



HSE

**Health & Safety
Executive**

**OFFSHORE TECHNOLOGY
REPORT - OTO 98 109**

**A Study of the Repeatability of
Explosion Tests
Preliminary Data Report for Test 13**

Explosions in Full Scale Offshore Module Geometries

Health & Safety Executive Contract MaTSU 8847/3522

Preliminary Data Report for Test 13

Summary of Experimental Conditions	
Date	5th August 1997
Time	13:46
Test Series	C
Confinement Configuration	C2
Obstacle Configuration	O1
Ignition Position	(X:13.5, Y:5.0, Z:4.25)
Mean Equivalence Ratio	1.07
Water Sprays	MV25 Full Area
Polythene Cut	No

All data contained in this preliminary report is subject to final confirmation.

CONTENTS

Table 1:	Flame Arrival Times
Table 2:	Internal Overpressures
Table 3:	External Overpressures
Table 4:	Gas Concentrations
Table 5:	Weather Conditions
Table 6:	Confinement Configuration
Appendix A	Internal Overpressure Profiles
Appendix B	External Overpressure Profiles
Appendix C	Strain Gauge Profiles
Appendix D	Linear Displacement Transducer Profiles

Table 1: Flame Arrival Times

Ionisation Probe	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Flame Arrival Time (msec)
IP-1	0.5	0.5	2.0	405.4
IP-2	6.0	0.5	2.0	378.5
IP-3	10.0	0.5	2.0	352.4
IP-4	14.0	0.5	2.0	309.2
IP-5	18.0	0.5	2.0	-
IP-6	22.0	0.5	2.0	326.6
IP-7	27.5	0.5	2.0	409.9
IP-8	0.5	4.0	2.0	394.5
IP-9	6.0	4.0	2.0	368.9
IP-10	14.0	4.0	2.0	317.2
IP-11	22.0	4.0	2.0	358.9
IP-12	27.5	4.0	2.0	399.2
IP-13	0.5	8.0	2.0	397.7
IP-14	6.0	8.0	2.0	381.1
IP-15	10.0	8.0	2.0	353.7
IP-16	14.0	8.0	2.0	314.8
IP-17	18.0	8.0	2.0	355.9
IP-18	22.0	8.0	2.0	378.3
IP-19	27.5	8.0	2.0	407.5
IP-20	0.5	11.5	2.0	409.9
IP-21	2.0	11.5	2.0	400.2
IP-22	6.0	11.5	2.0	390.7
IP-23	10.0	11.5	2.0	357.5
IP-24	14.0	11.5	2.0	369.4
IP-25	18.0	11.5	2.0	398.4
IP-26	22.0	11.5	2.0	481.1
IP-27	26.0	11.5	2.0	408.0
IP-28	27.5	11.5	2.0	401.0
IP-29	0.5	0.5	4.0	411.1
IP-30	6.0	0.5	4.0	365.1
IP-31	10.0	0.5	4.0	541.5
IP-32	14.0	0.5	4.0	291.4
IP-33	18.0	0.5	4.0	345.2

Ionisation Probe	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Flame Arrival Time (msec)
IP-34	22.0	0.5	4.0	370.8
IP-35	26.0	0.5	4.0	393.4
IP-36	27.5	0.5	4.0	370.7
IP-37	0.5	4.0	4.0	394.6
IP-38	6.0	4.0	4.0	364.0
IP-39	14.0	4.0	4.0	141.8
IP-40	22.0	4.0	4.0	394.0
IP-41	26.0	4.0	4.0	362.1
IP-42	27.5	4.0	4.0	402.2
IP-43	0.5	8.0	4.0	399.6
IP-44	2.0	8.0	4.0	-
IP-45	6.0	8.0	4.0	361.5
IP-46	10.0	8.0	4.0	325.5
IP-47	14.0	8.0	4.0	298.5
IP-48	18.0	8.0	4.0	334.2
IP-49	22.0	8.0	4.0	369.5
IP-50	26.0	8.0	4.0	408.9
IP-51	27.5	8.0	4.0	-
IP-52	26.0	10.0	4.0	418.3
IP-53	27.5	10.0	4.0	394.0
IP-54	0.5	11.5	4.0	419.8
IP-55	2.0	11.5	4.0	432.8
IP-56	6.0	11.5	4.0	-
IP-57	10.0	11.5	4.0	360.2
IP-58	14.0	11.5	4.0	365.7
IP-59	18.0	11.5	4.0	370.6
IP-60	22.0	11.5	4.0	398.8
IP-61	26.0	11.5	4.0	490.4
IP-62	27.5	11.5	4.0	422.6
IP-63	0.5	0.5	6.0	398.9
IP-64	6.0	0.5	6.0	371.7
IP-65	10.0	0.5	6.0	360.5
IP-66	14.0	0.5	6.0	352.9
IP-67	18.0	0.5	6.0	362.8

Ionisation Probe	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Flame Arrival Time (msec)
IP-68	22.0	0.5	6.0	384.3
IP-69	27.5	0.5	6.0	408.7
IP-70	0.5	4.0	6.0	397.7
IP-71	6.0	4.0	6.0	371.2
IP-72	14.0	4.0	6.3	298.2
IP-73	22.0	4.0	6.0	370.8
IP-74	27.5	4.0	6.0	398.4
IP-75	0.5	8.0	6.0	394.4
IP-76	6.0	8.0	6.0	397.3
IP-77	10.0	8.0	6.0	347.0
IP-78	14.0	8.0	6.0	304.8
IP-79	18.0	8.0	6.0	338.6
IP-80	22.0	8.0	6.0	359.1
IP-81	27.5	8.0	6.0	411.5
IP-82	0.5	11.5	6.0	404.9
IP-83	2.0	11.5	6.0	401.3
IP-84	6.0	11.5	6.0	379.4
IP-85	10.0	11.5	6.0	361.4
IP-86	14.0	11.5	6.0	355.2
IP-87	18.0	11.5	6.0	361.8
IP-88	22.0	11.5	6.0	394.2
IP-89	26.0	11.5	6.0	432.6
IP-90	27.5	11.5	6.0	405.1

Table 2: Internal Overpressures

Pressure Transducer	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Maximum Overpressure (mbar)	1.5ms Running Average			
					Maximum Overpressure (mbar)	Time of Arrival (ms)	Idealised Profile Representation	
							Rise Time (ms)	Duration (ms)
PI-1	0.8	0.0	1.5	836.2	828.3	402.2	42.9	67.3
PI-2	5.8	0.0	1.5	638.8	614.8	400.6	77.8	109.2
PI-3	13.9	0.0	1.5	530.9	520.7	402.6	107.2	159.7
PI-4	21.9	0.0	1.5	658.3	628.7	388.0	57.5	116.9
PI-5	26.9	0.0	1.5	575.1	479.1	416.4	72.6	102.8
PI-6	0.5	6.0	0.0	828.5	749.7	406.2	54.2	83.3
PI-7	9.0	6.0	0.0	462.7	453.9	389.5	90.0	150.5
PI-8	14.0	6.0	0.0	520.9	506.2	400.9	99.8	153.8
PI-9	21.0	6.0	0.0	458.8	437.1	392.5	77.2	134.3
PI-10	27.5	6.0	0.0	579.7	524.1	402.6	55.8	95.3
PI-11	0.5	11.5	0.0	715.0	663.7	412.5	57.9	78.1
PI-12	12.3	11.5	0.0	345.4	338.3	368.4	61.5	147.6
PI-13	27.5	11.5	0.0	542.5	519.2	422.6	73.7	85.2
PI-14	0.8	0.5	4.0	967.1	883.9	397.3	38.1	53.5
PI-15	4.5	0.6	4.0	-	-	-	-	-
PI-16	11.2	0.0	5.5	663.9	535.9	398.4	99.6	128.0
PI-17	12.0	0.5	4.0	457.9	447.5	397.9	109.2	156.5
PI-18	22.0	0.5	4.0	537.4	524.9	383.0	55.1	118.0
PI-19	27.5	0.5	4.0	744.6	519.2	414.4	66.8	87.4
PI-20	10.2	4.0	4.0	434.8	421.9	393.6	104.8	155.4
PI-21	0.5	7.0	4.0	583.3	530.1	407.4	62.1	92.0
PI-22	18.0	8.0	4.0	358.9	347.2	393.7	97.5	147.7
PI-23	27.5	6.0	4.0	475.8	443.5	411.2	68.0	101.7
PI-24	0.5	11.5	4.0	504.8	464.9	412.3	62.5	84.6
PI-25	10.0	11.5	4.0	294.8	274.6	384.4	81.7	147.4
PI-26	18.0	11.5	4.0	319.7	300.1	369.2	56.9	137.1
PI-27	27.5	11.5	4.0	667.4	488.0	417.2	66.9	84.0
PI-28	0.8	0.8	8.0	1,249.3	858.4	401.0	44.4	51.3
PI-29	13.9	1.7	8.0	804.8	460.7	401.3	107.2	151.1
PI-30	26.1	1.7	8.0	955.4	547.0	415.5	72.6	78.0
PI-31	5.9	5.0	8.0	529.7	489.1	377.3	59.4	137.4
PI-32	18.9	5.0	8.0	448.3	422.8	367.6	65.2	153.4
PI-33	1.1	11.1	8.0	475.5	411.9	395.7	47.3	84.6
PI-34	12.8	11.2	8.0	332.9	300.8	364.5	57.2	149.2
PI-35	26.1	11.3	8.0	552.8	473.2	401.6	51.4	82.1

Table 3 : External Overpressures

Pressure Transducer	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Maximum Overpressure (mbar)	Maximum Overpressure 1.5ms Running Average (mbar)
PE-1	28.0	6.0	4.0	479.4	450.6
PE-2	40.0	6.0	1.0	714.8	375.2
PE-3	52.0	6.0	1.0	380.6	305.8
PE-4	76.0	6.0	1.0	192.6	141.7
PE-5	47.2	25.2	1.0	271.0	229.1
PE-6	61.3	39.3	1.0	187.0	165.5
PE-7	14.0	18.0	1.0	216.1	204.6
PE-8	14.0	24.0	1.0	567.6	548.6
PE-9	14.0	36.0	1.0	168.1	160.7
PE-10	14.0	60.0	1.0	102.9	93.9
PE-11	-21.2	25.2	1.0	361.9	225.4

Table 4: Gas Concentrations

Measuring Position	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)	Natural Gas Concentration (%)
1	24.1	4.4	1.4	9.5
2	12.0	8.3	0.8	9.5
3	1.0	2.4	1.1	9.5
4	7.7	9.8	3.5	9.5
5	14.1	5.2	4.3	-
6	26.2	2.0	5.3	-
7	7.6	8.1	4.9	-
8	19.8	7.8	7.7	9.5

Table 5: Weather Conditions

Air Temperature (°C)	Atmospheric Pressure (mbar)	Wind Speed (ms ⁻¹)	Wind Direction (° from Magnetic North)
15.6	987	6.3	98

Table 6: Confinement Configuration

Confinement Configuration	Rig Face*	Confinement
C2	North	Open
	East	Open
	South	Confined
	West	Open

* - Origin is at the junction of the West and South faces at ground level. Roof and floor also confined.

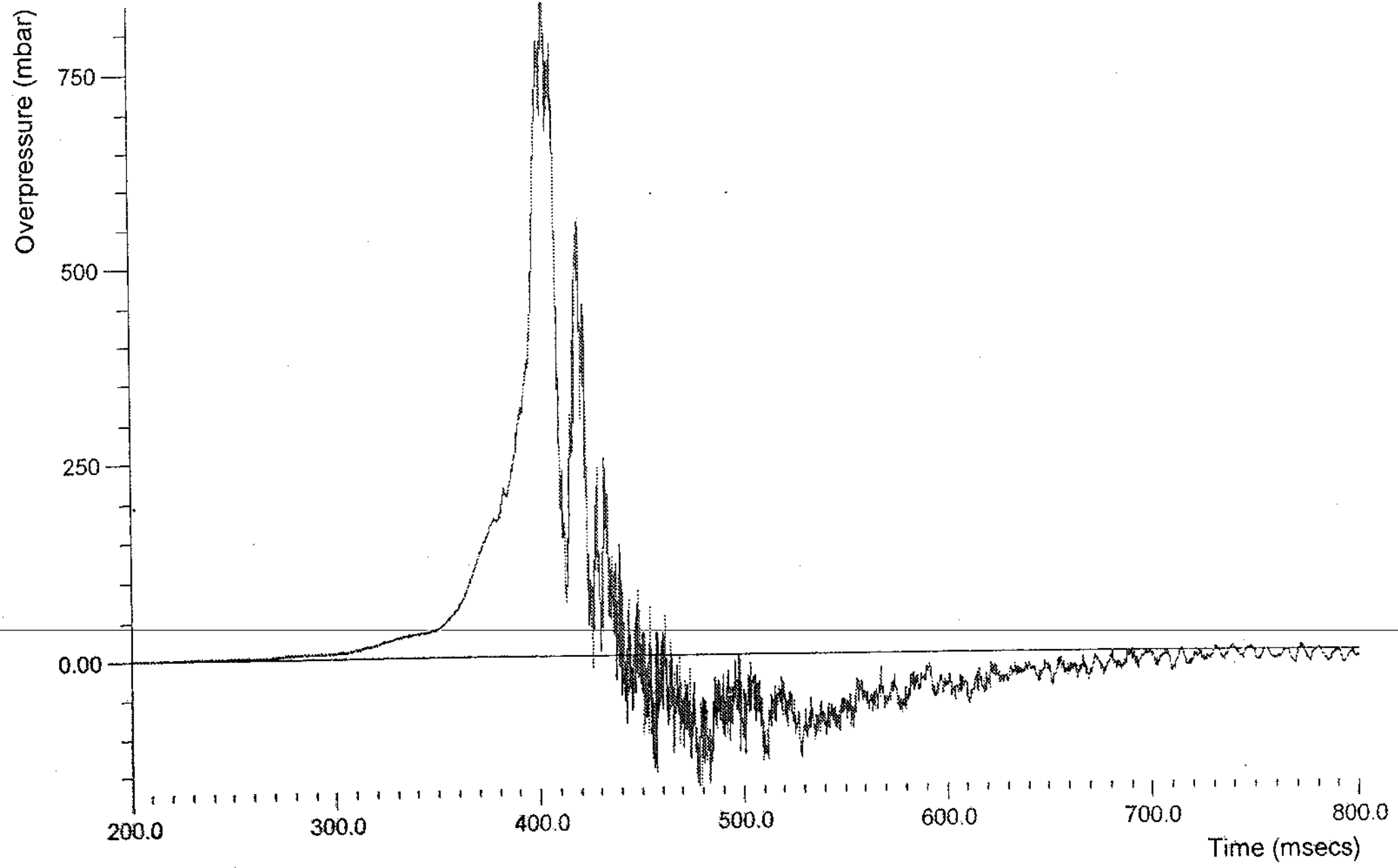
Table 7: Water Deluge Configuration

Nozzle Type	MV25
Number of Nozzles in Mezzanine Deck	75
Number of Nozzles in Cellar Deck	17
Water Inlet Pressure (barg)	-
Water Pressure at Nozzle (barg)	-
Total Water Flowrate (l min ⁻¹)	4594
Area Coverage - Cellar Deck (l min ⁻¹ m ⁻²)	13.7
Area Coverage - Mezzanine Deck (l min ⁻¹ m ⁻²)*	11.0

