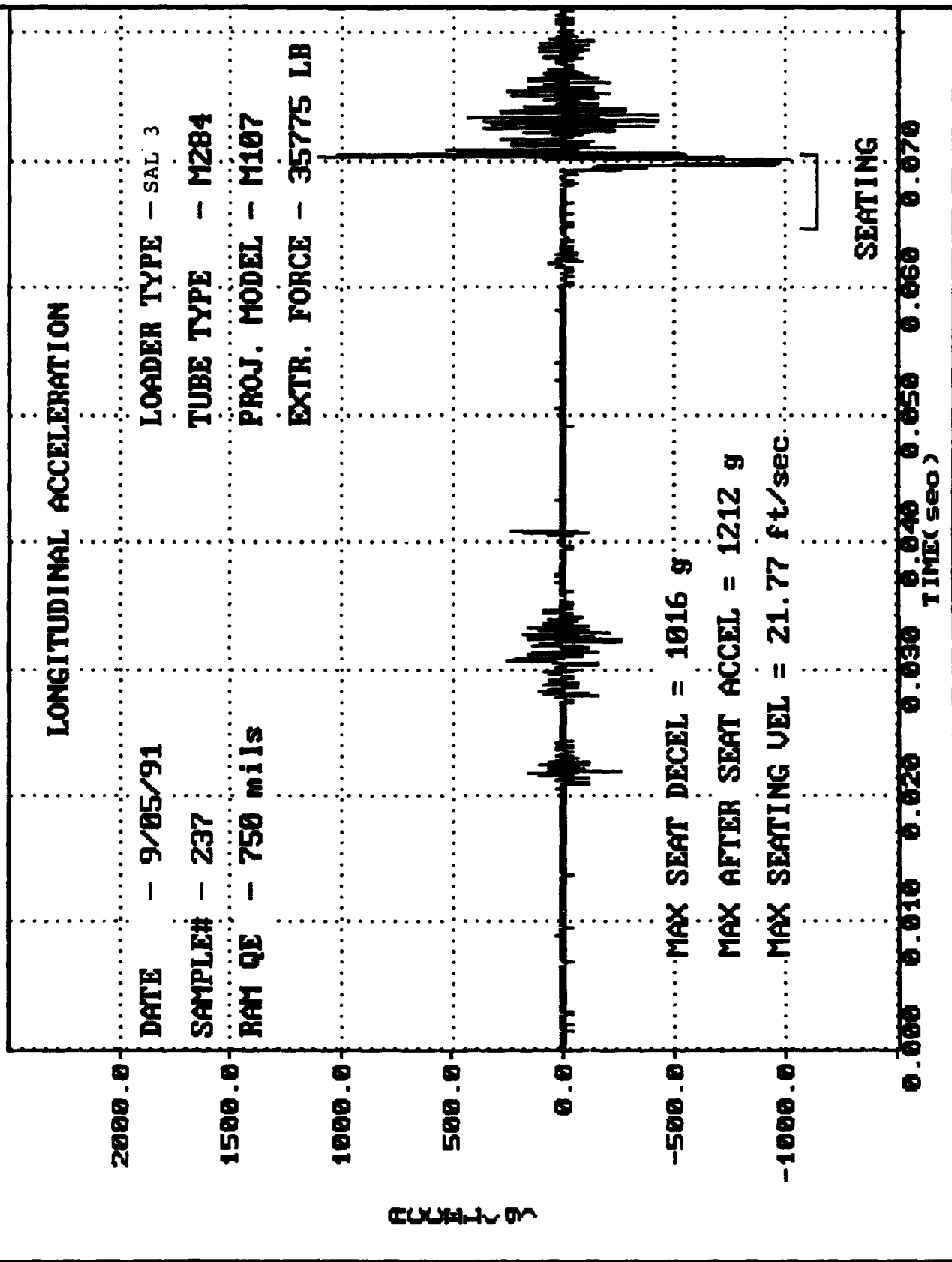
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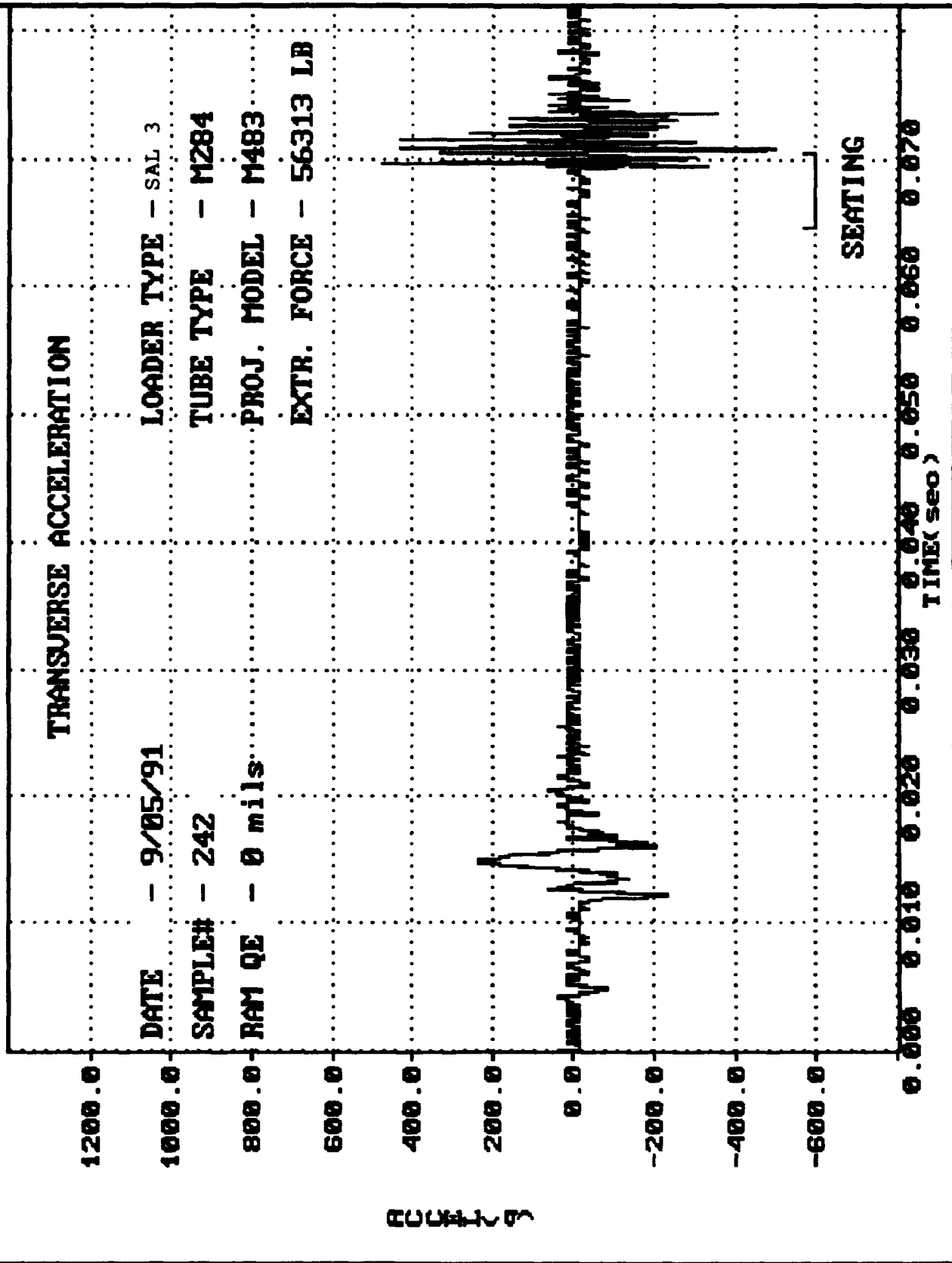
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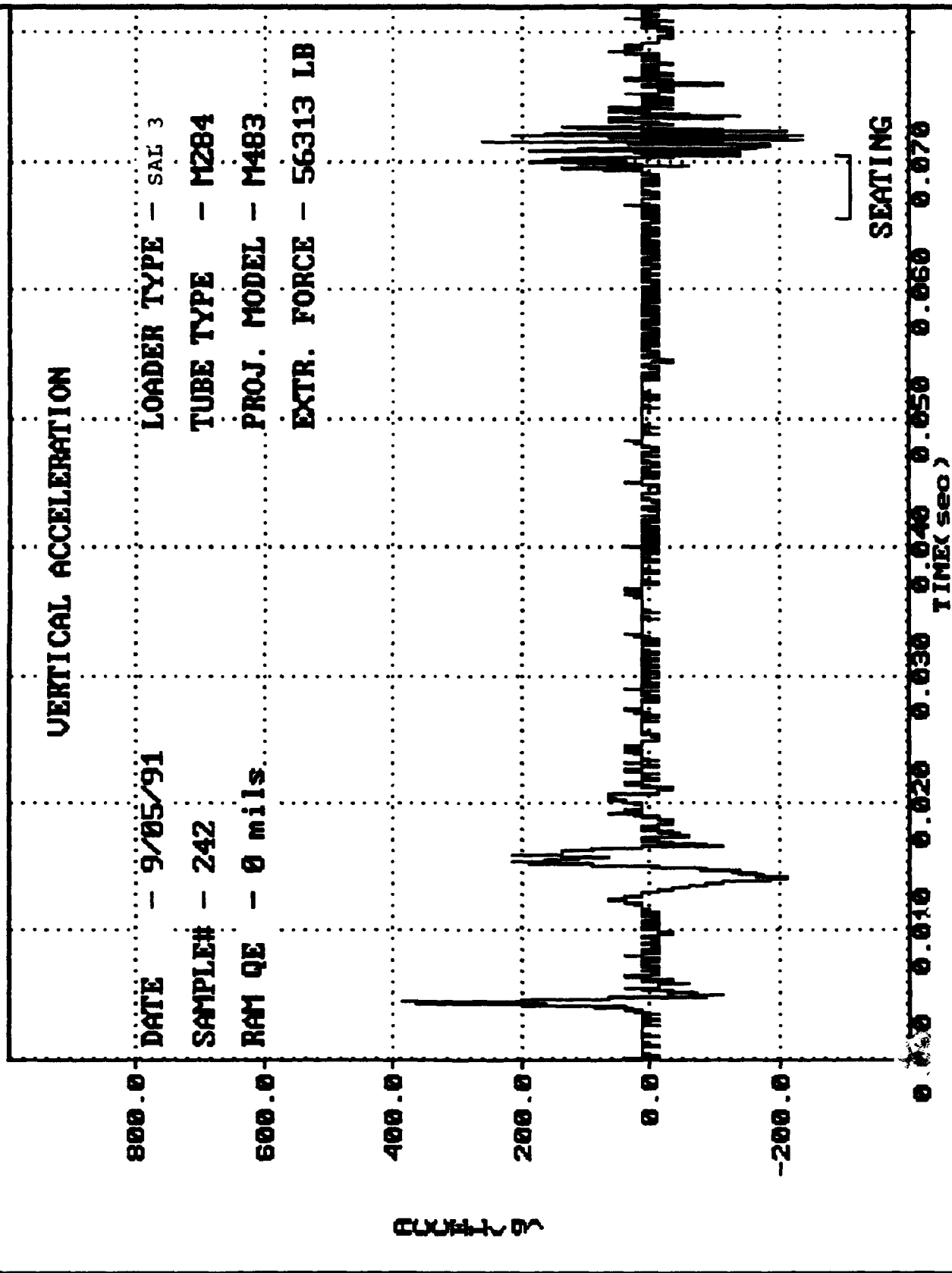
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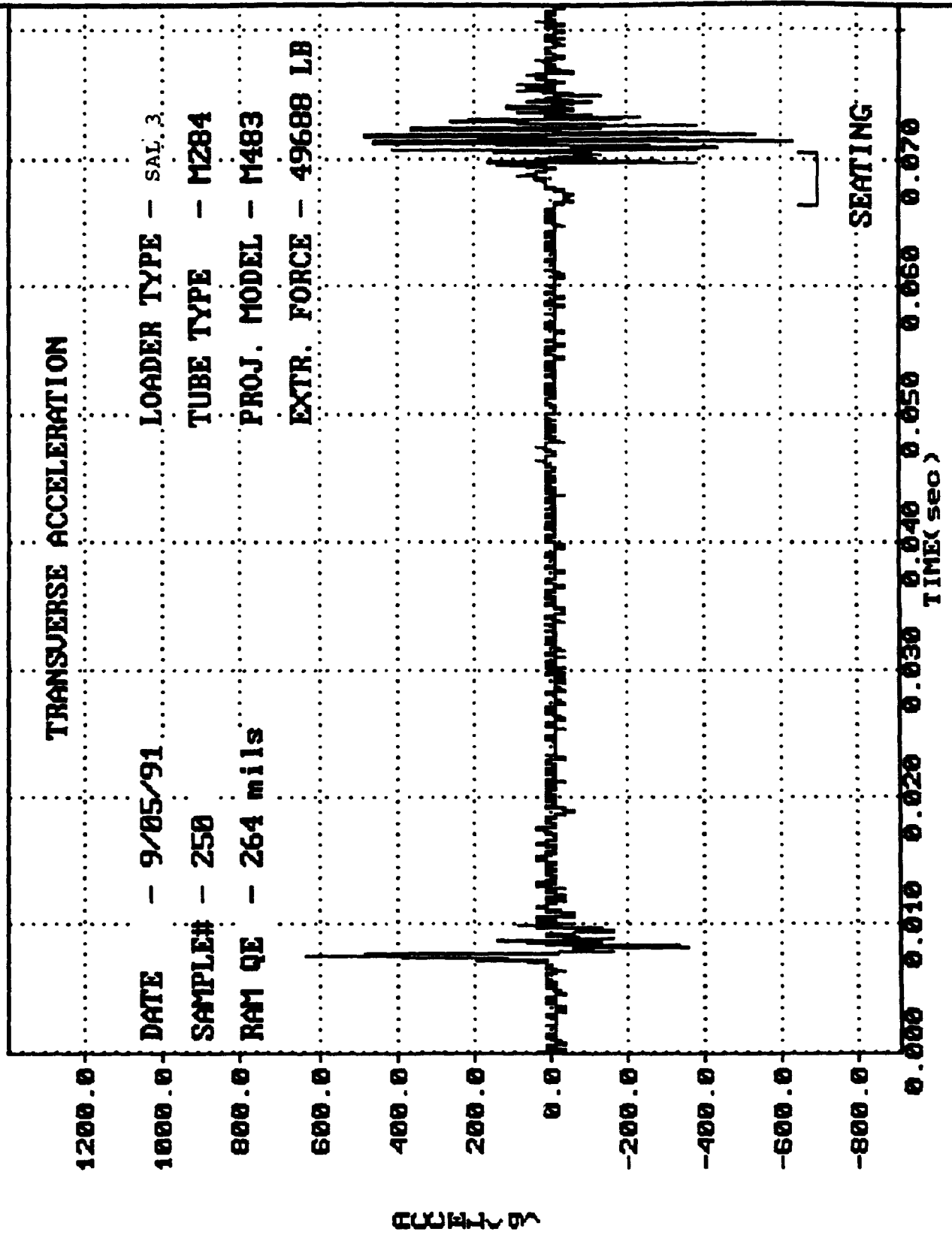