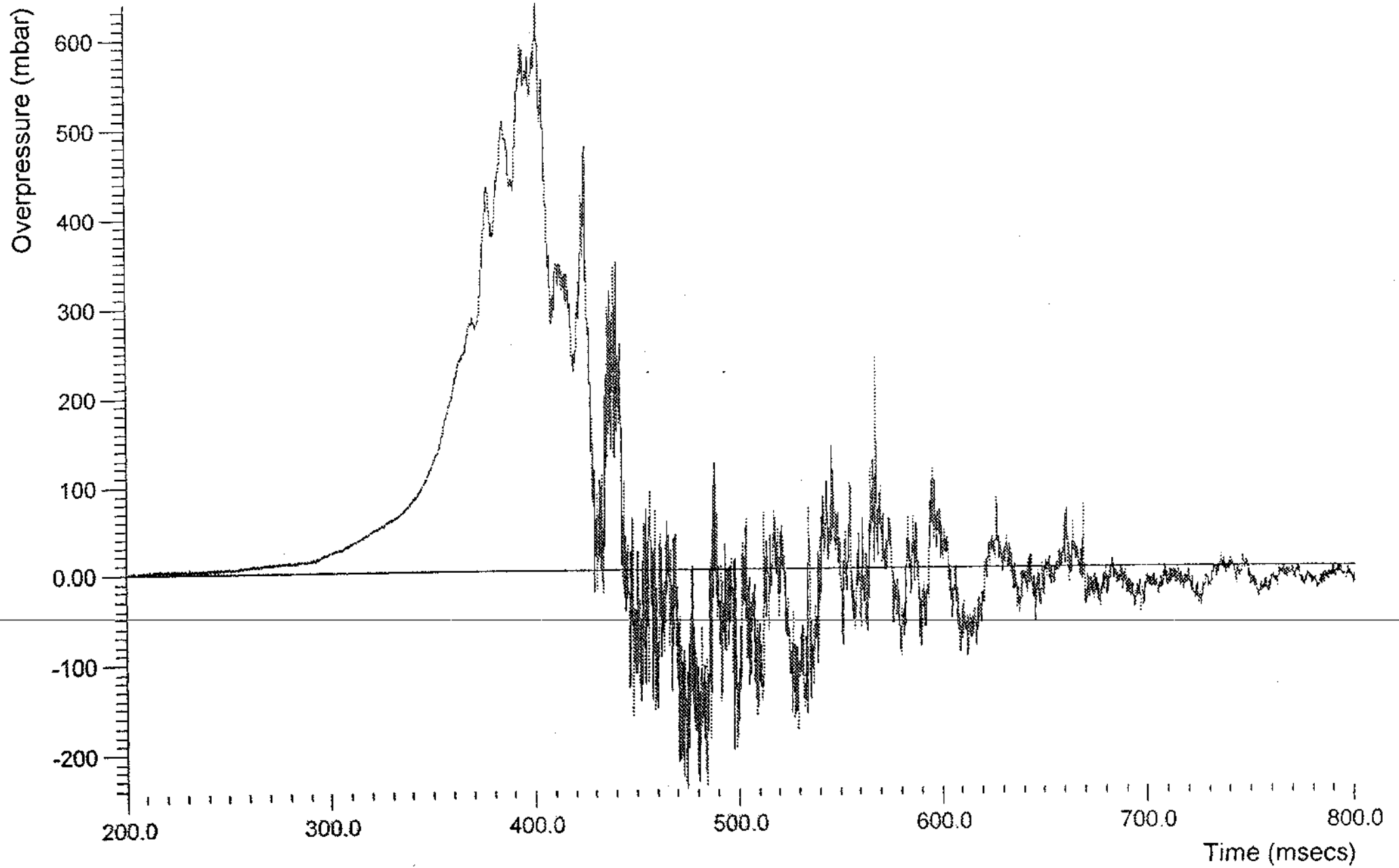
* The area coverage at the mezzanine deck is obtained using the area coverage at the cellar deck and the analysis of the water deluge system performed by Frontline Engineering and Consultancy Limited.

Appendix A: Internal Overpressure Profiles

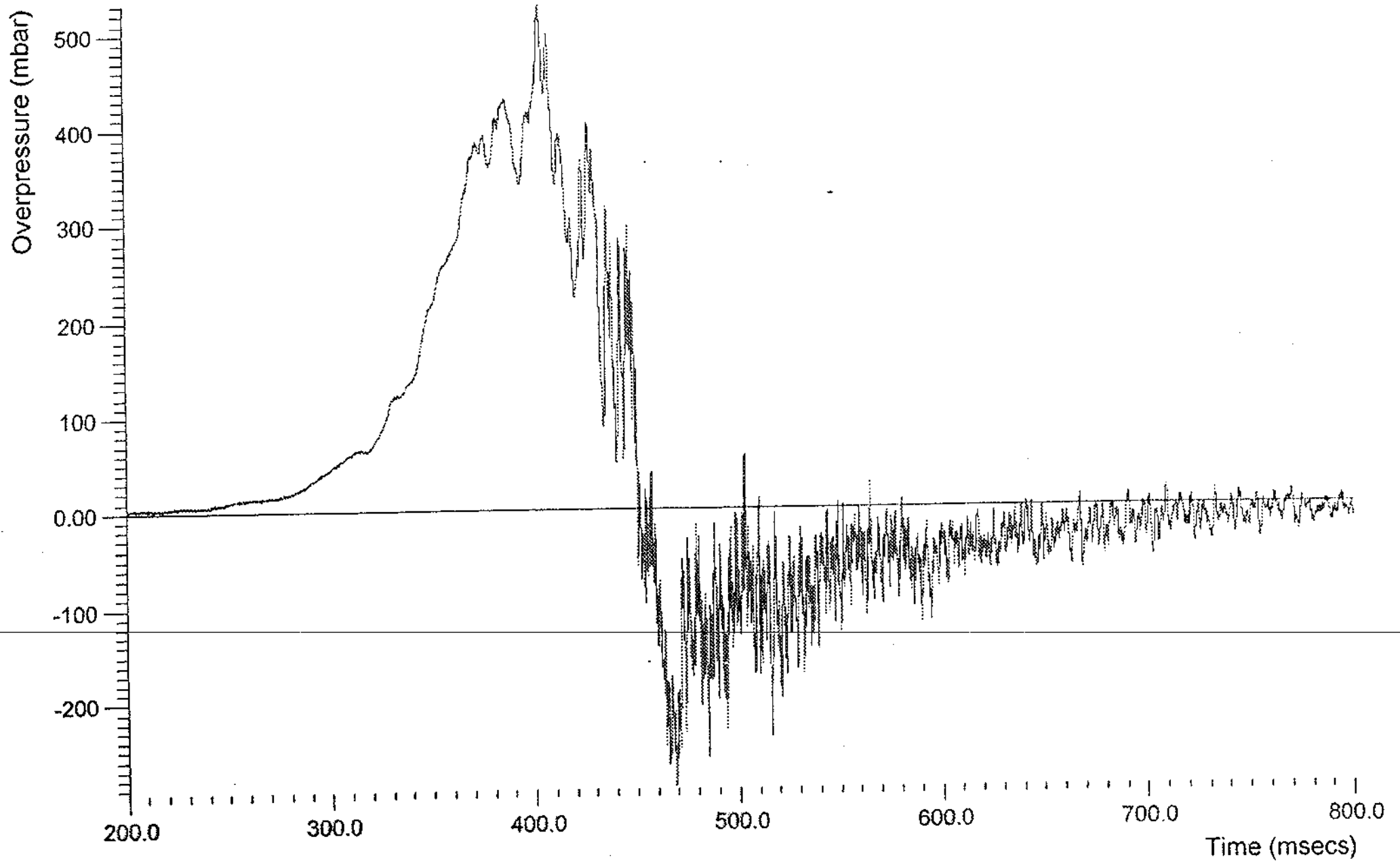
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-1



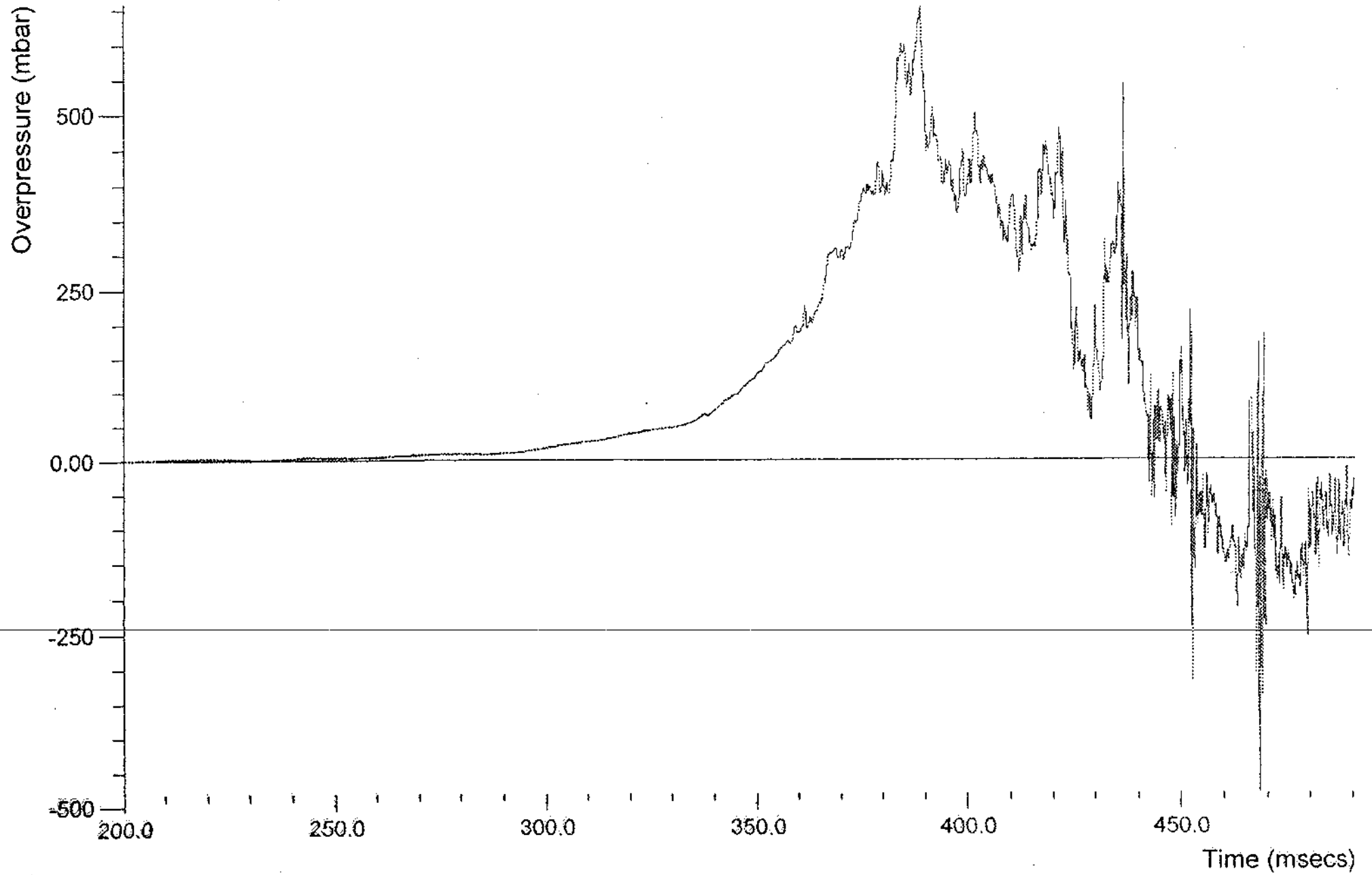
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-2



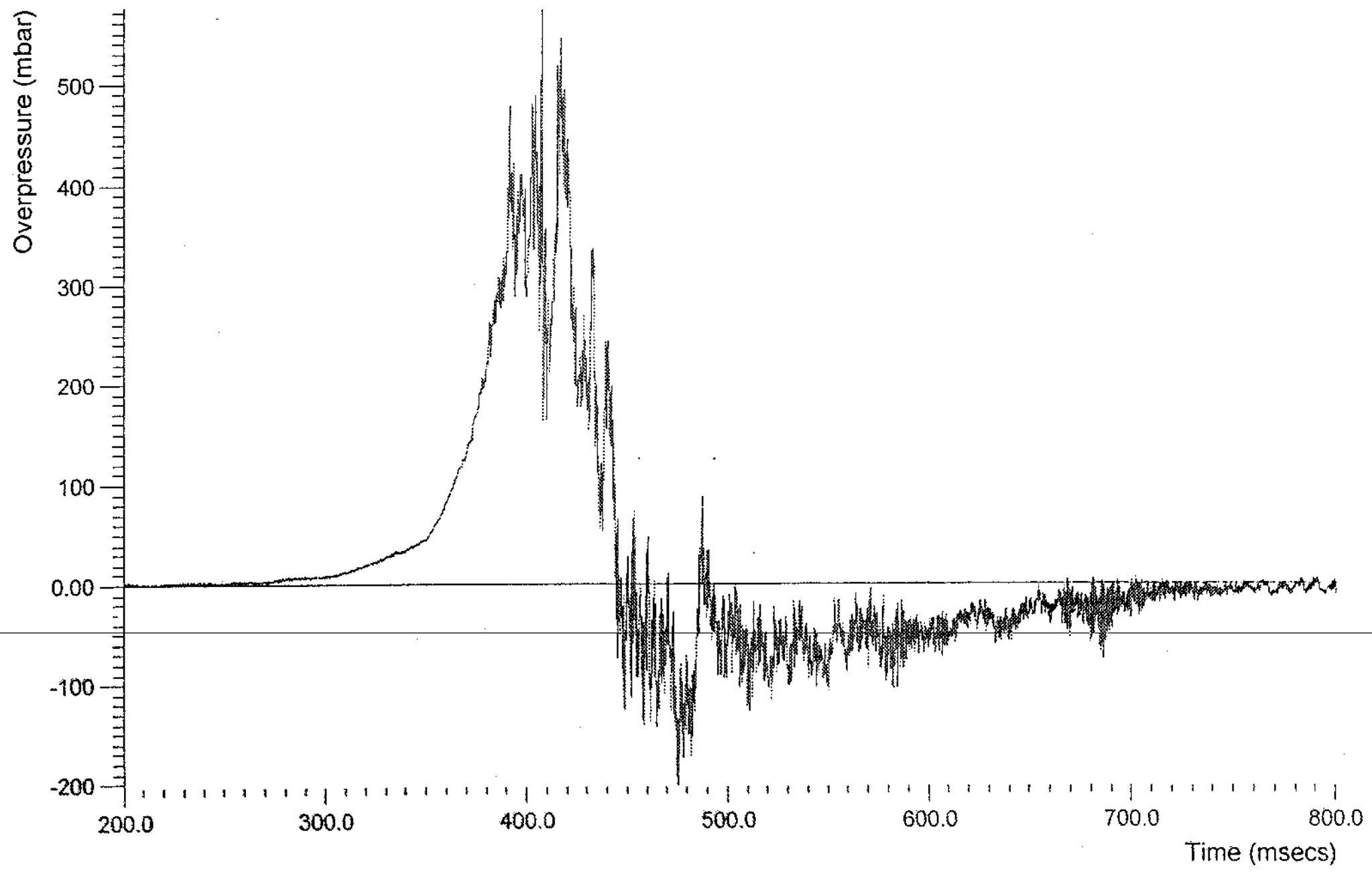
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-3



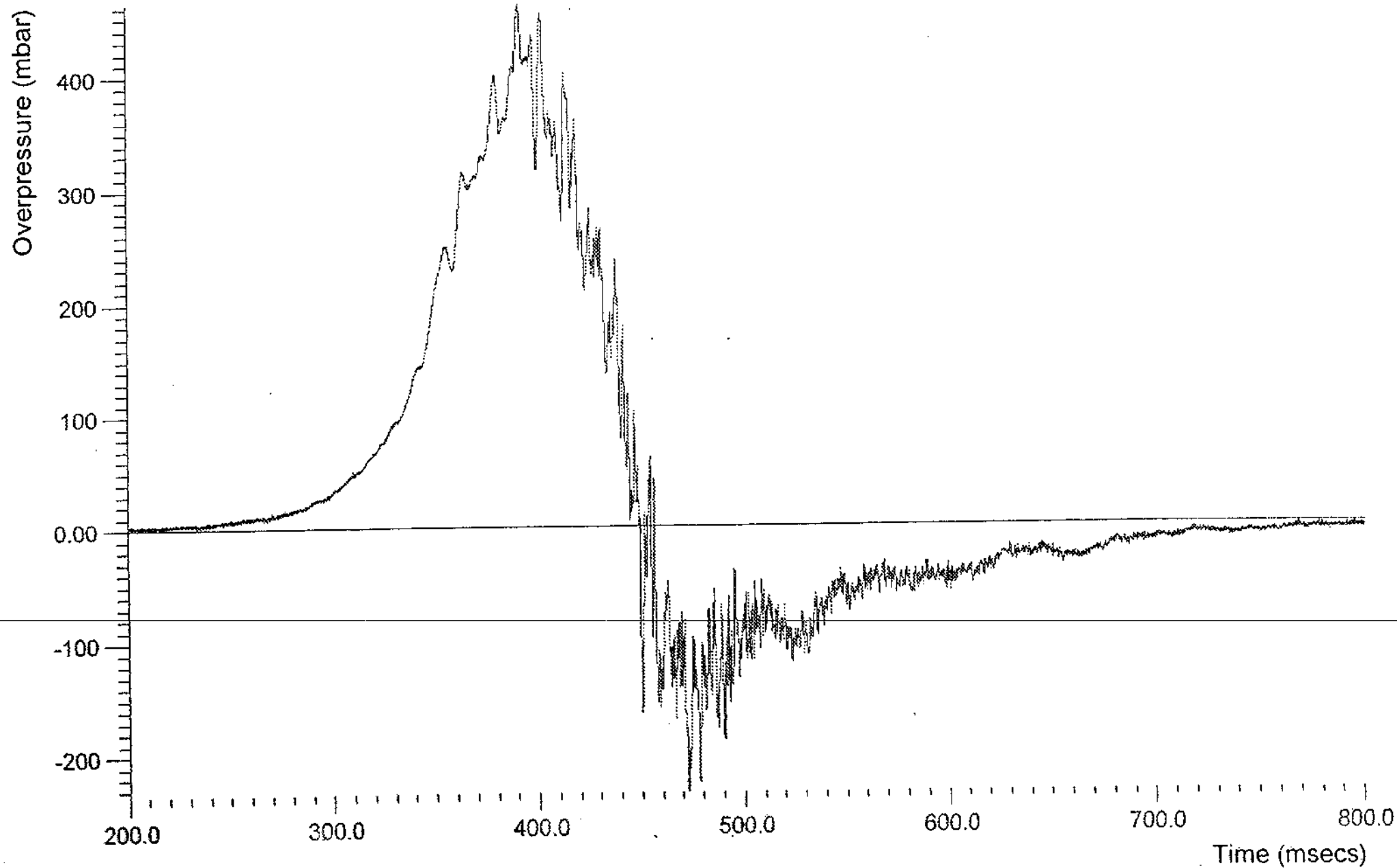
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-4



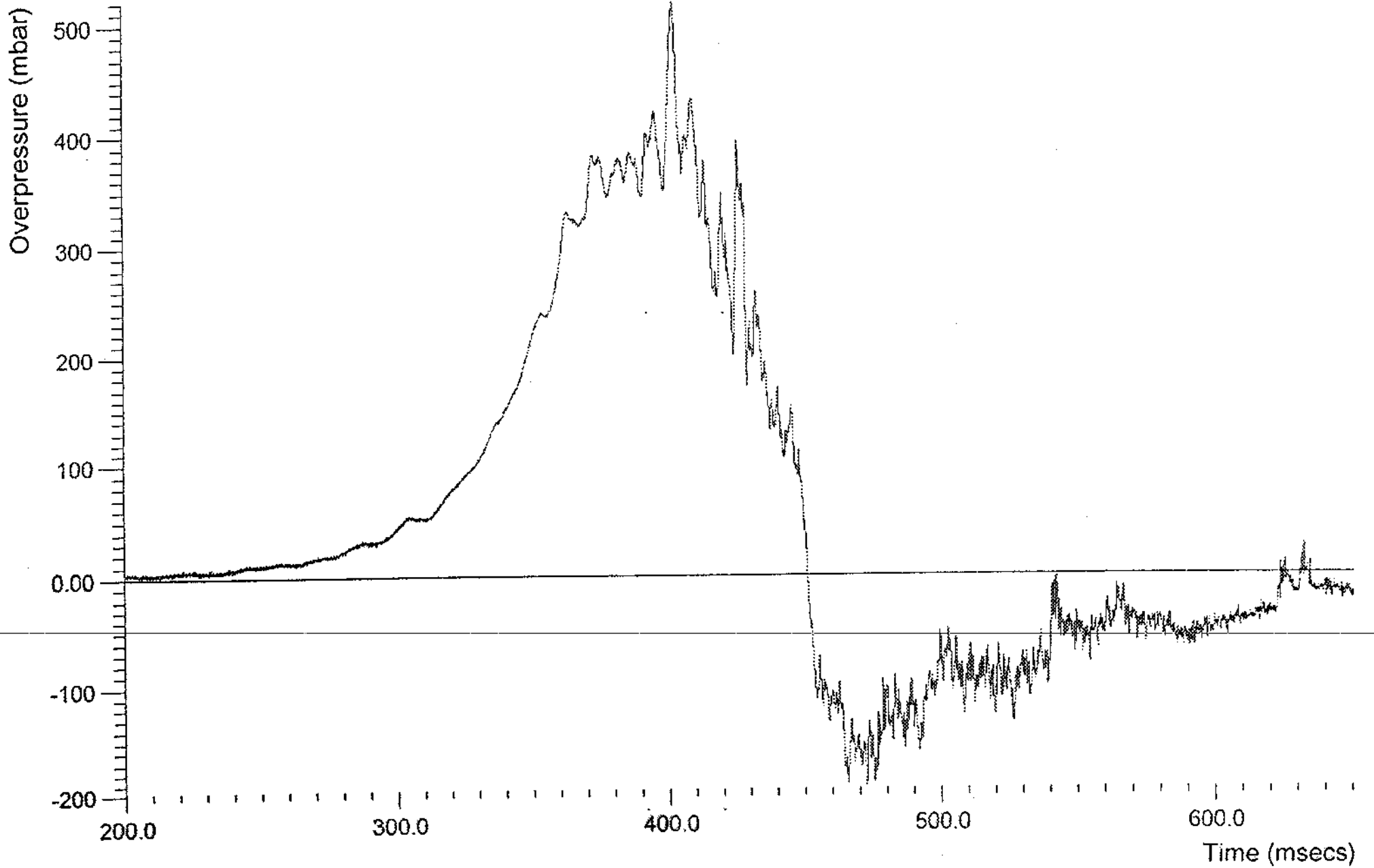
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-5



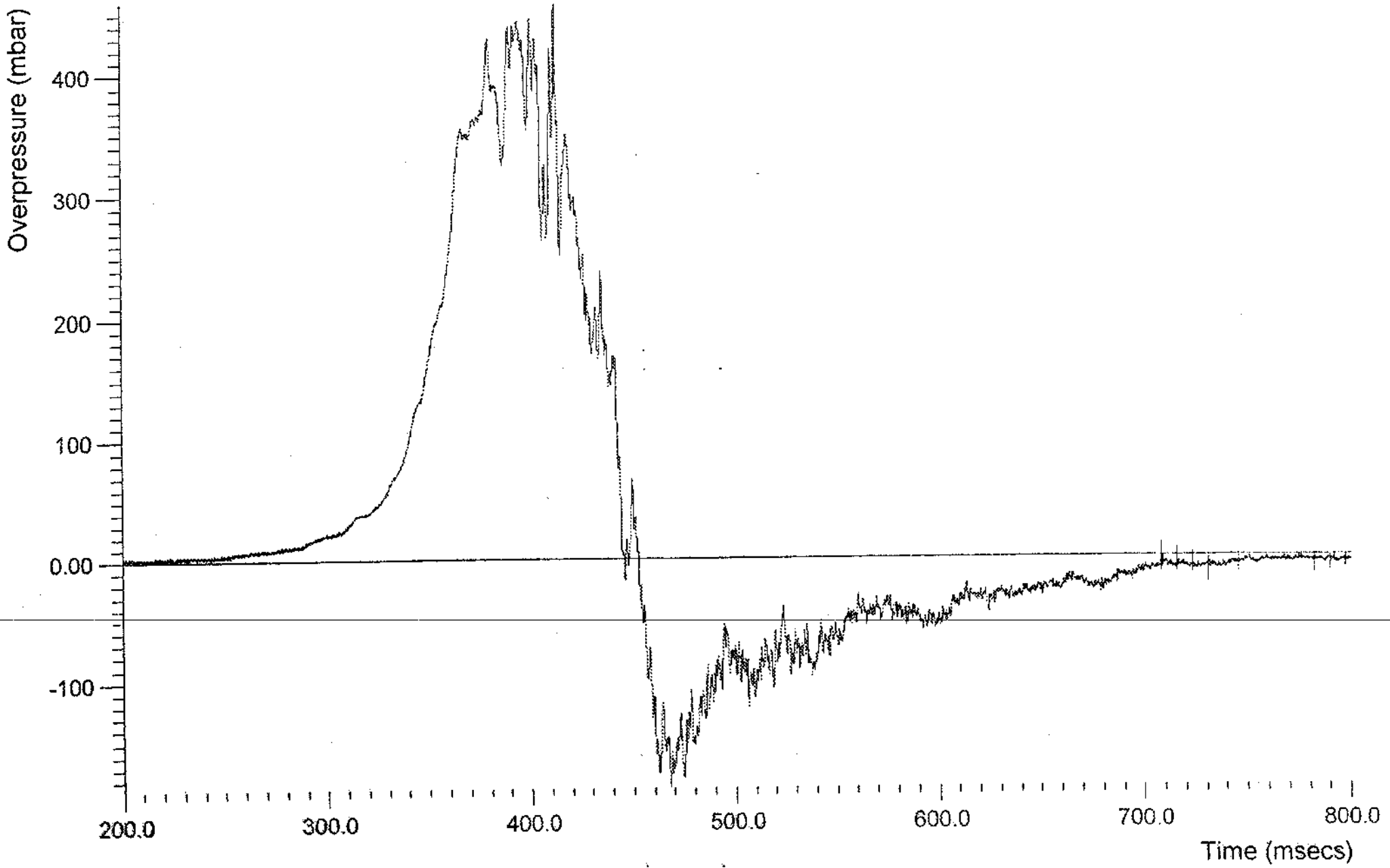
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-7



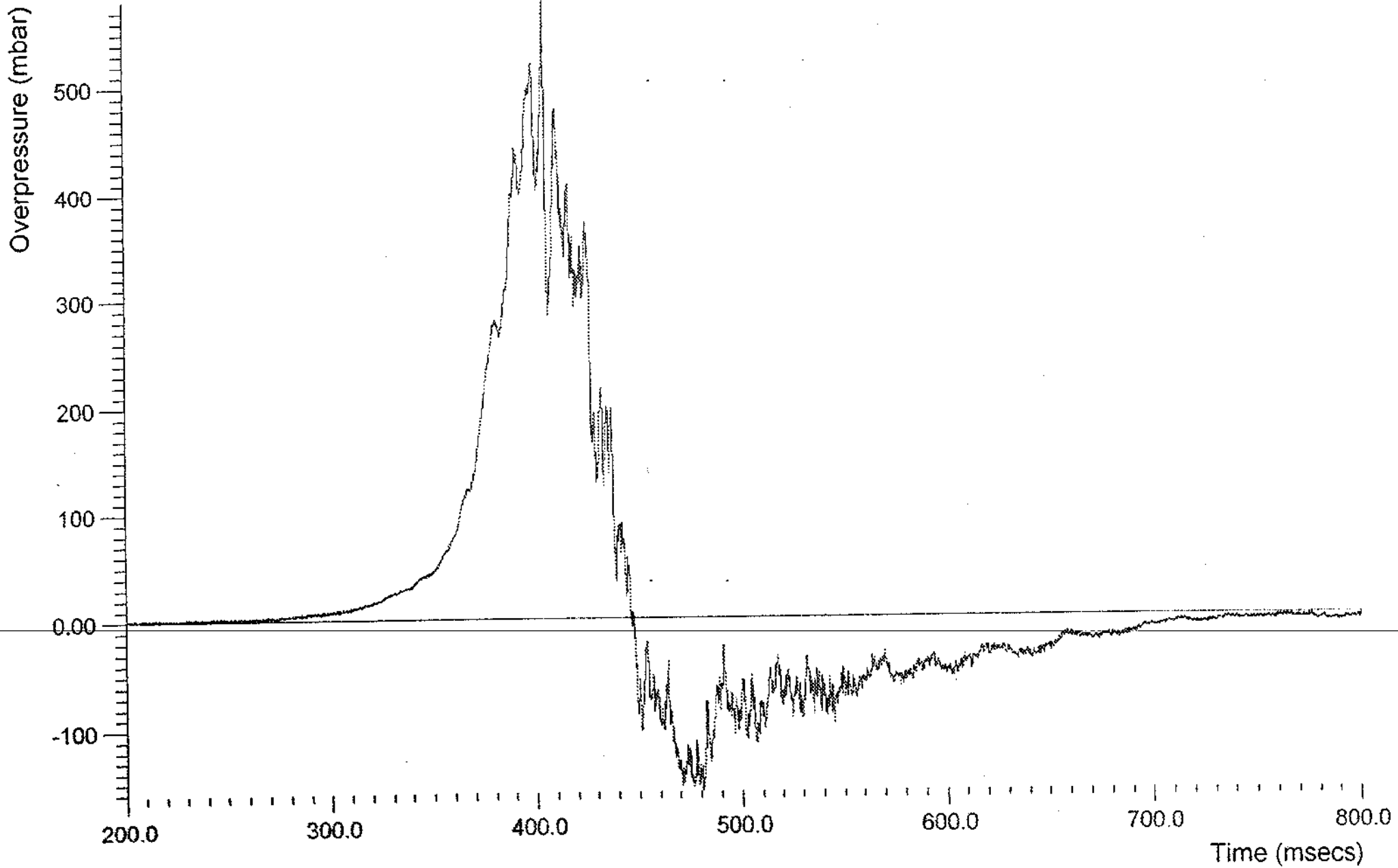
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-8



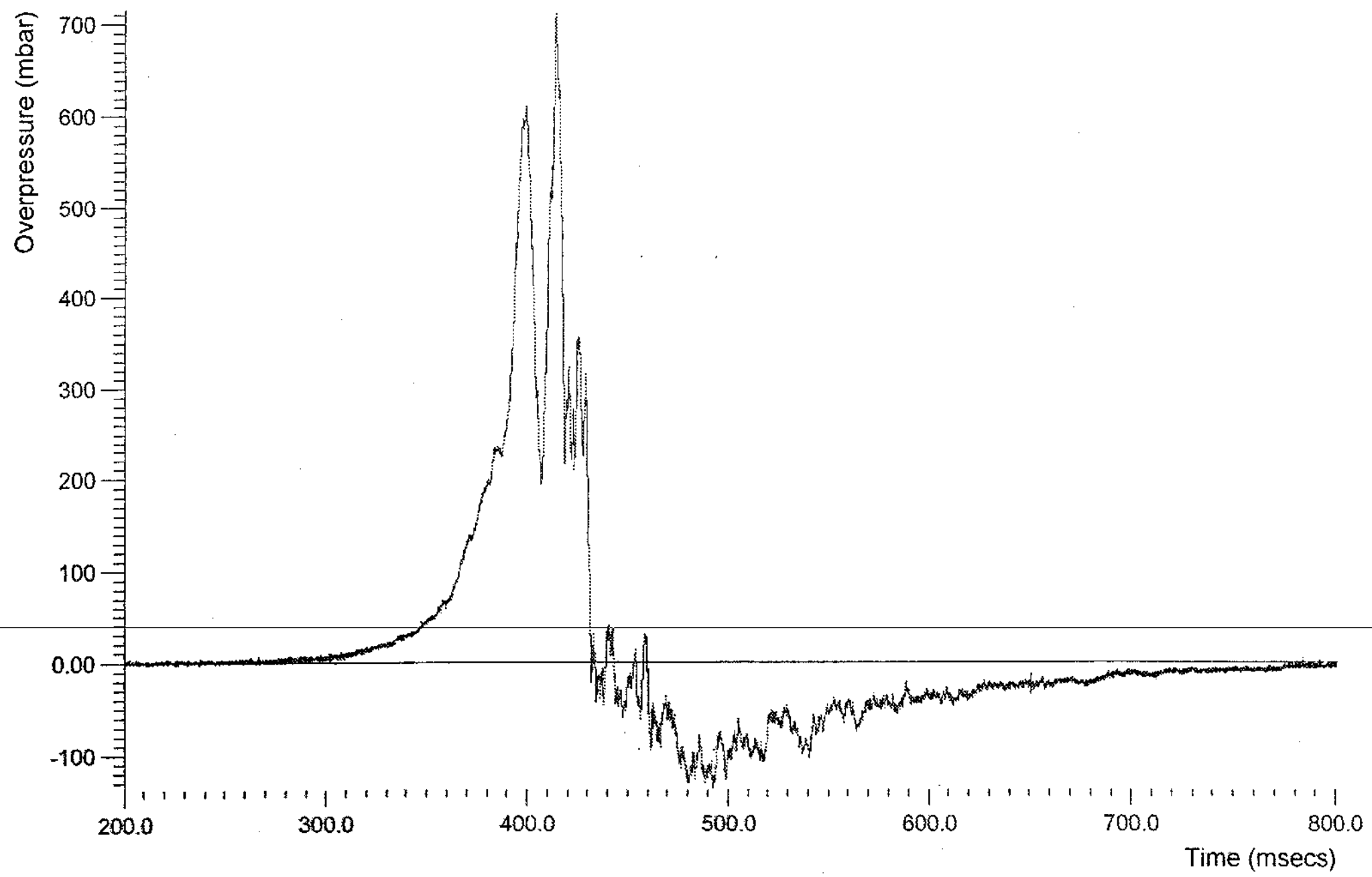
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-9