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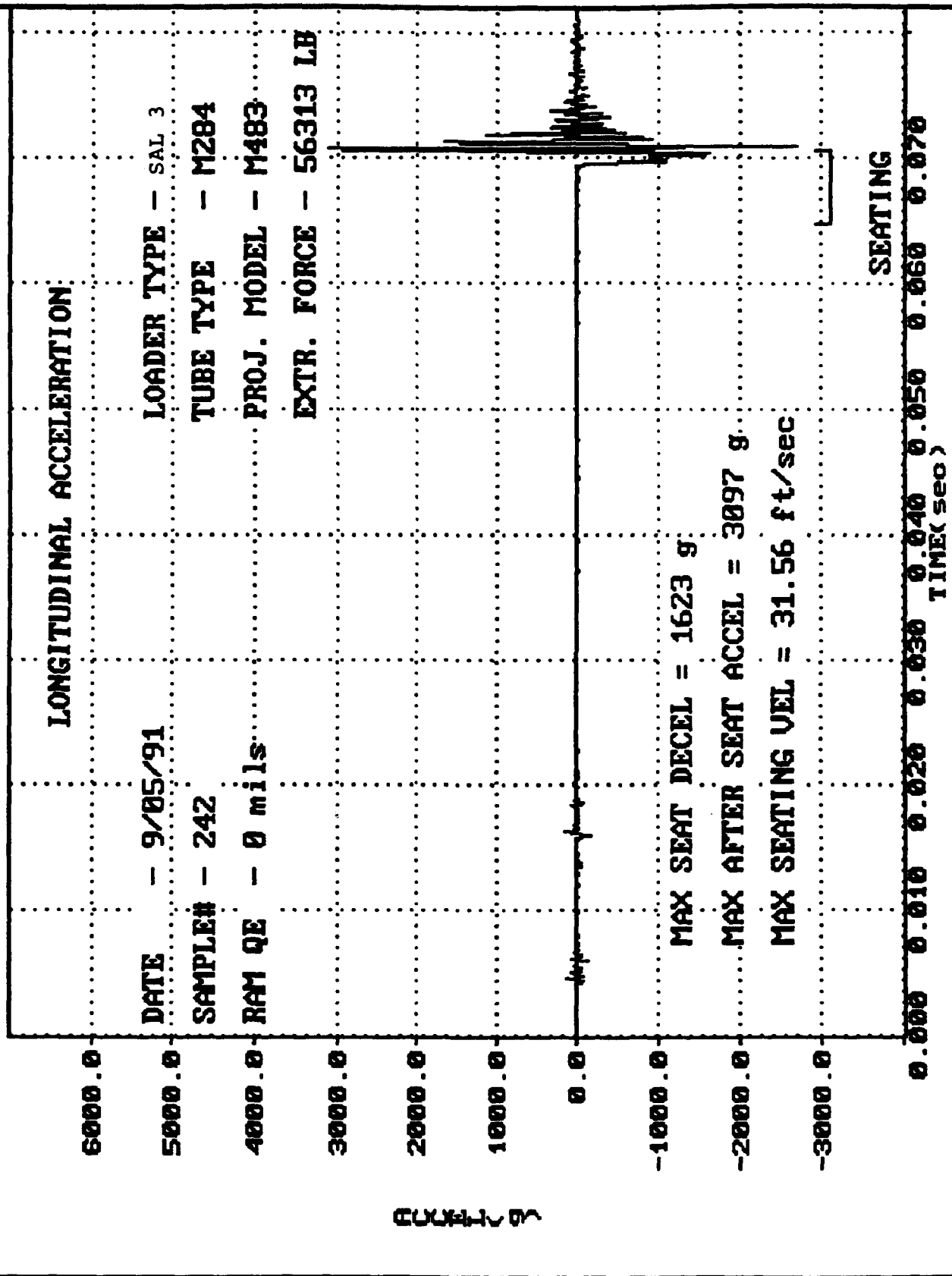
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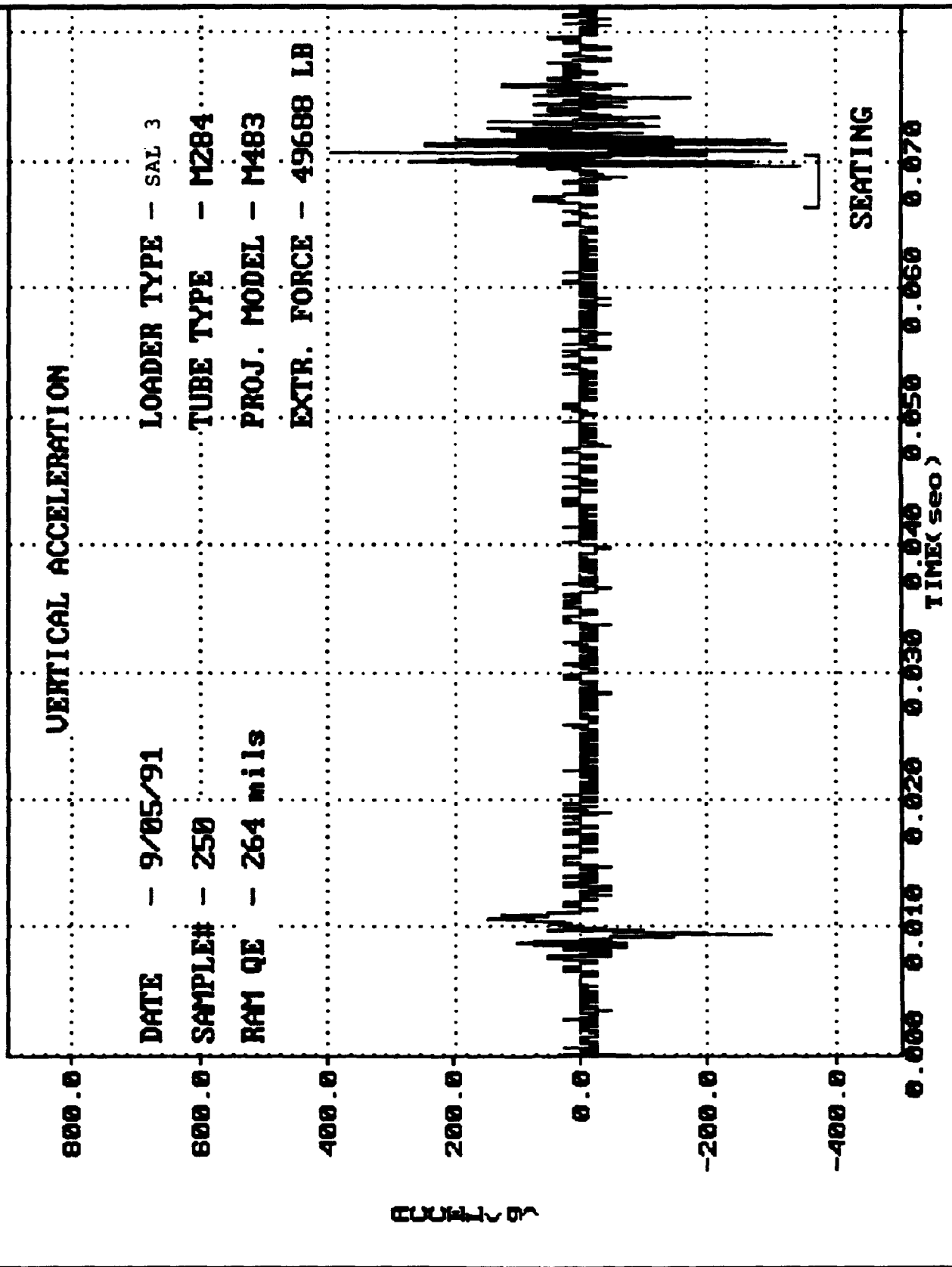
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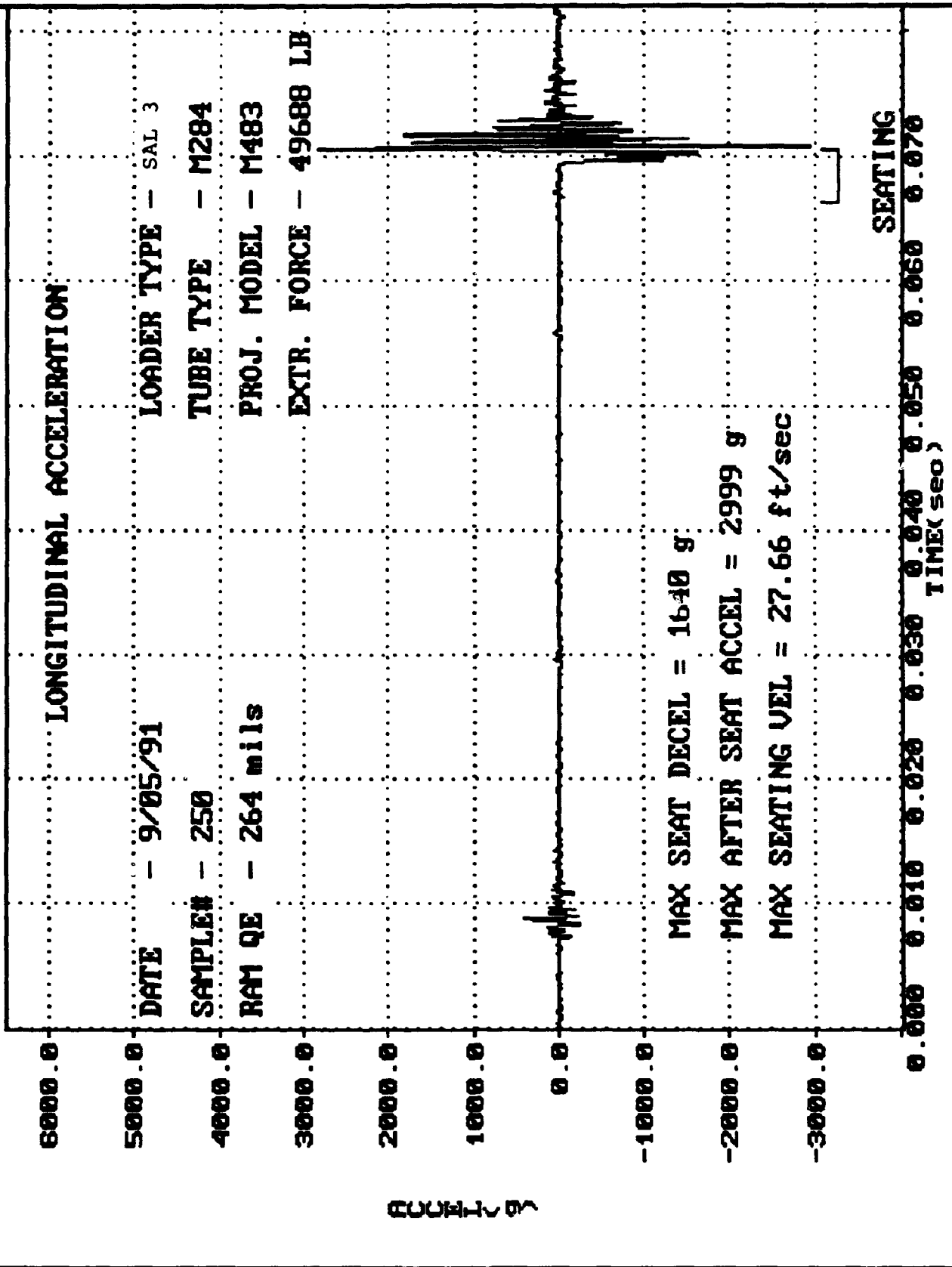
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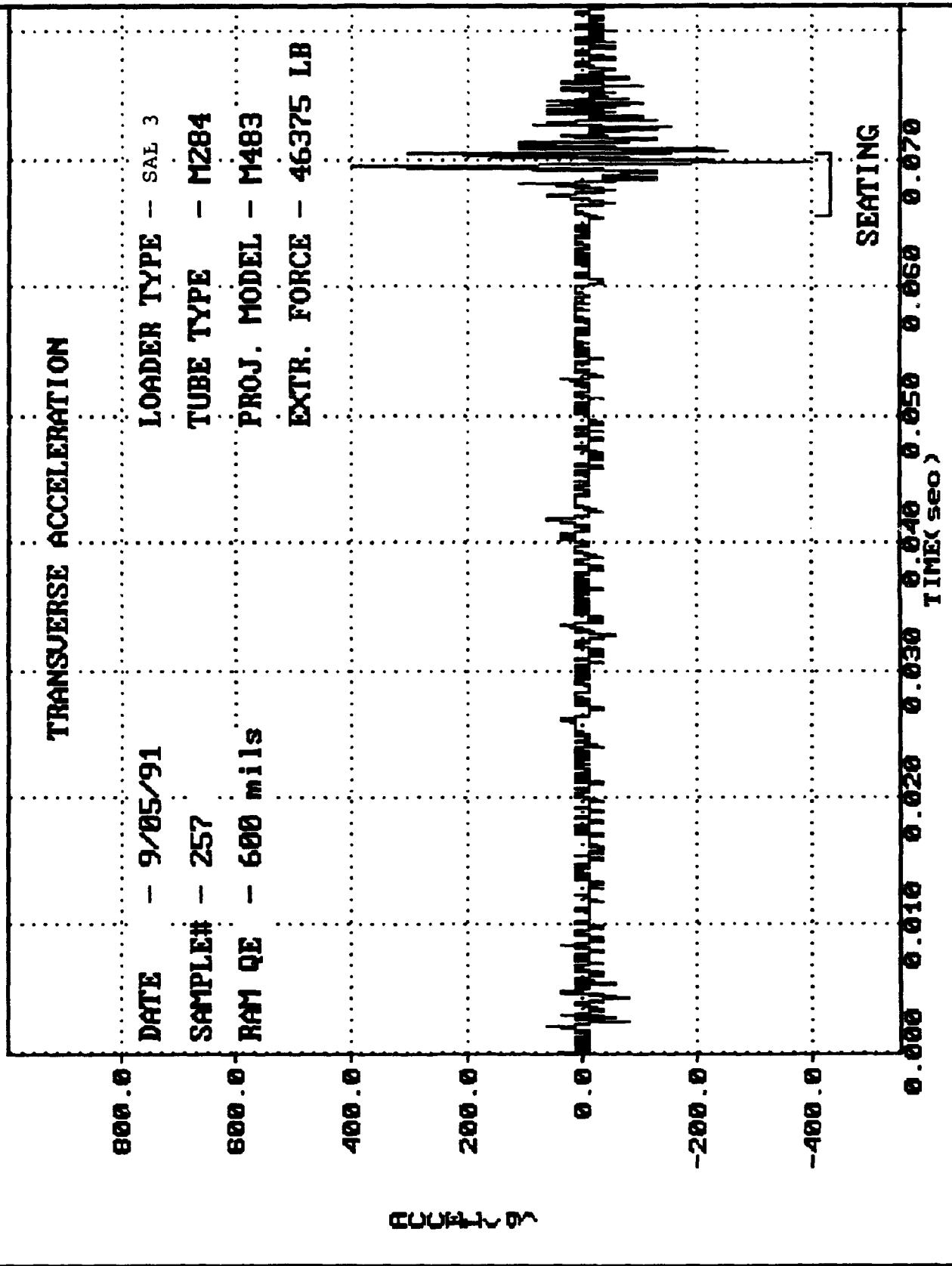