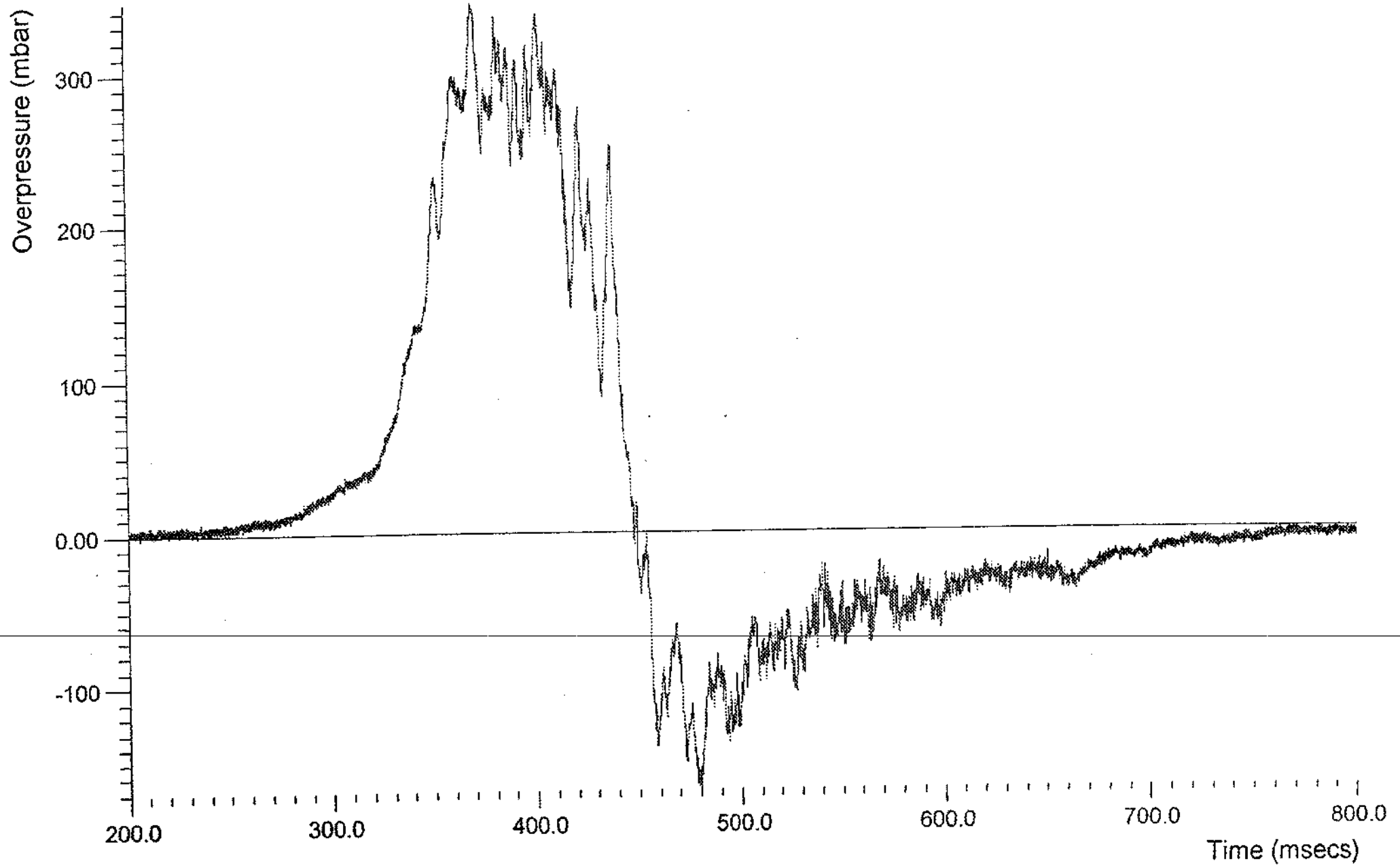
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-10



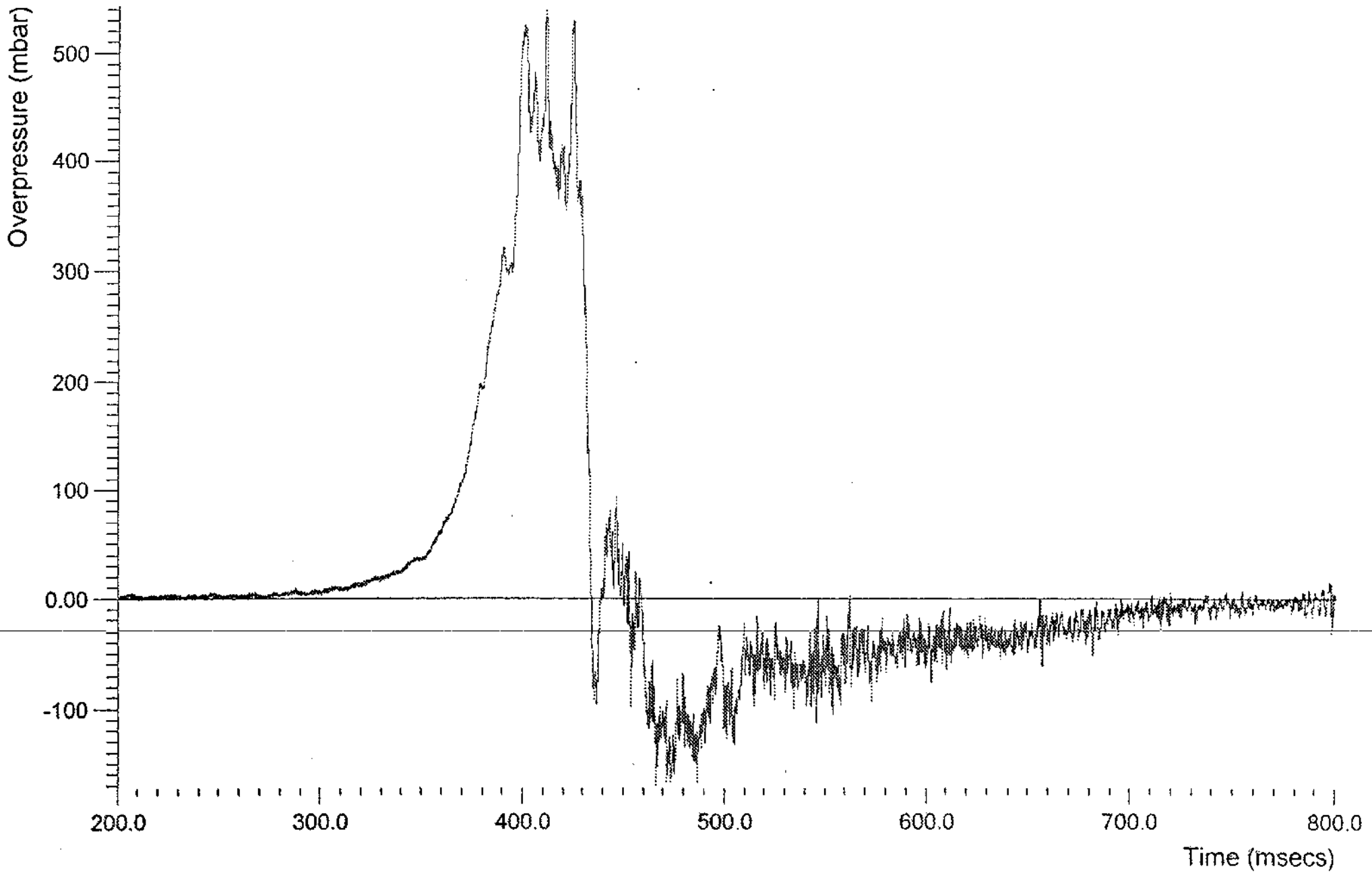
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-11



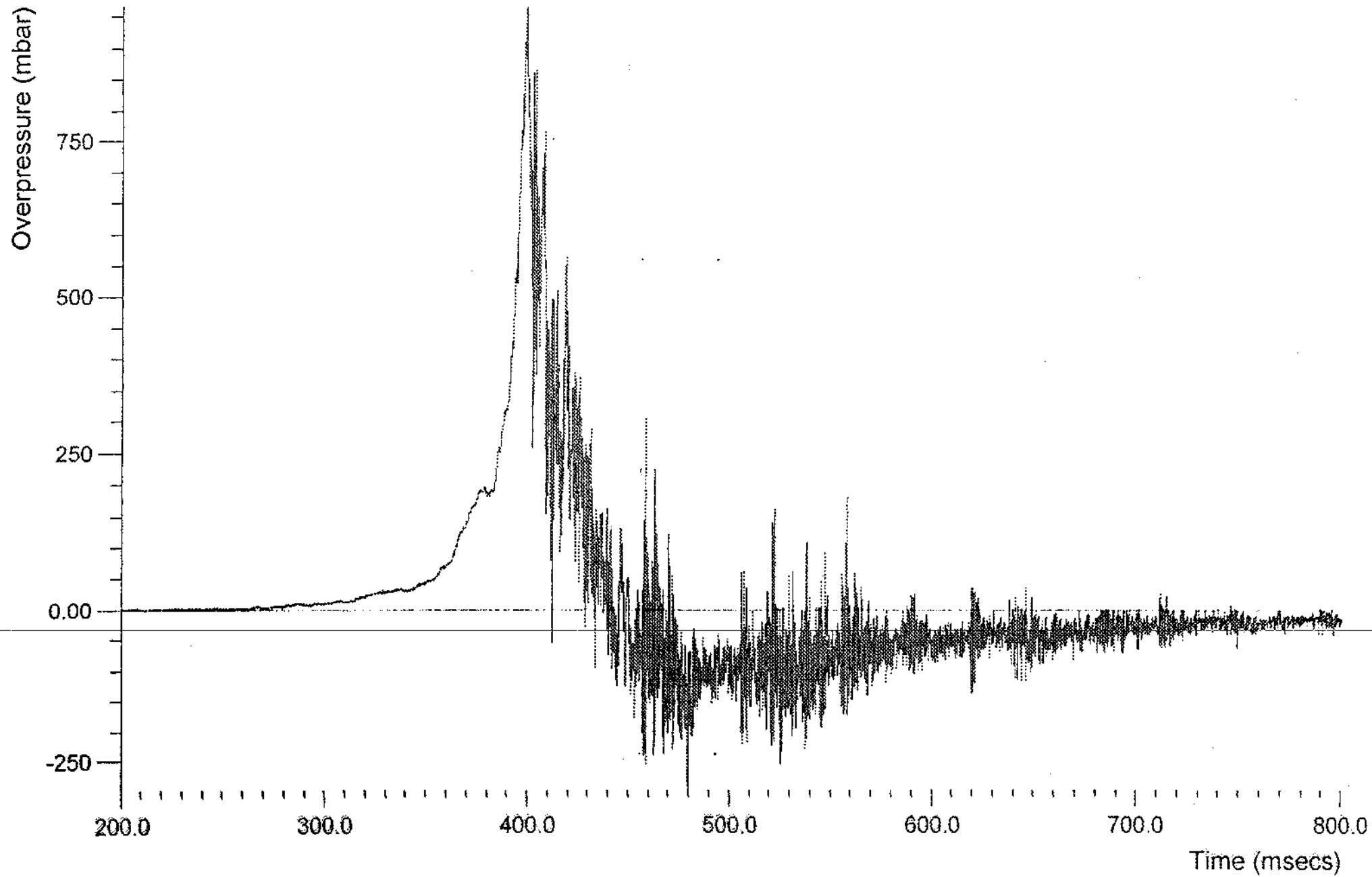
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-12



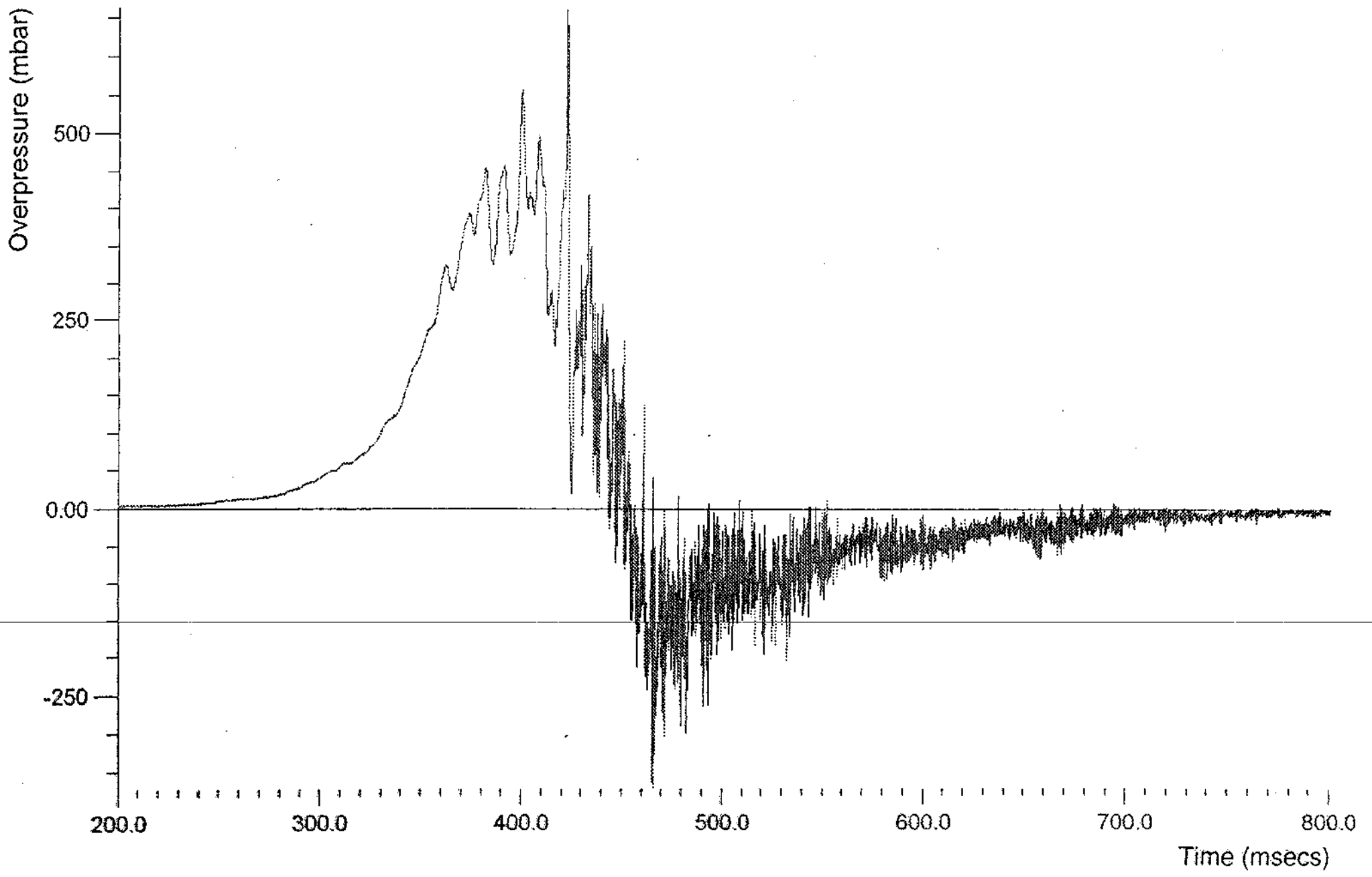
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-13