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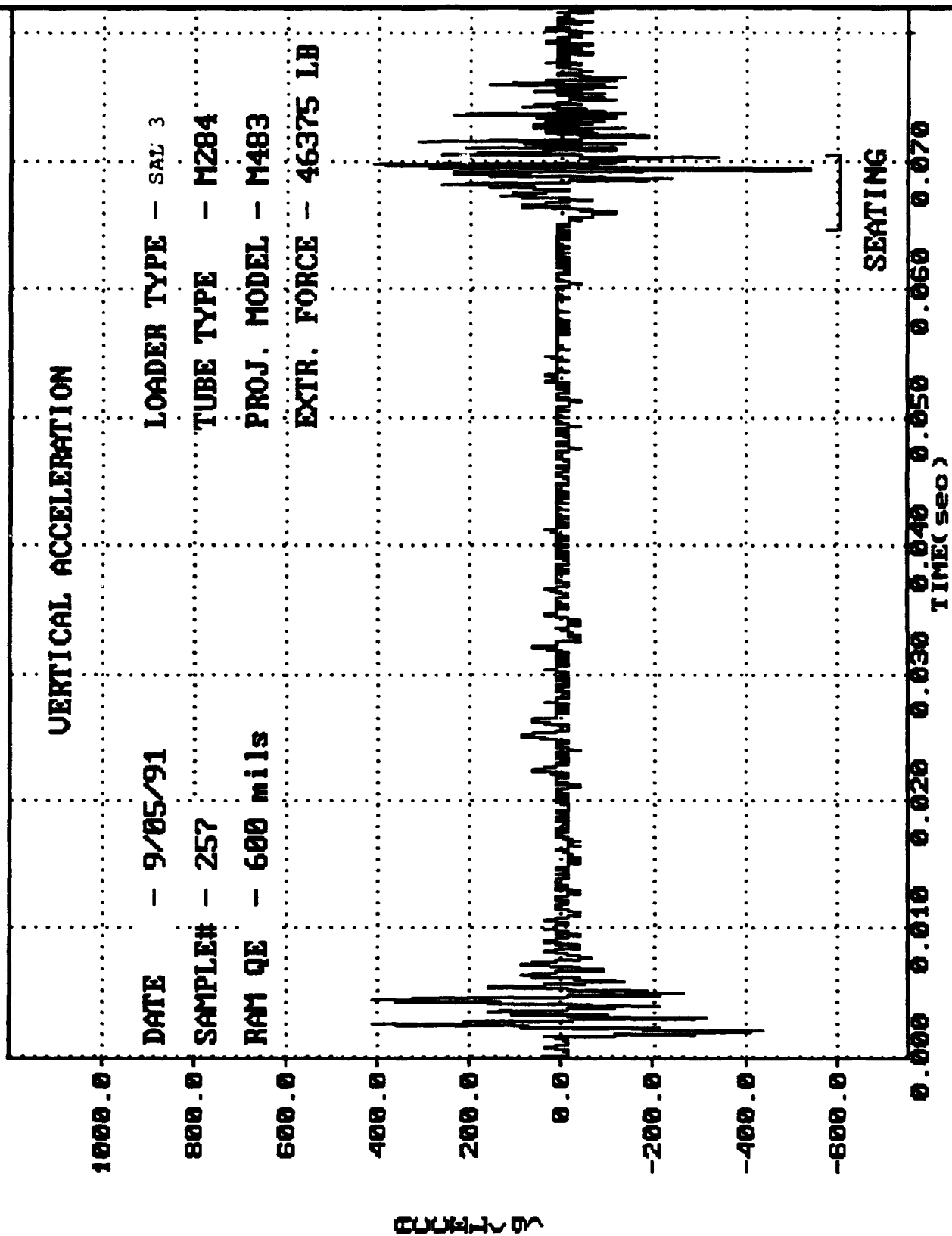
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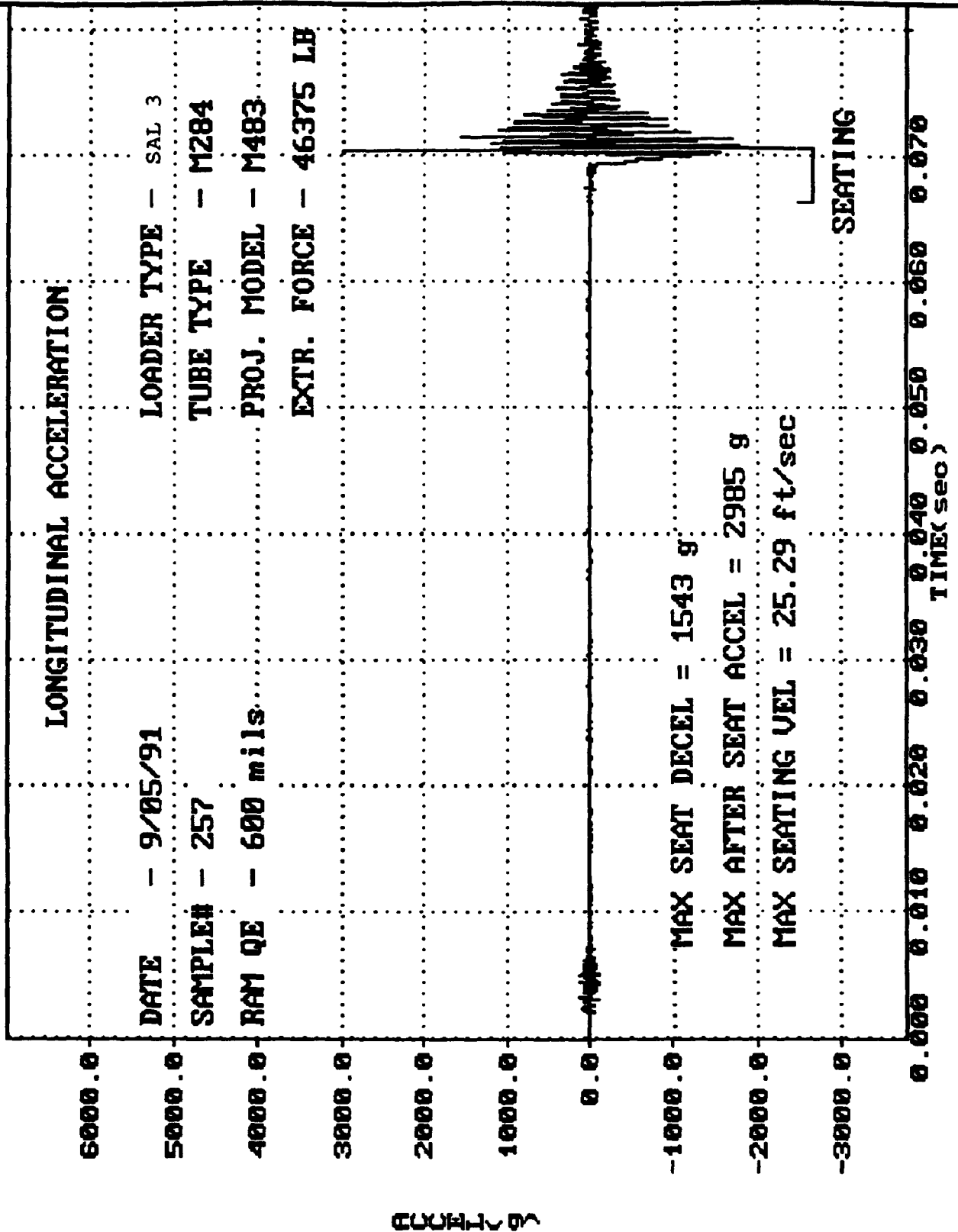
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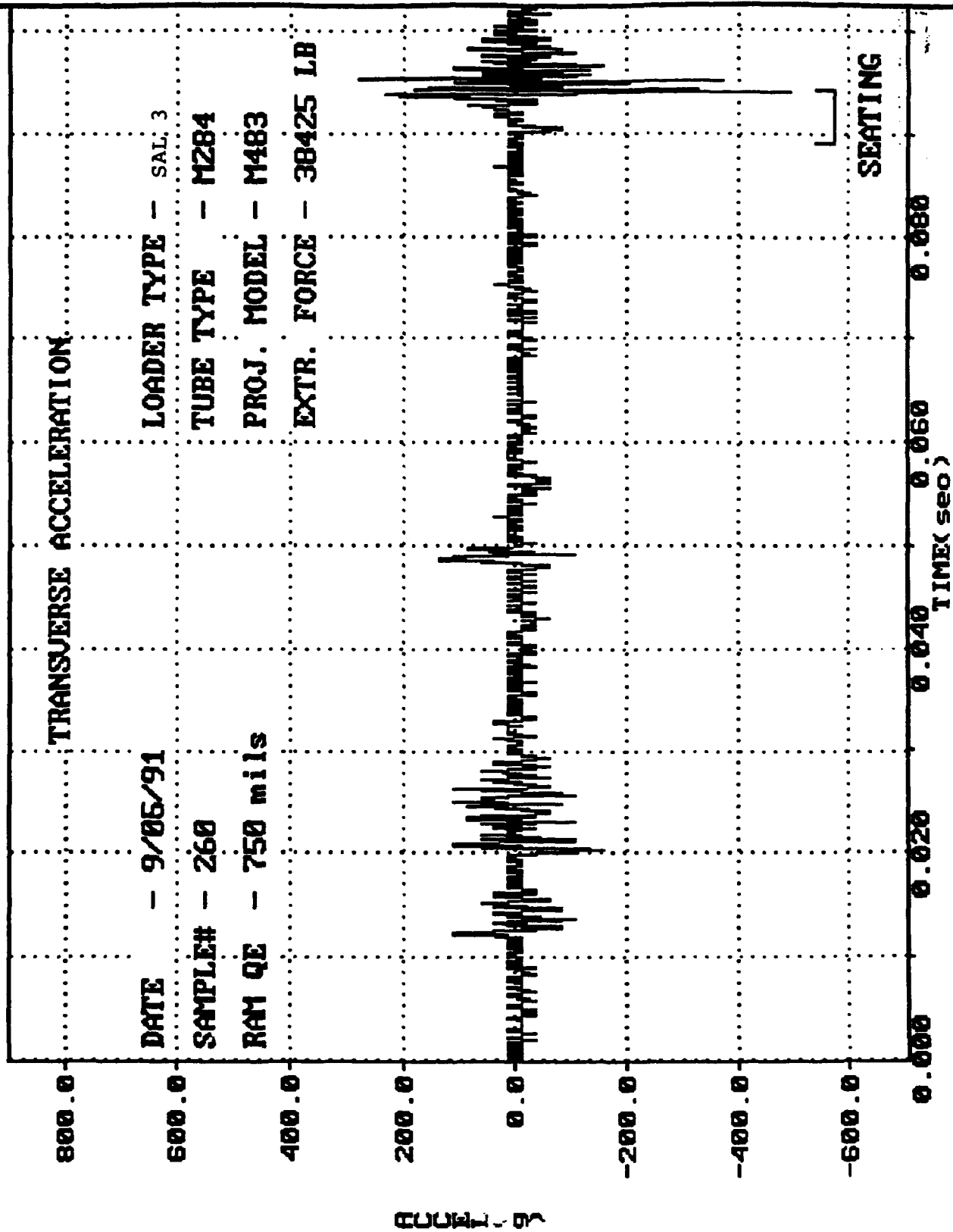
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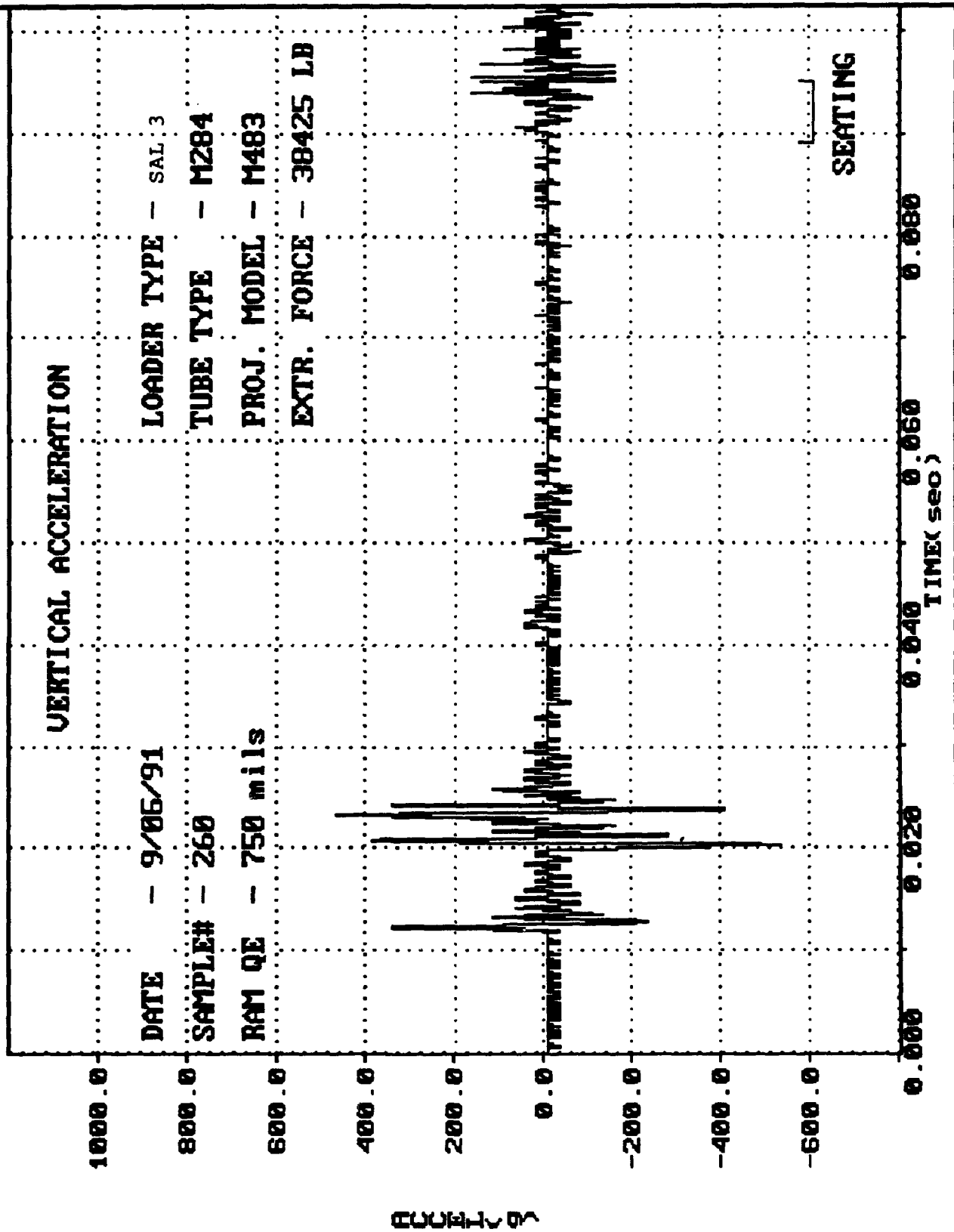