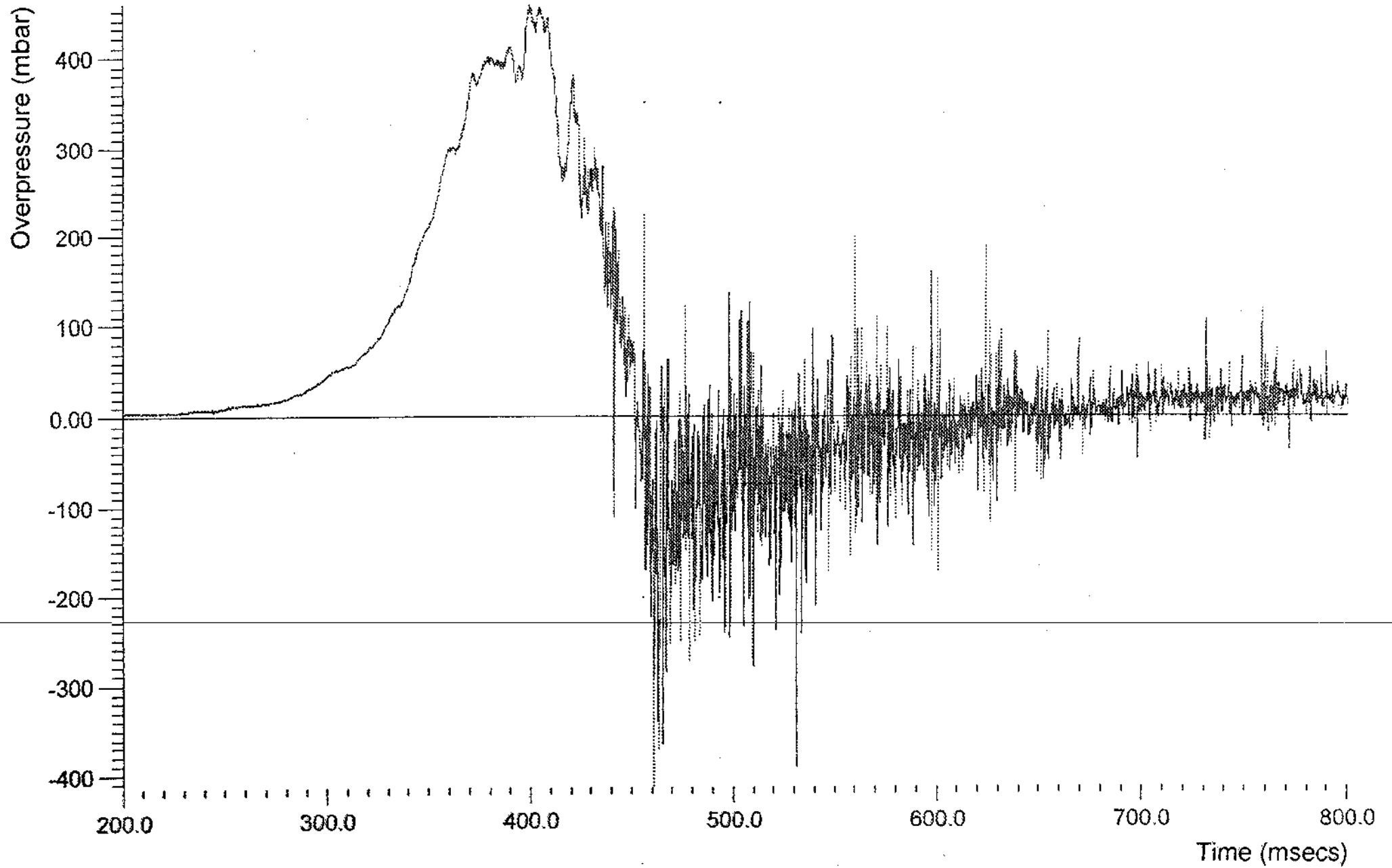
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-14



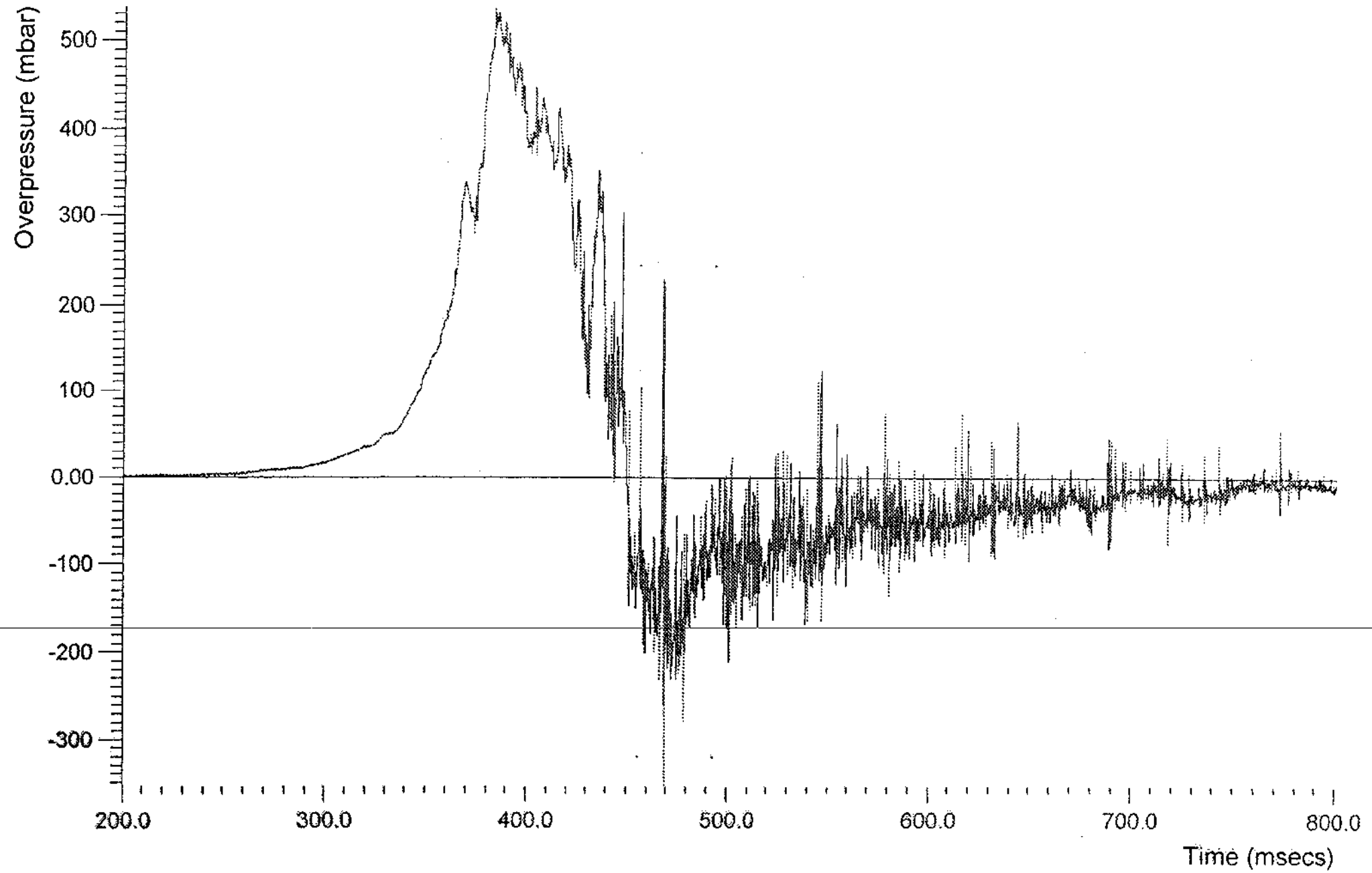
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-16



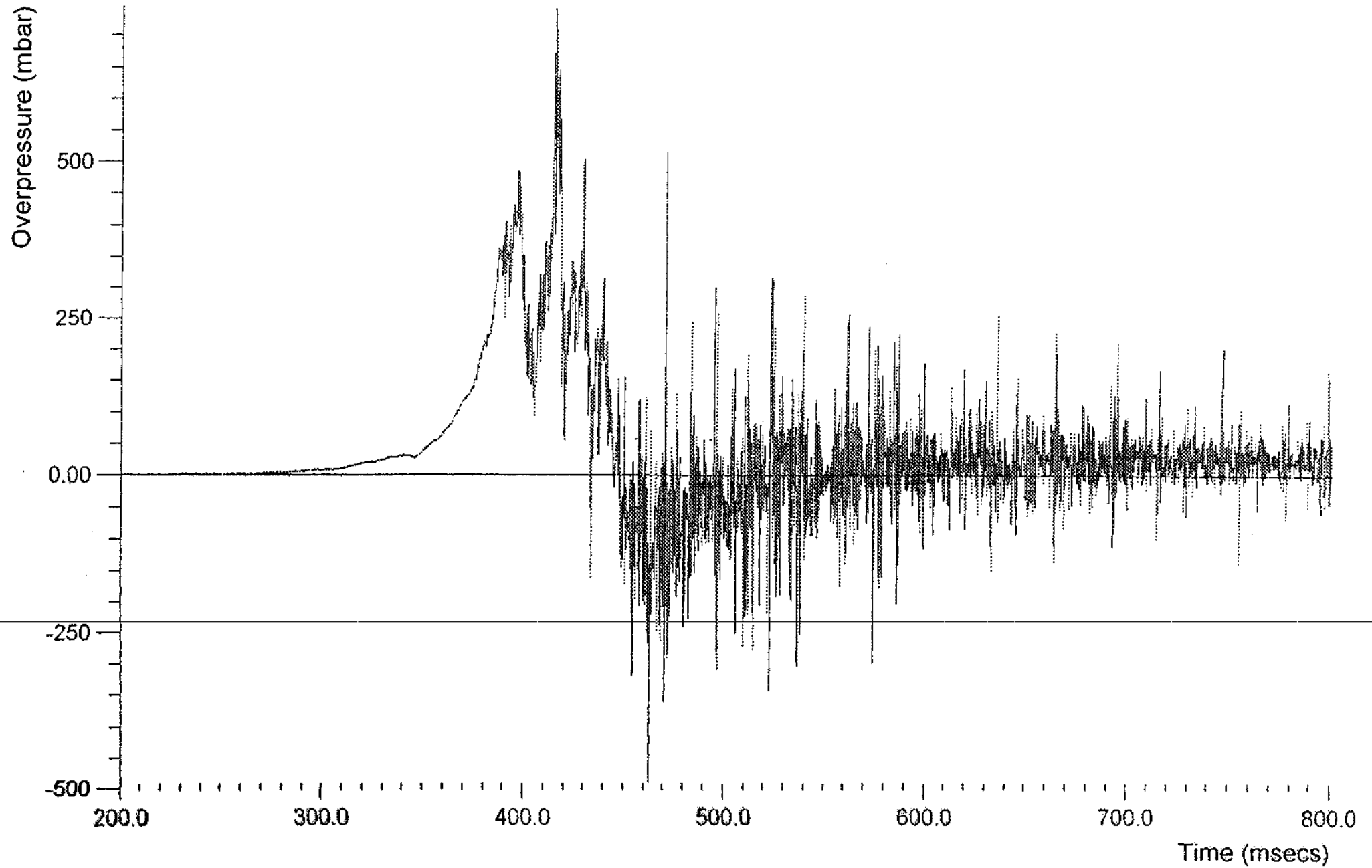
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-17



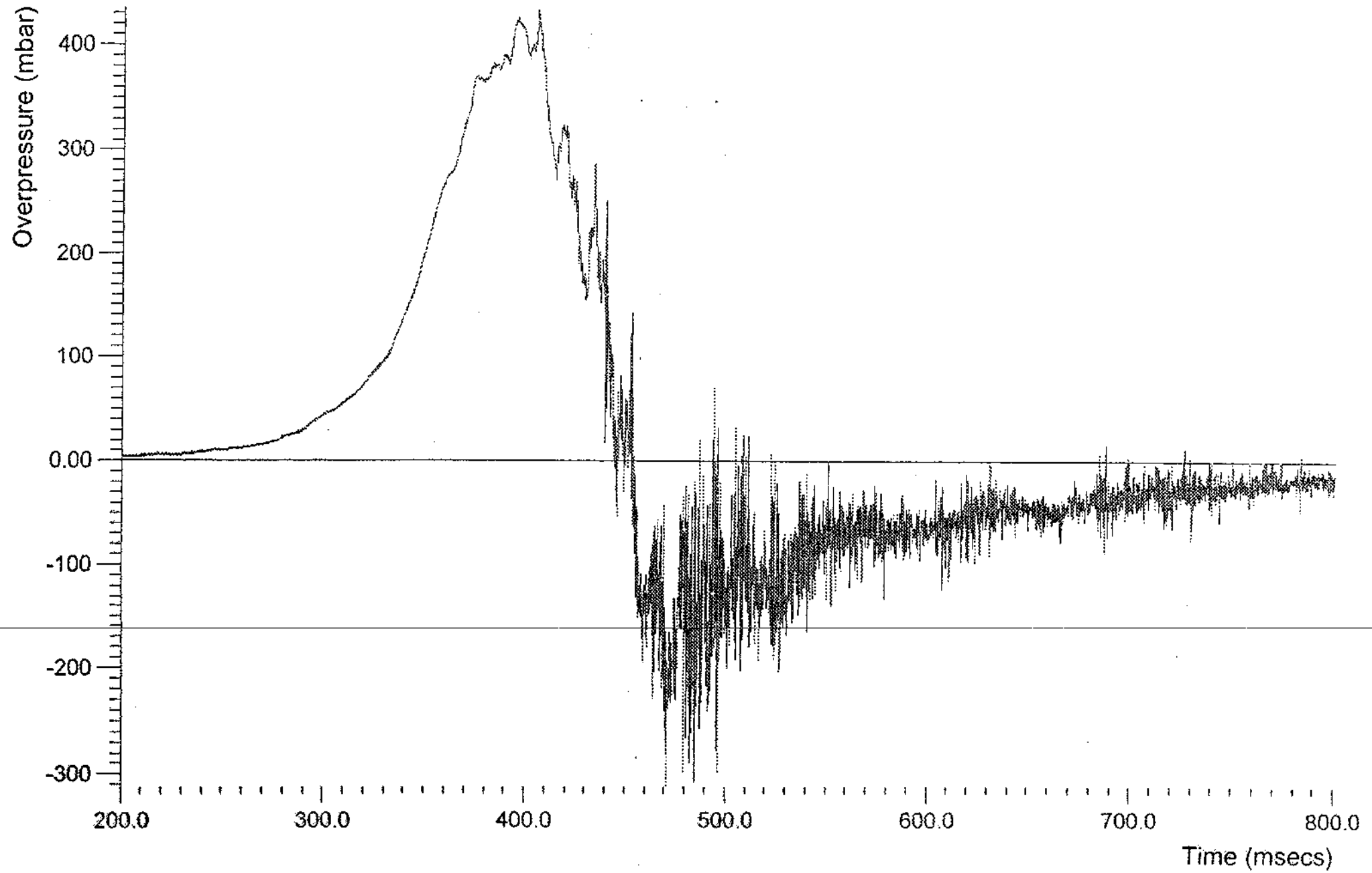
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-18



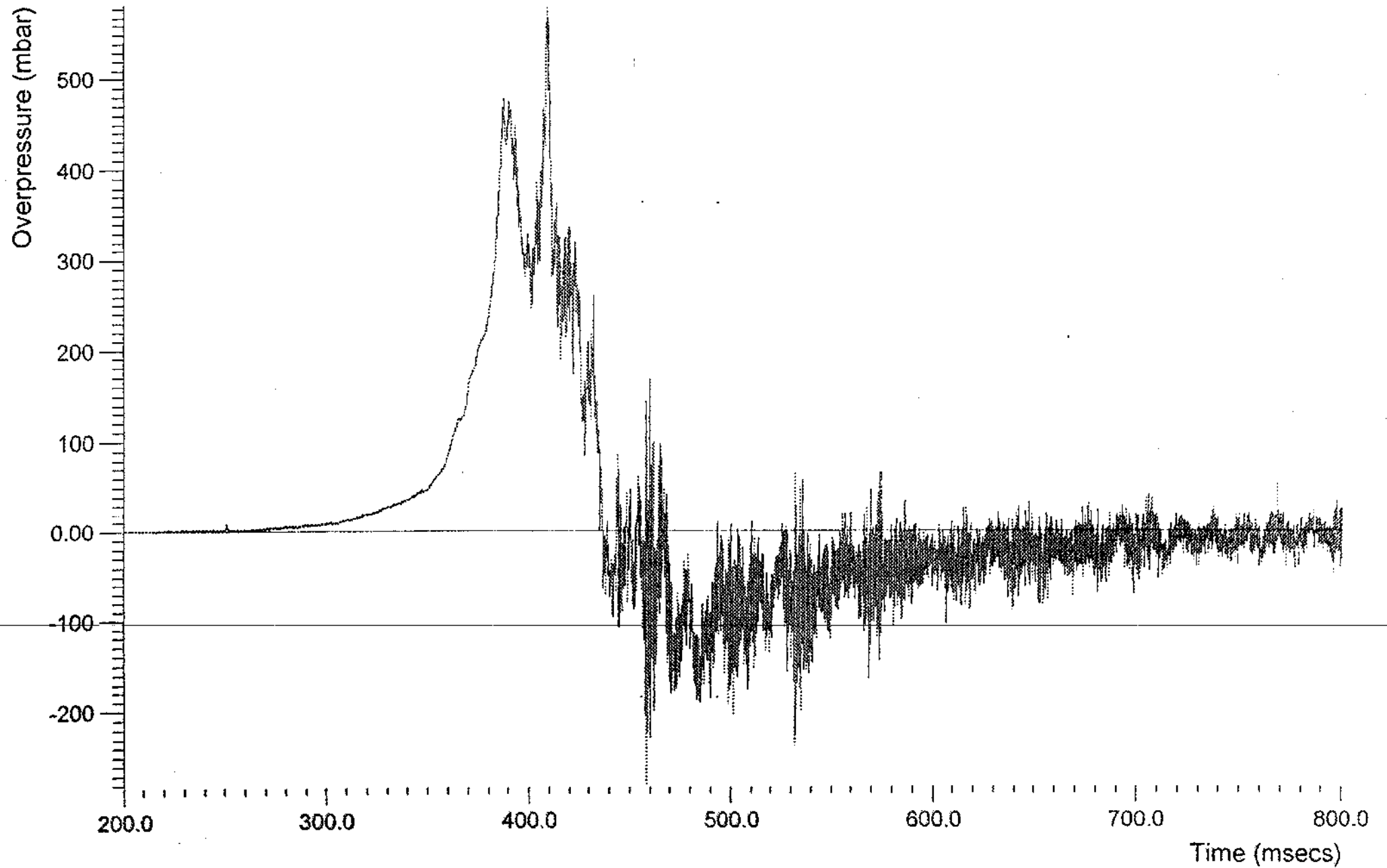
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-19