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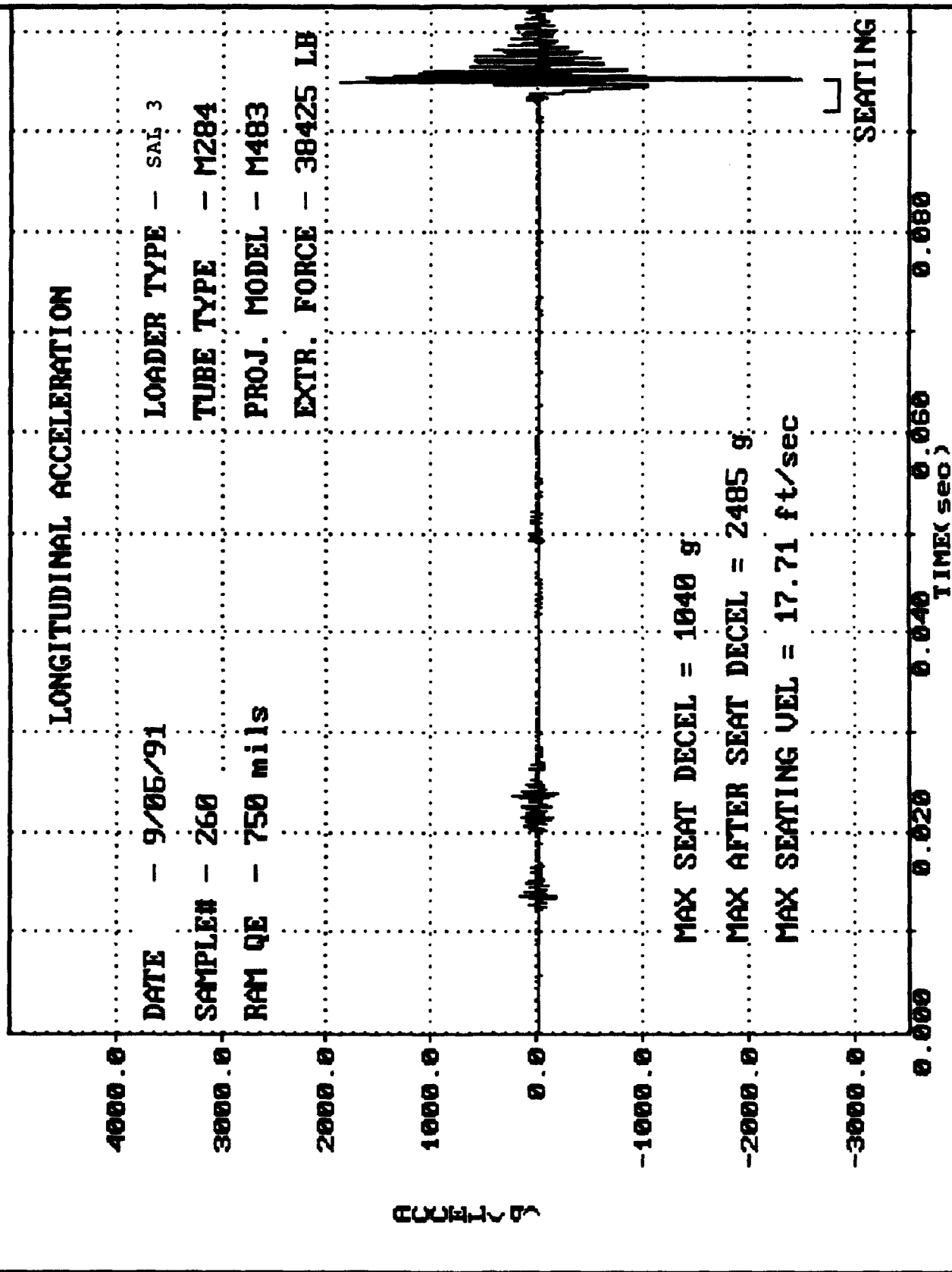
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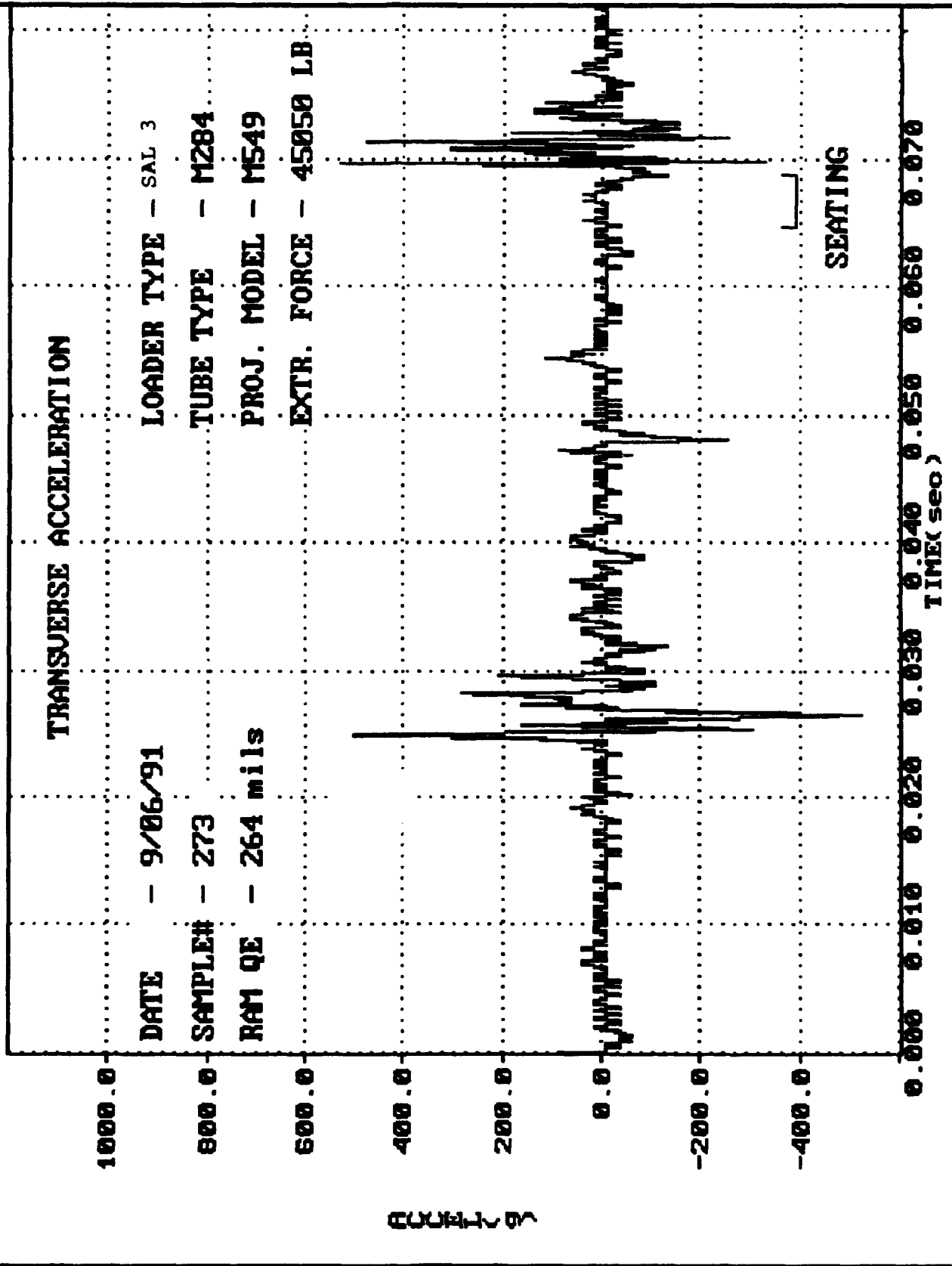
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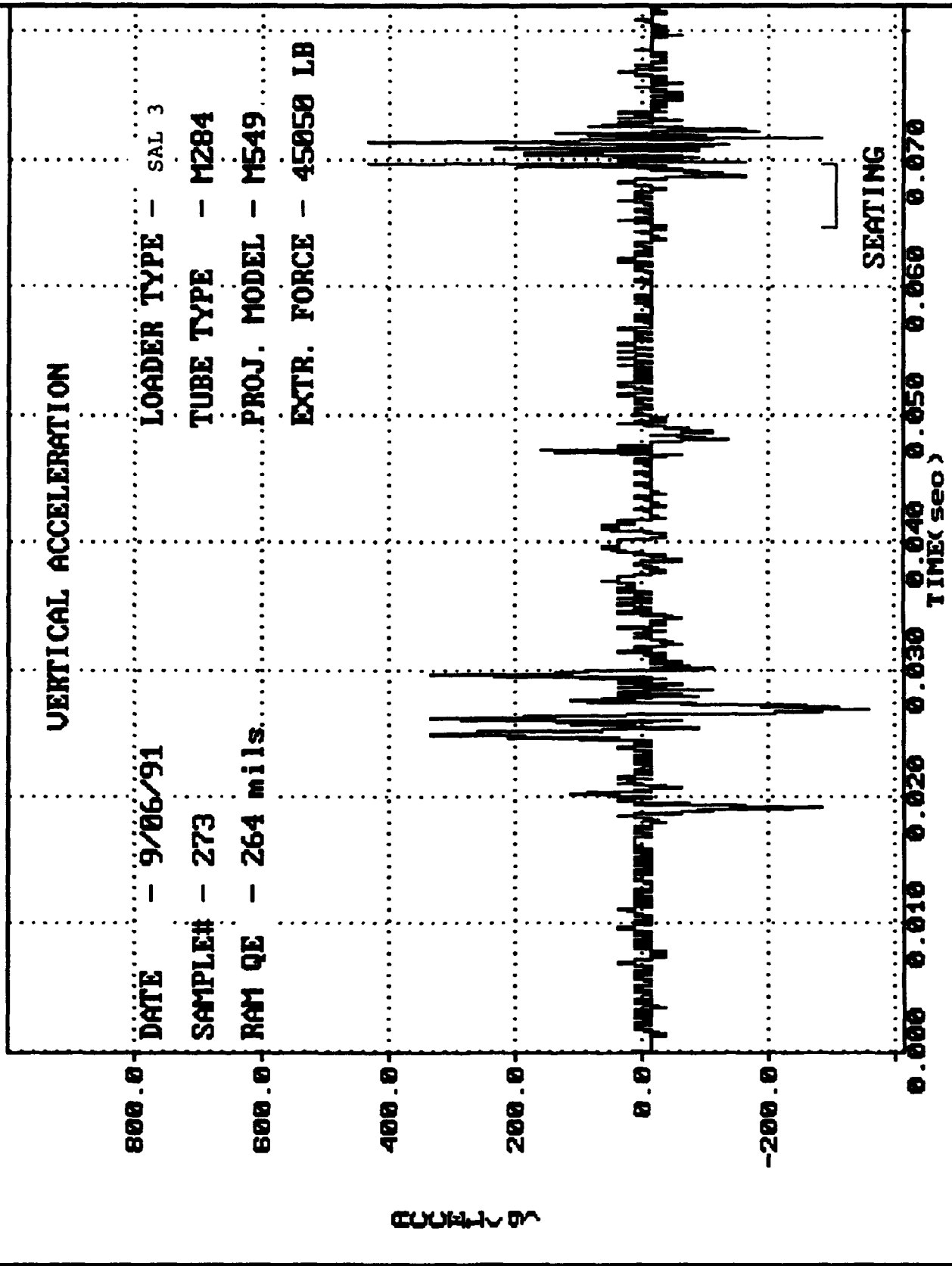
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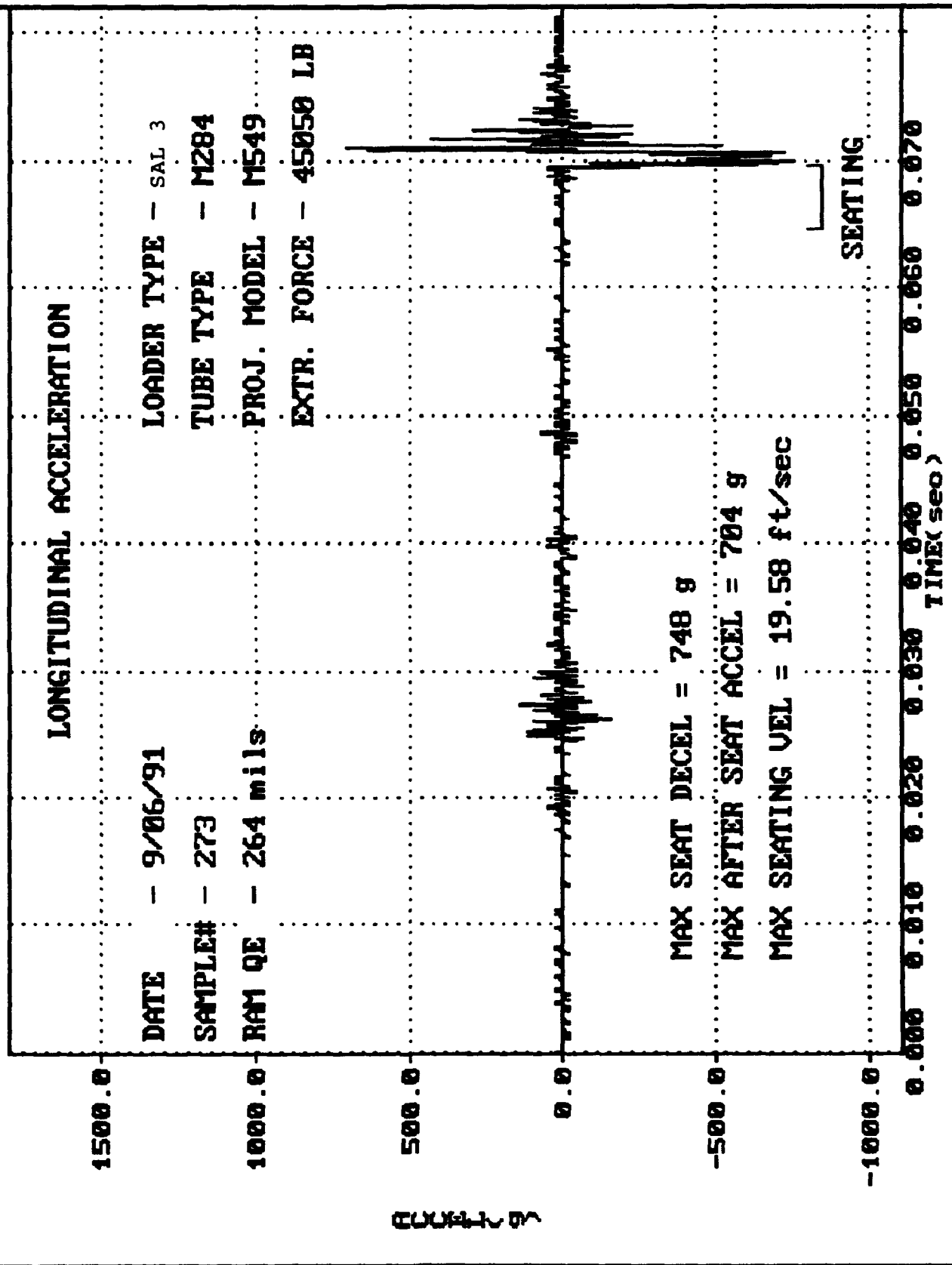
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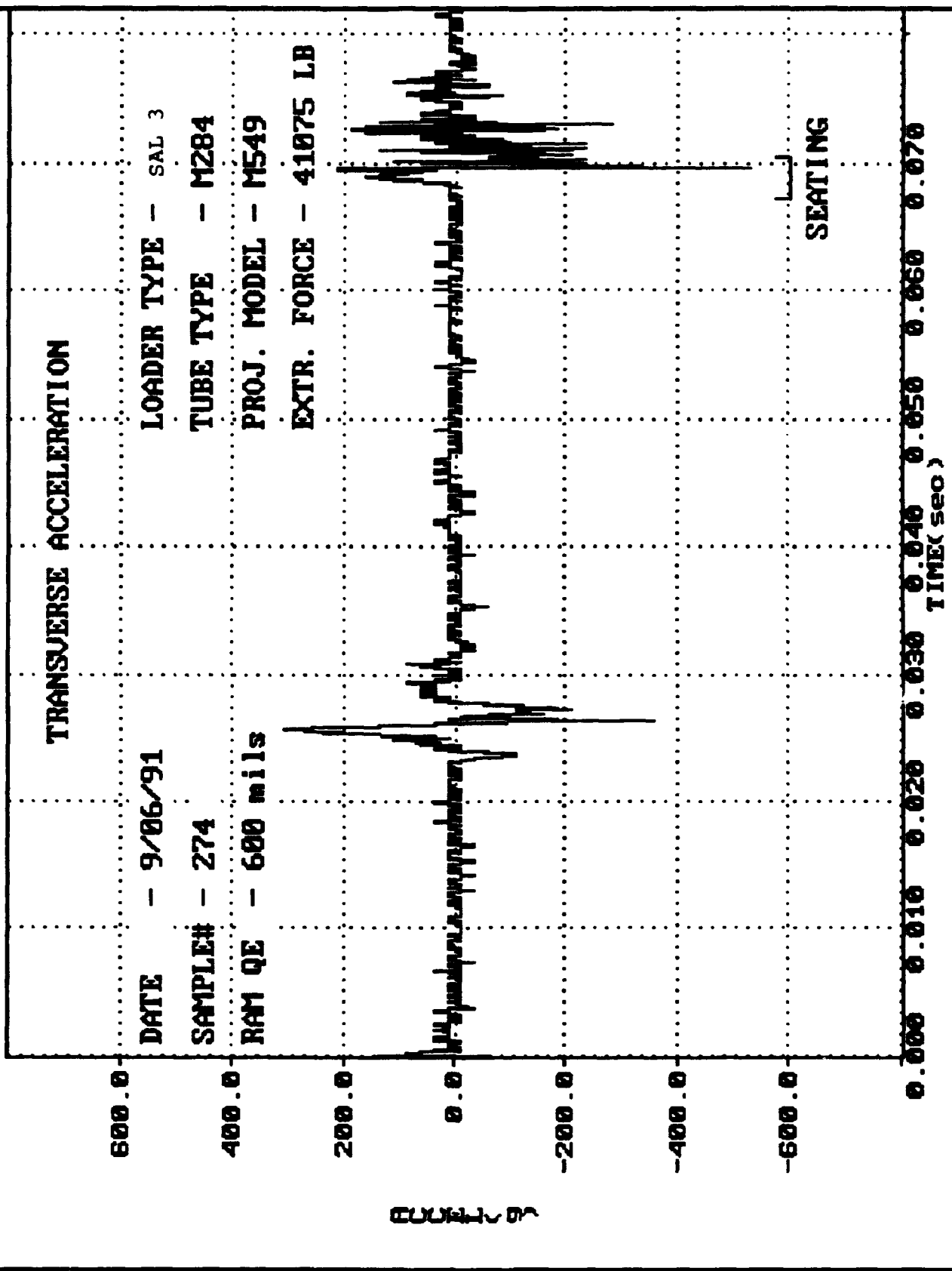
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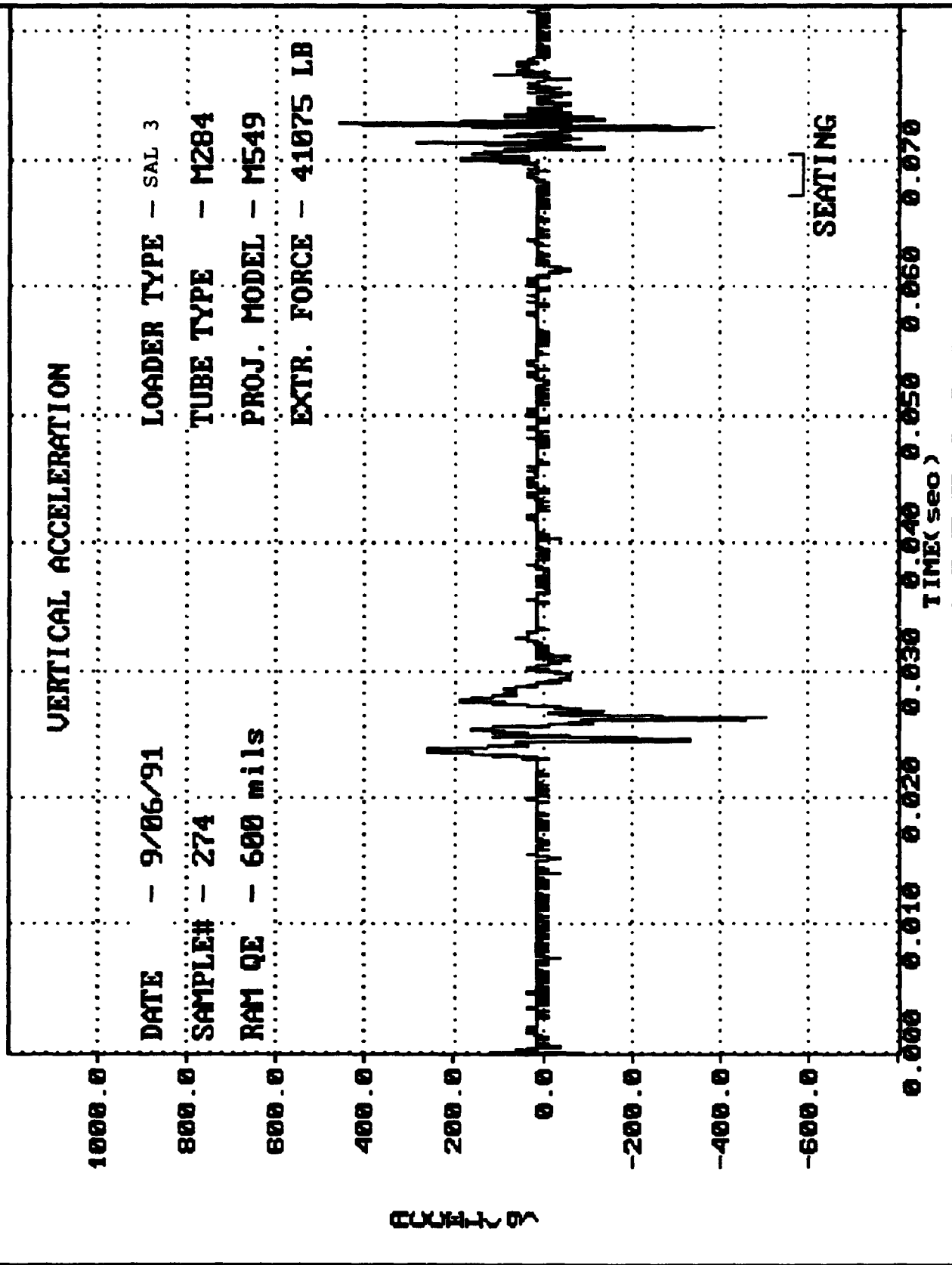
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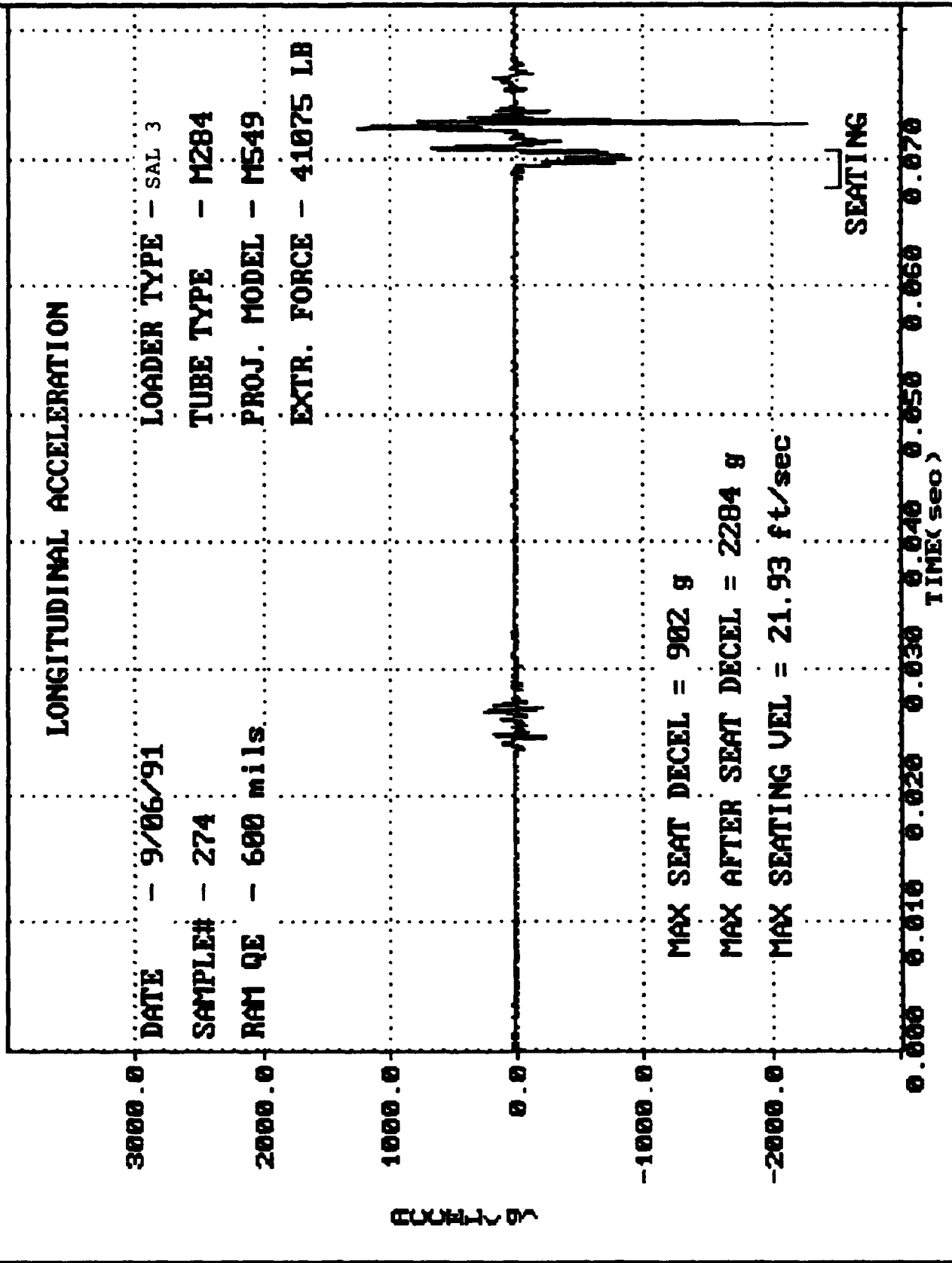