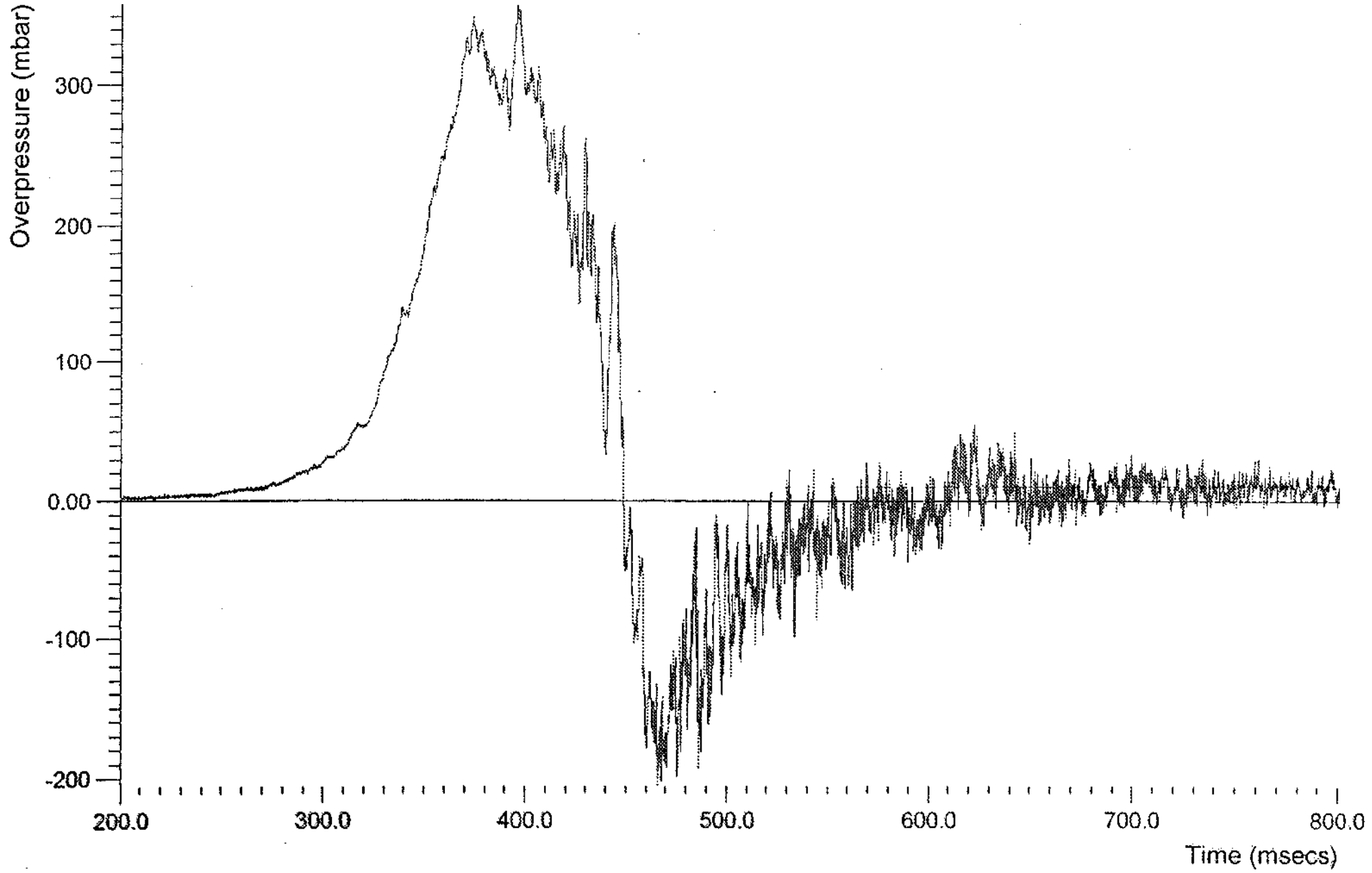
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-20



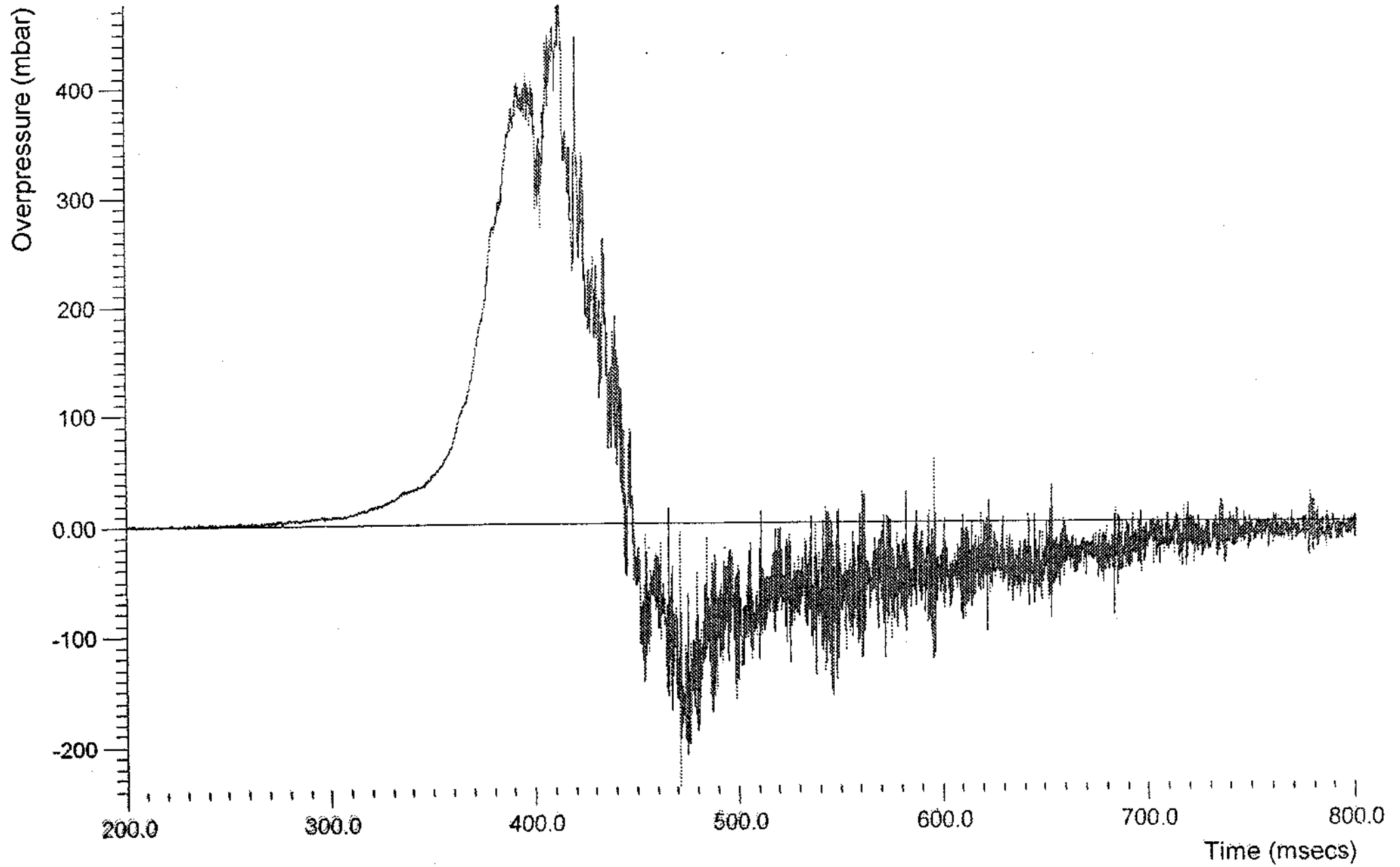
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-21



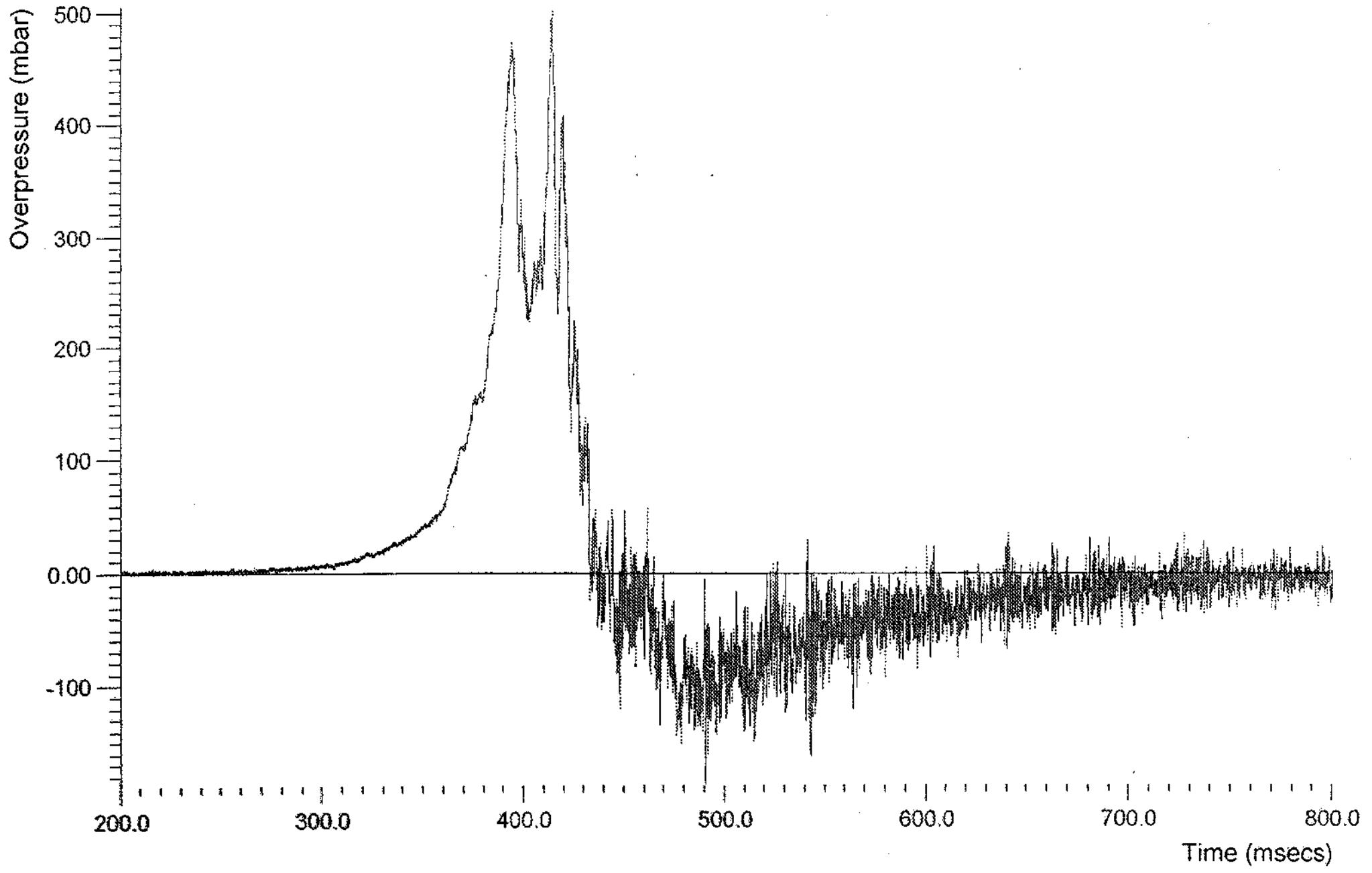
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-22



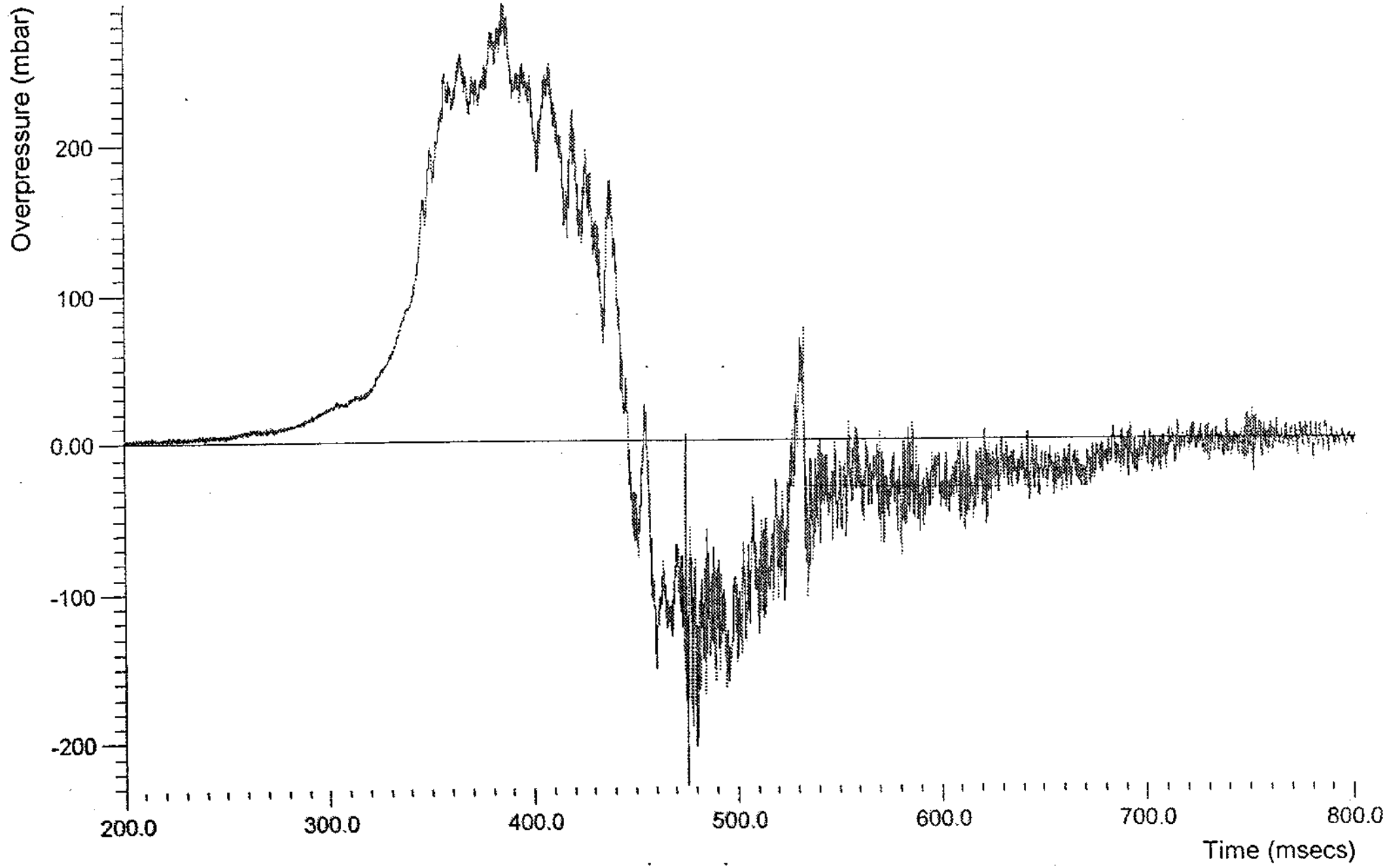
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-23