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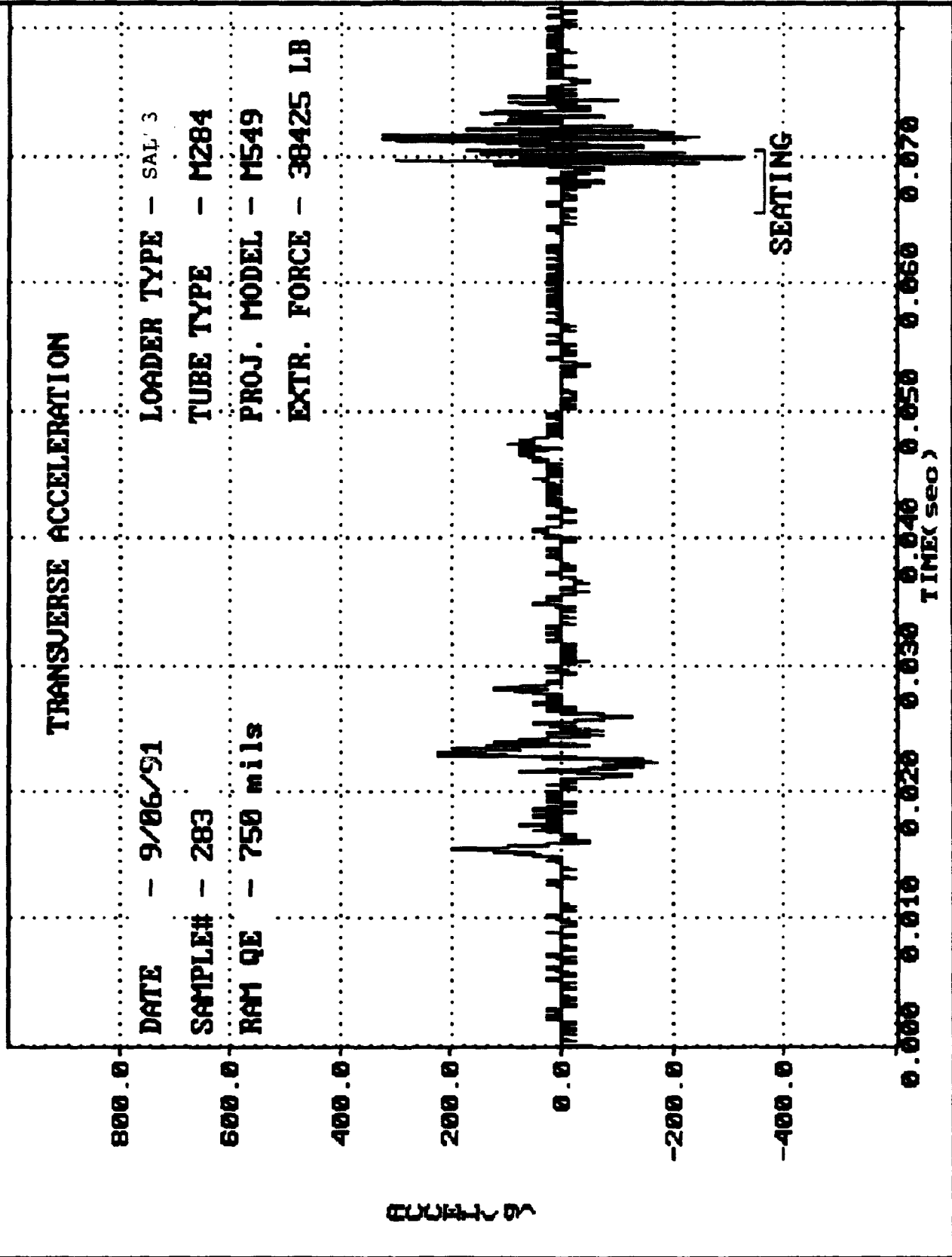
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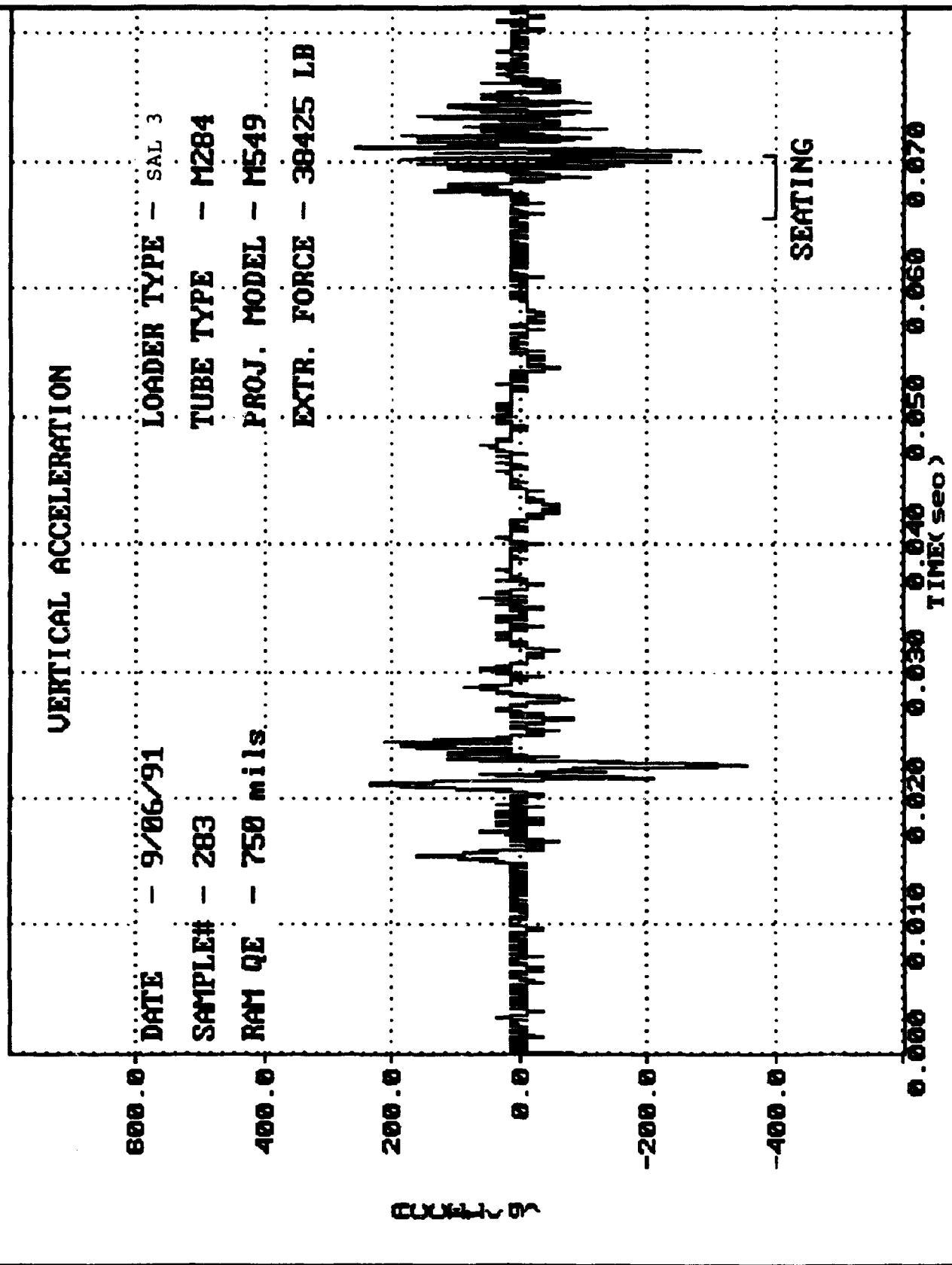
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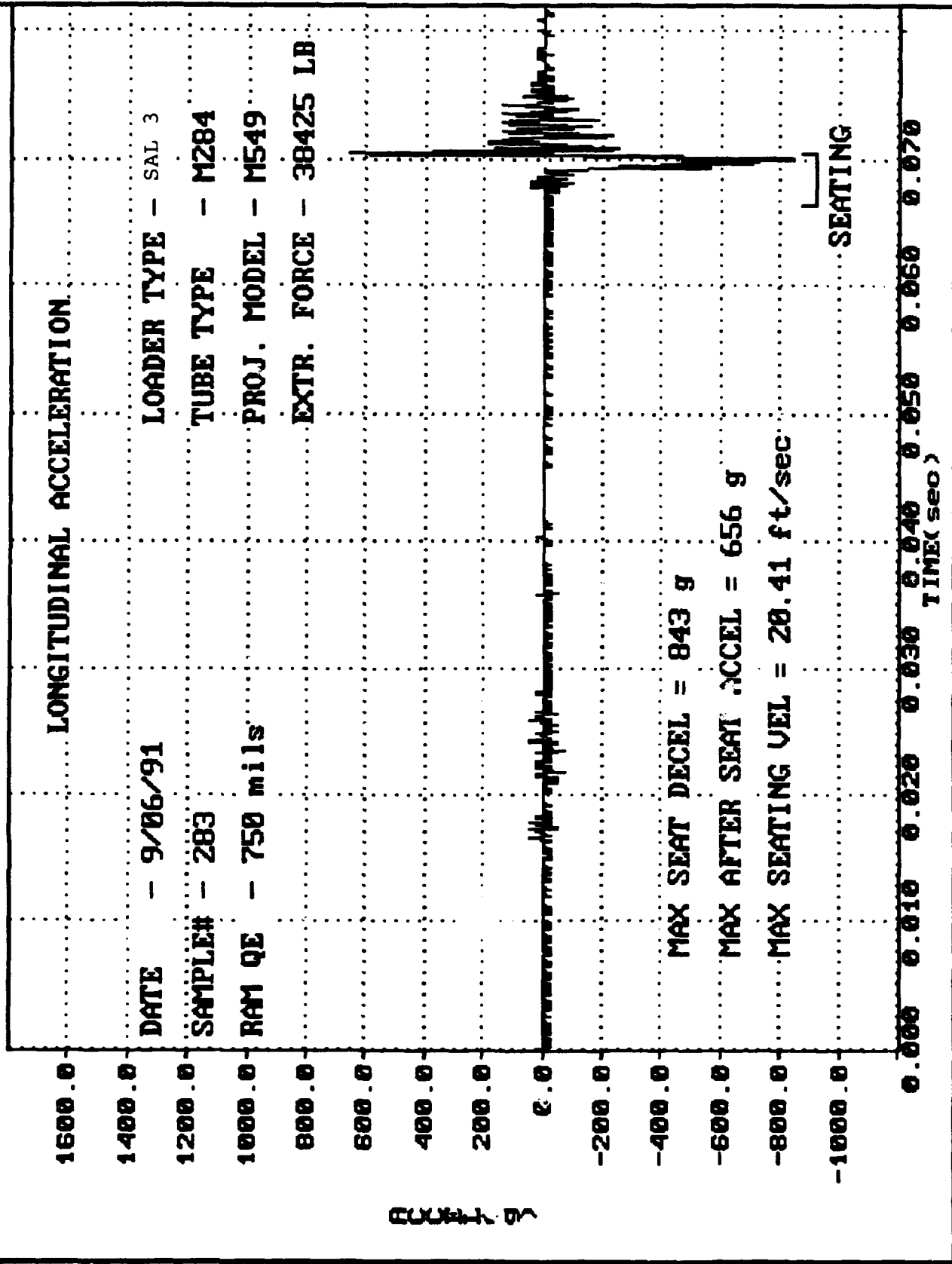
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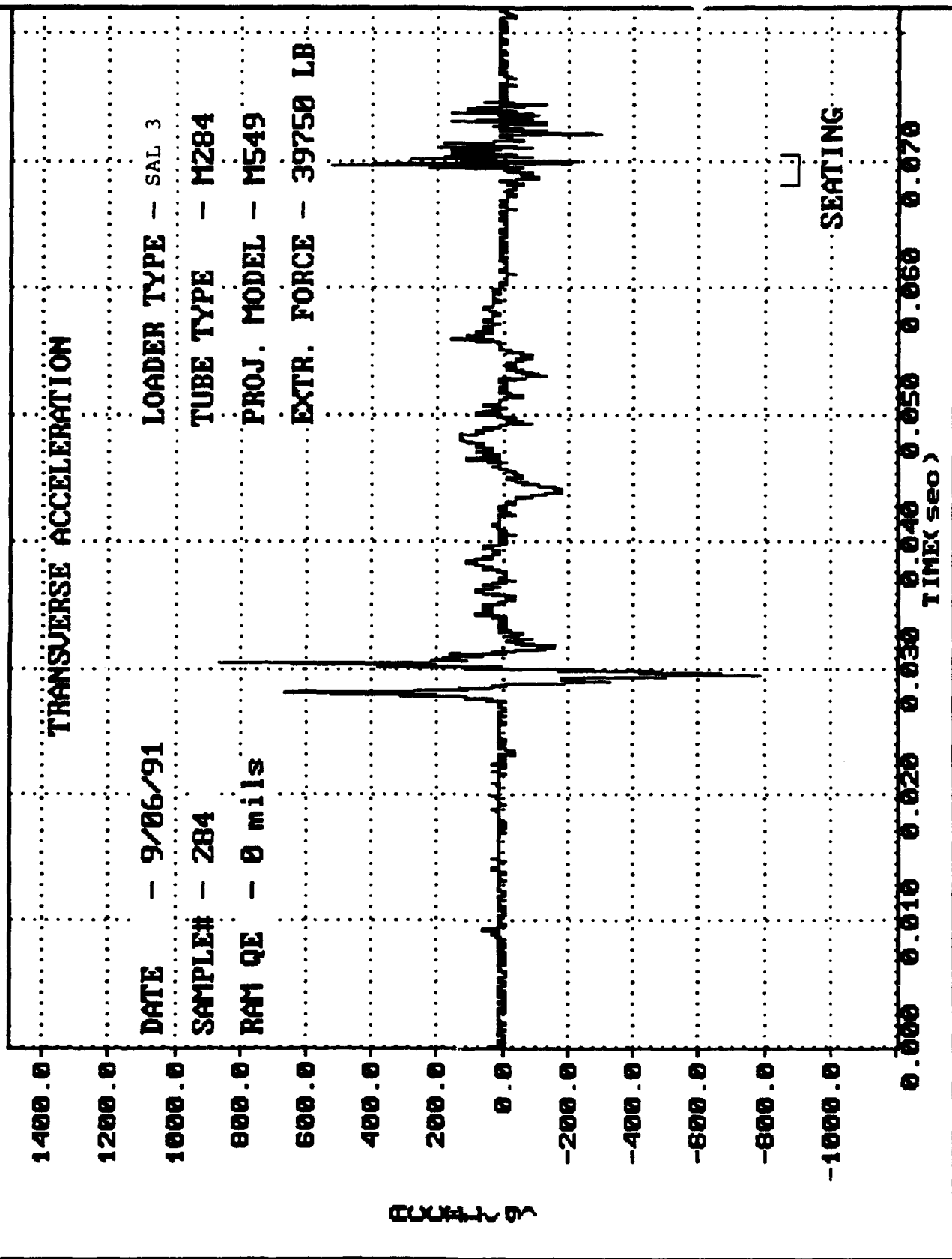
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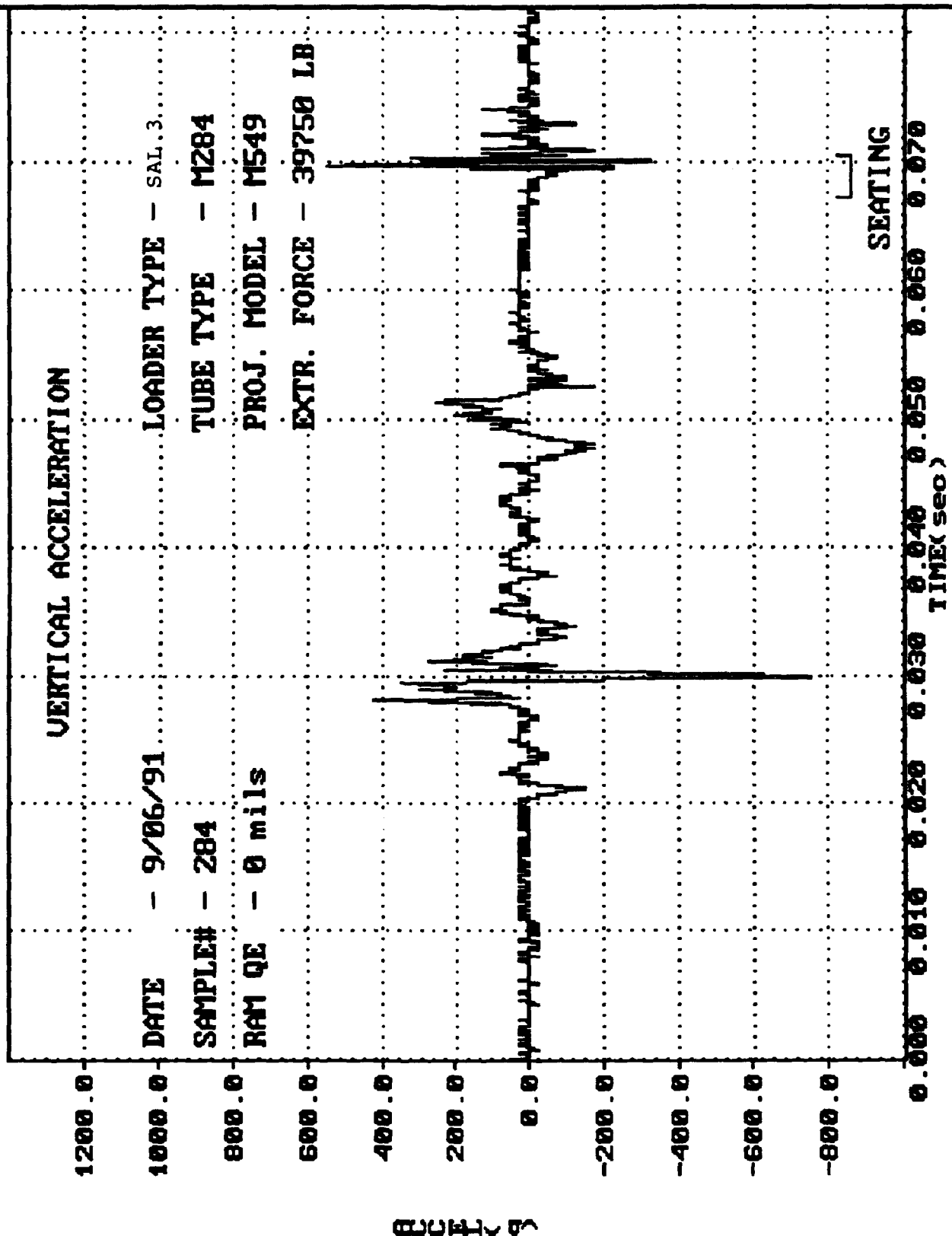
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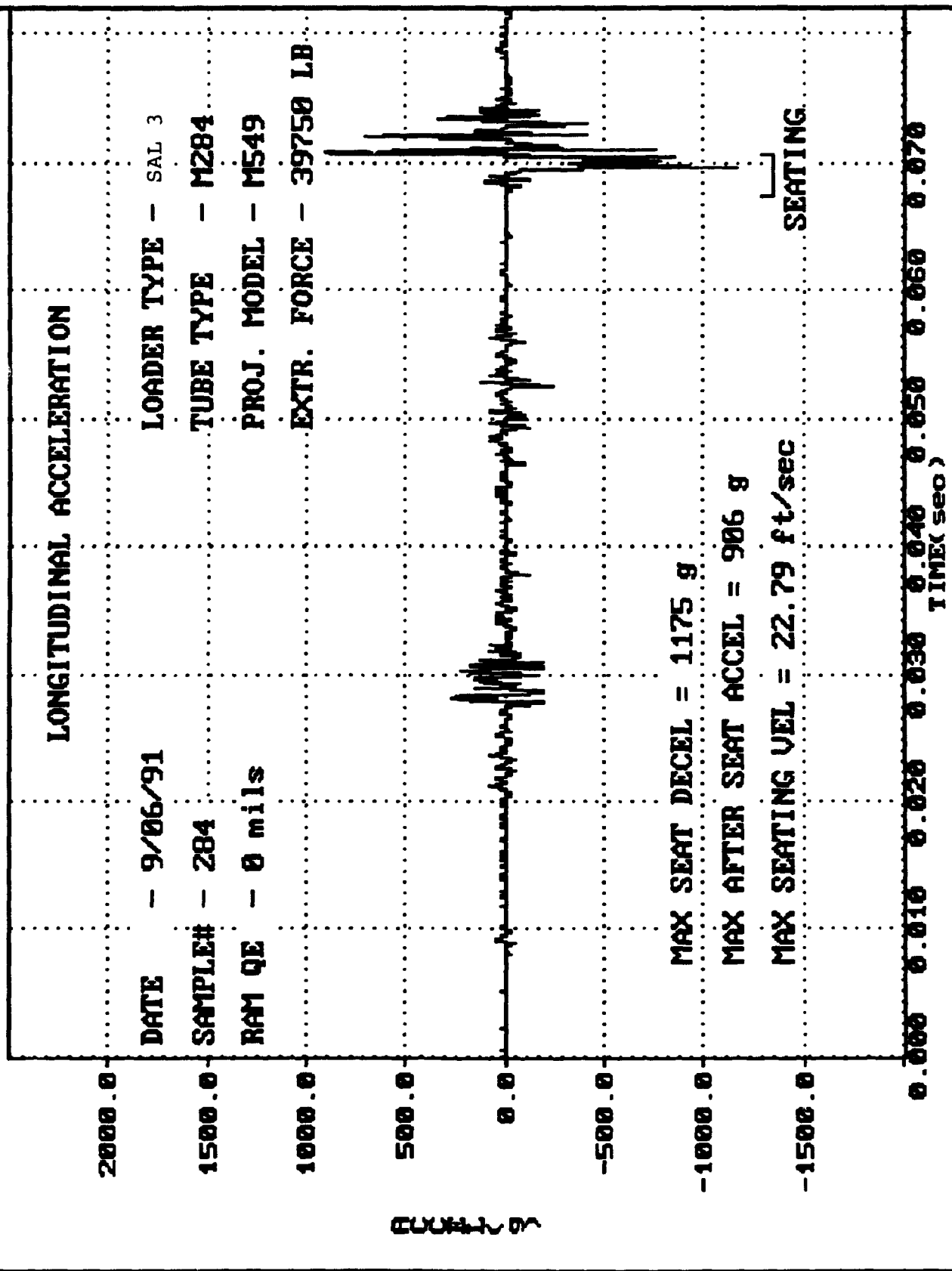
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Technical Report ARAED-TR-93026

INSTRUMENTATION FOR THE FOREIGN WEAPONS EVALUATION PROGRAM

Joseph Petrellese, Jr.

April 1994

Approved for public release; distribution unlimited.

Replace the table of contents and the appendix cover sheets with the attached pages.

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May 1994

ERRATA AD A 279128

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SAL 1 RAMS

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