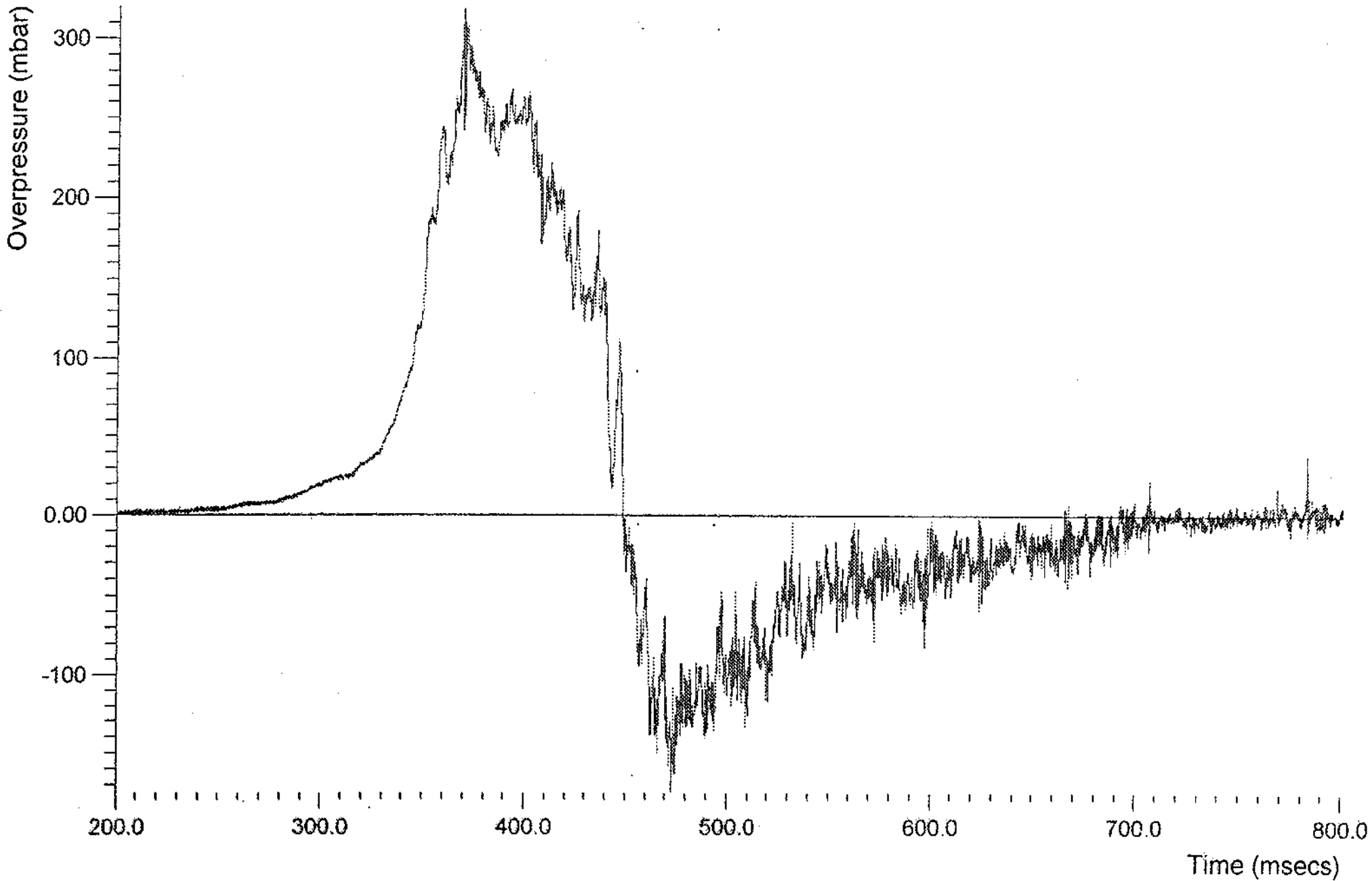
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-24



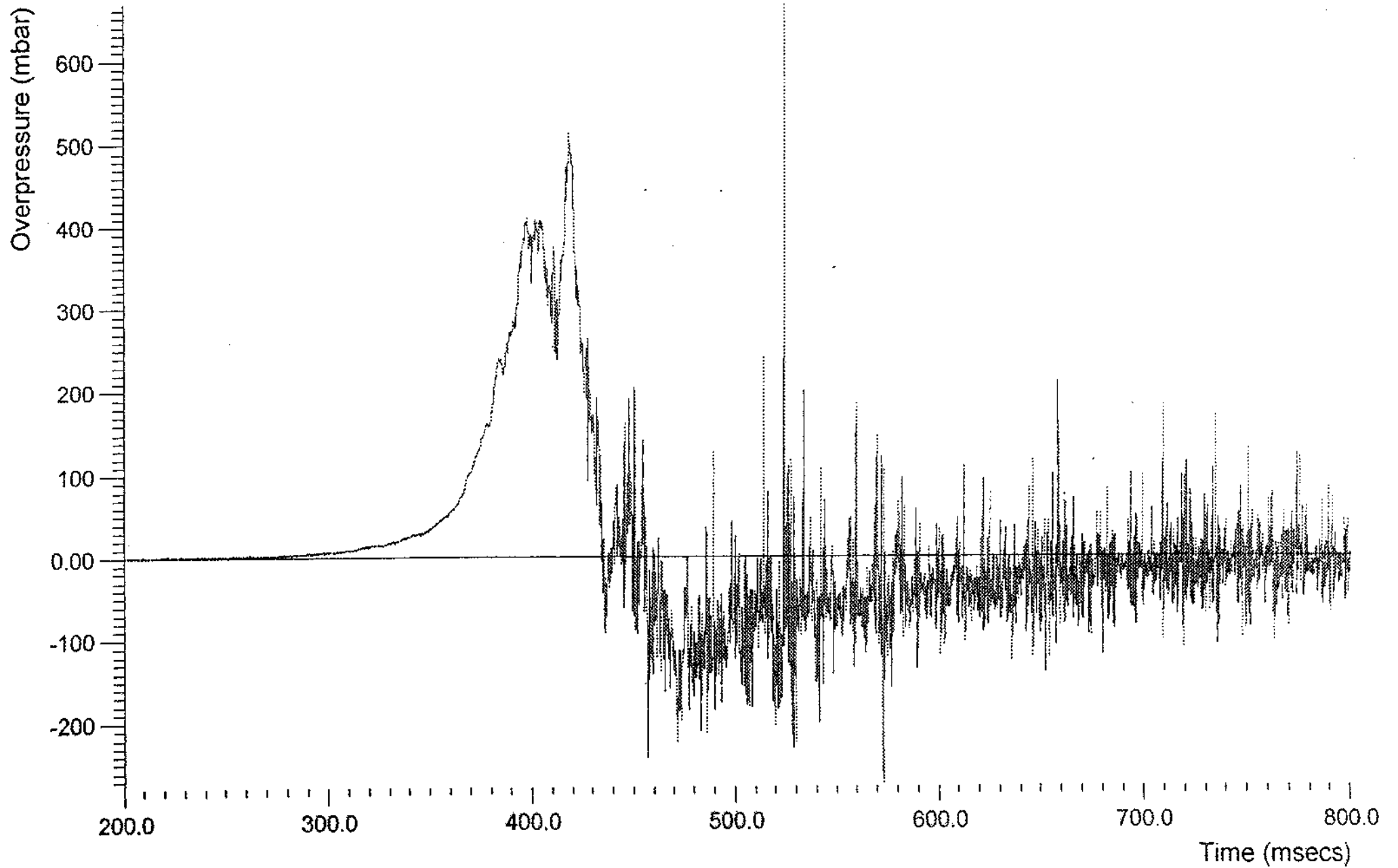
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-25



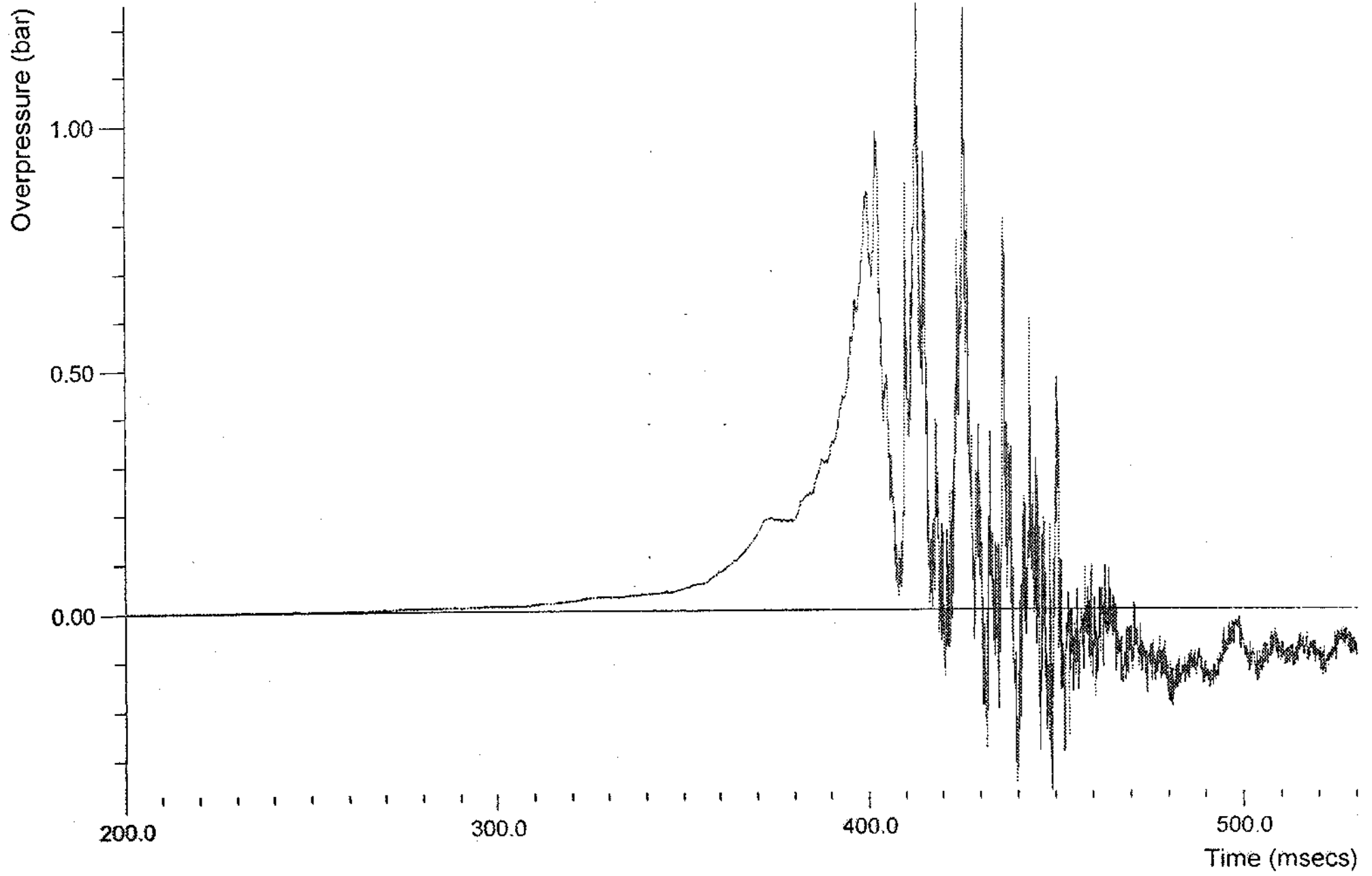
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-26



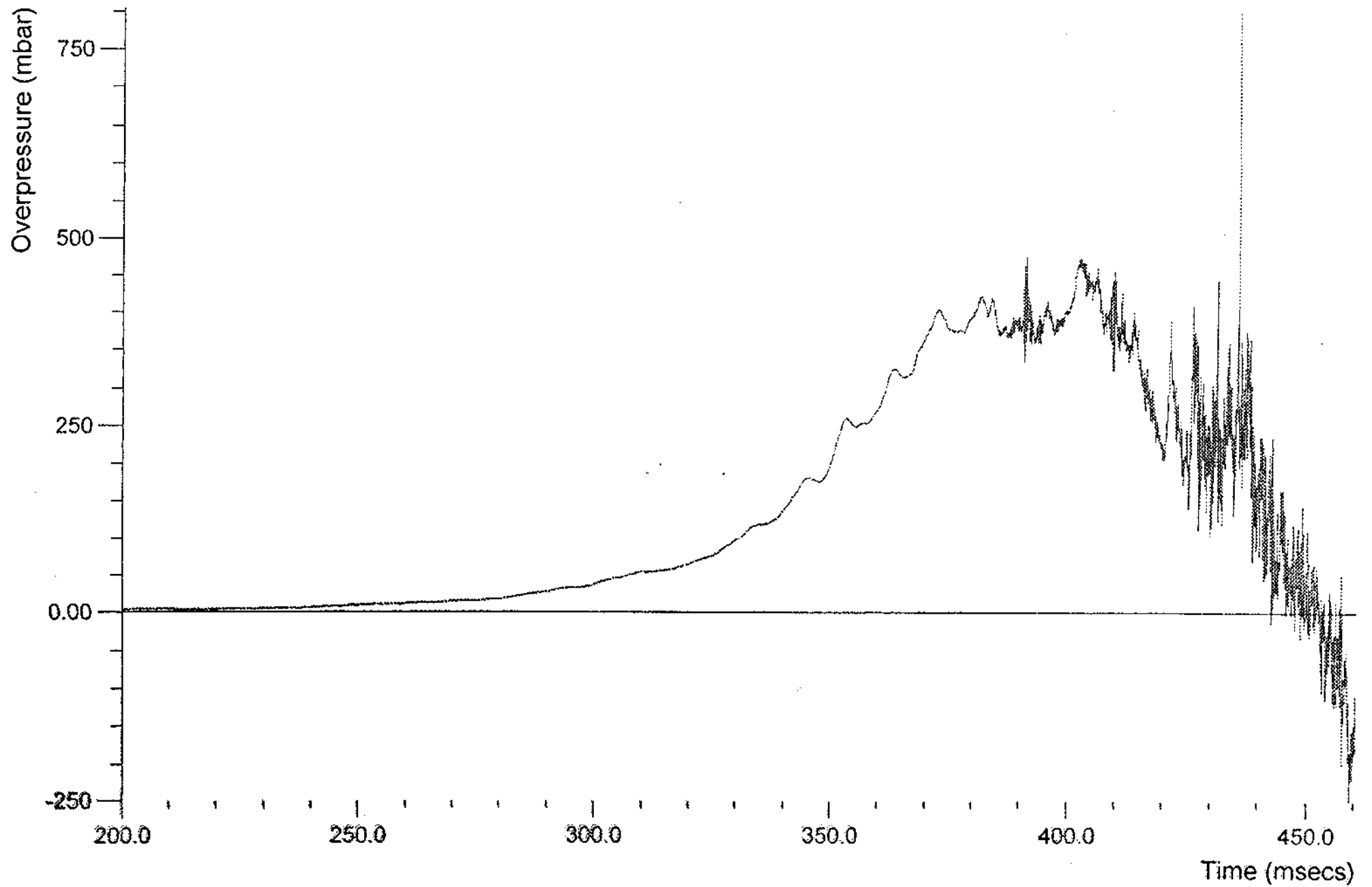
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-27



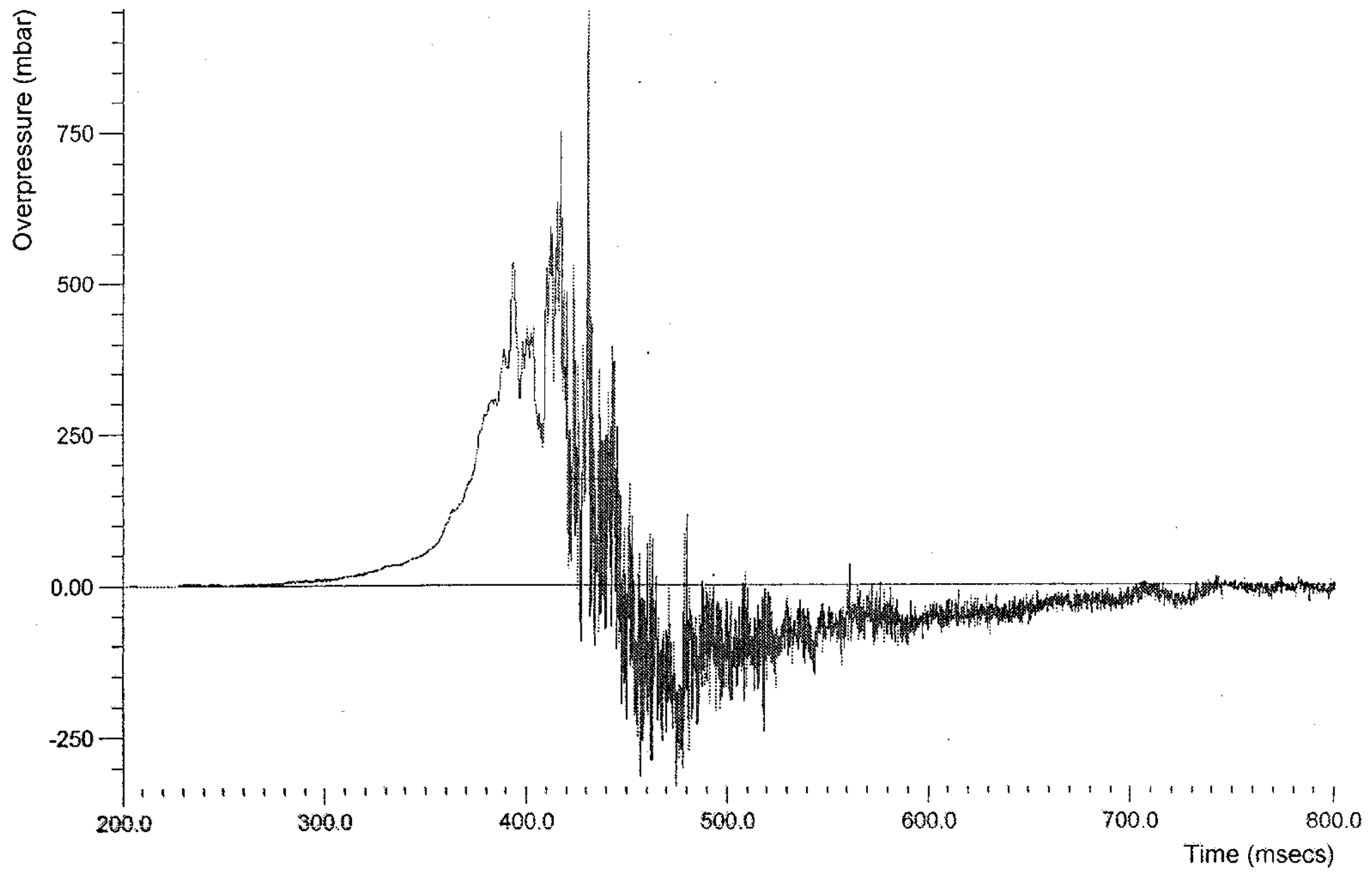
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-28



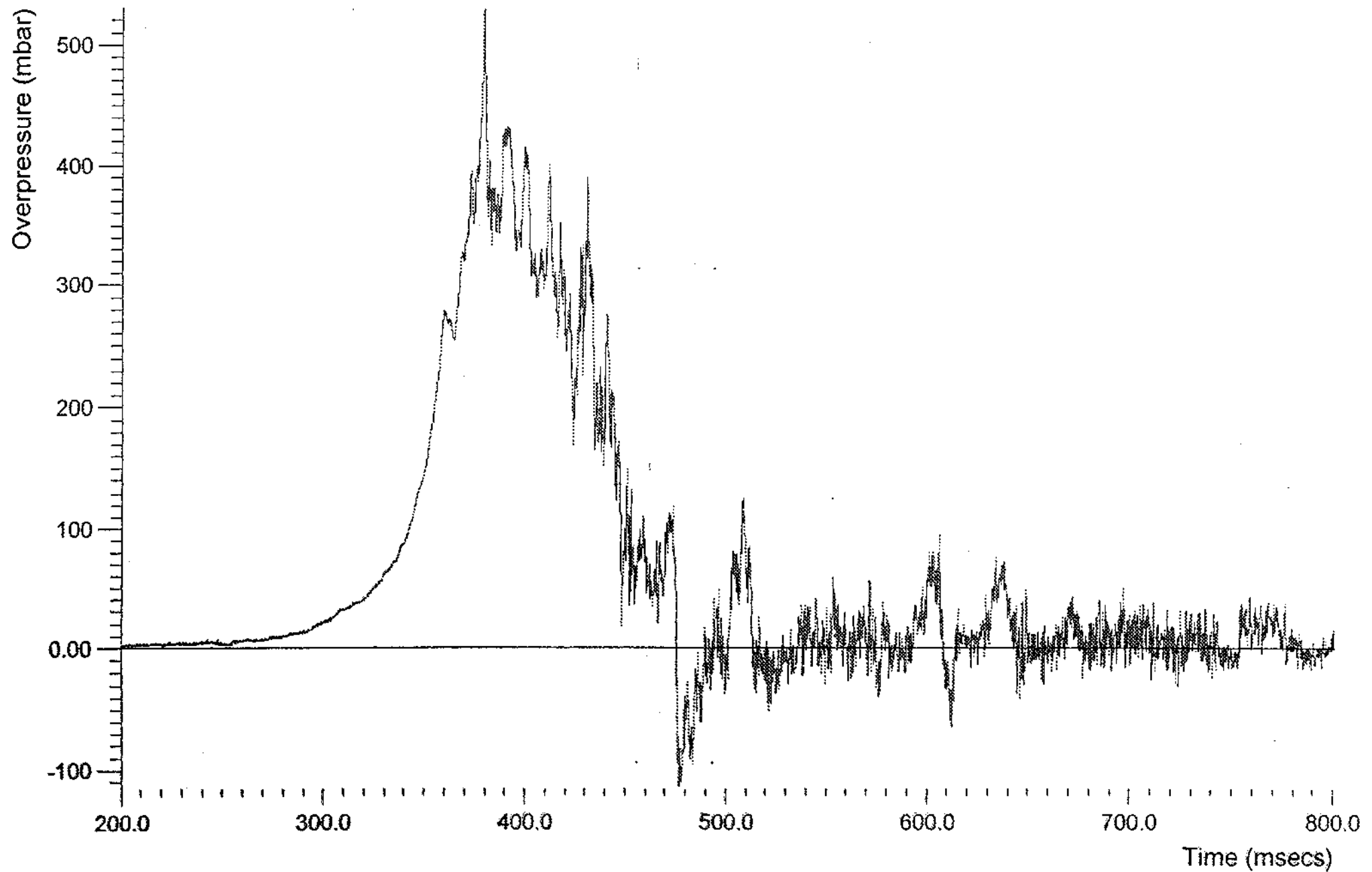
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-29



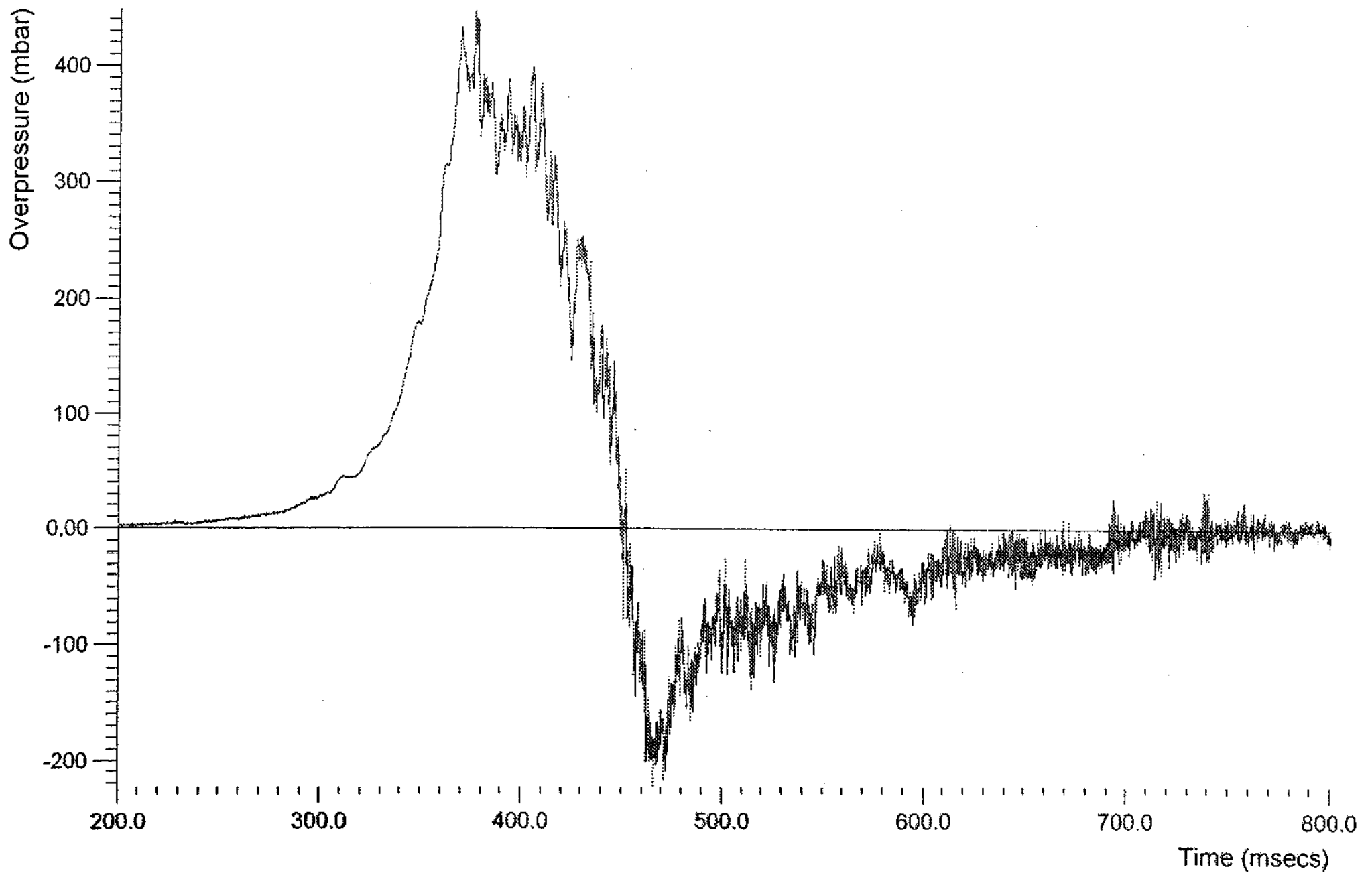
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-30



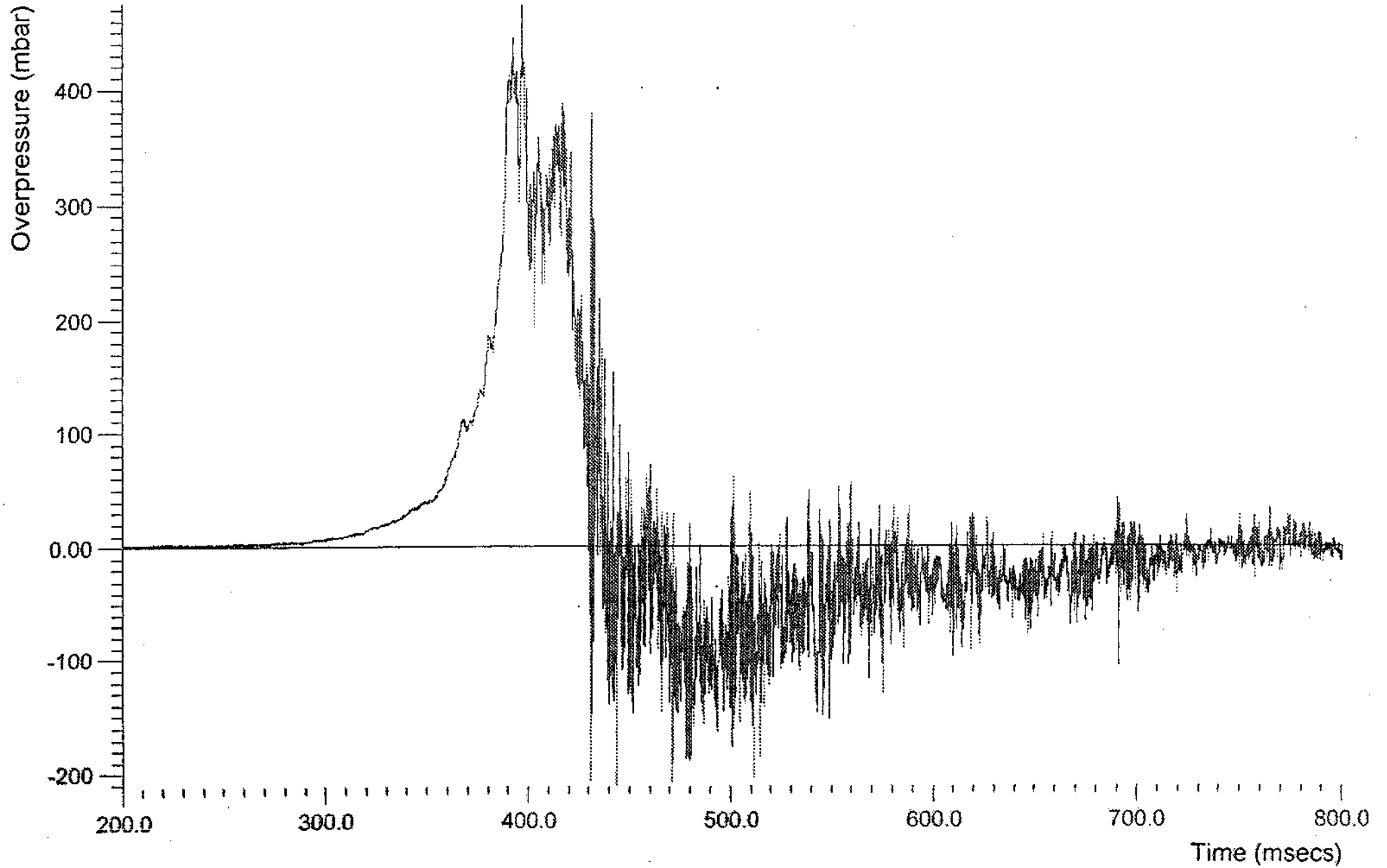
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-31



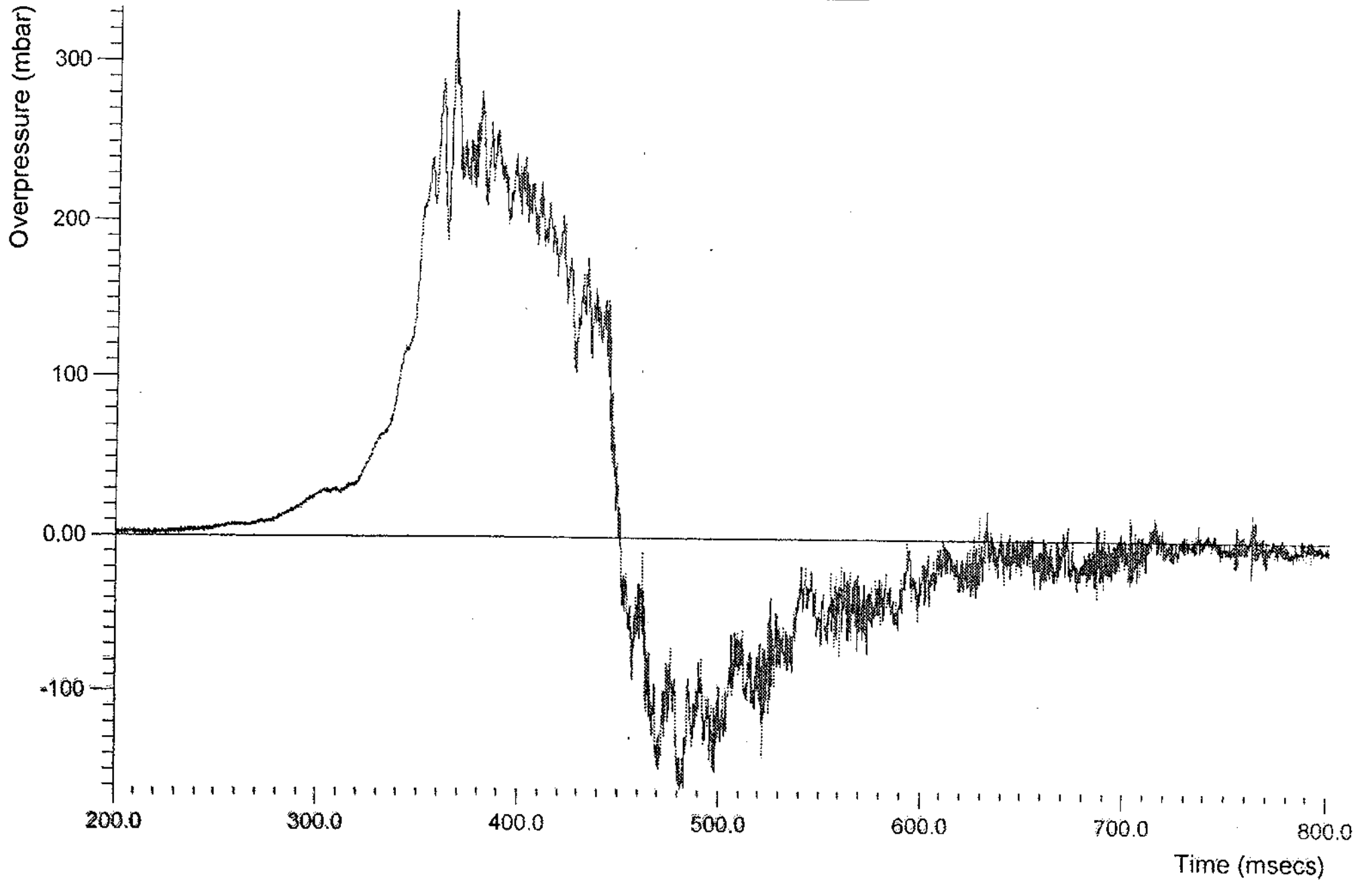
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-32



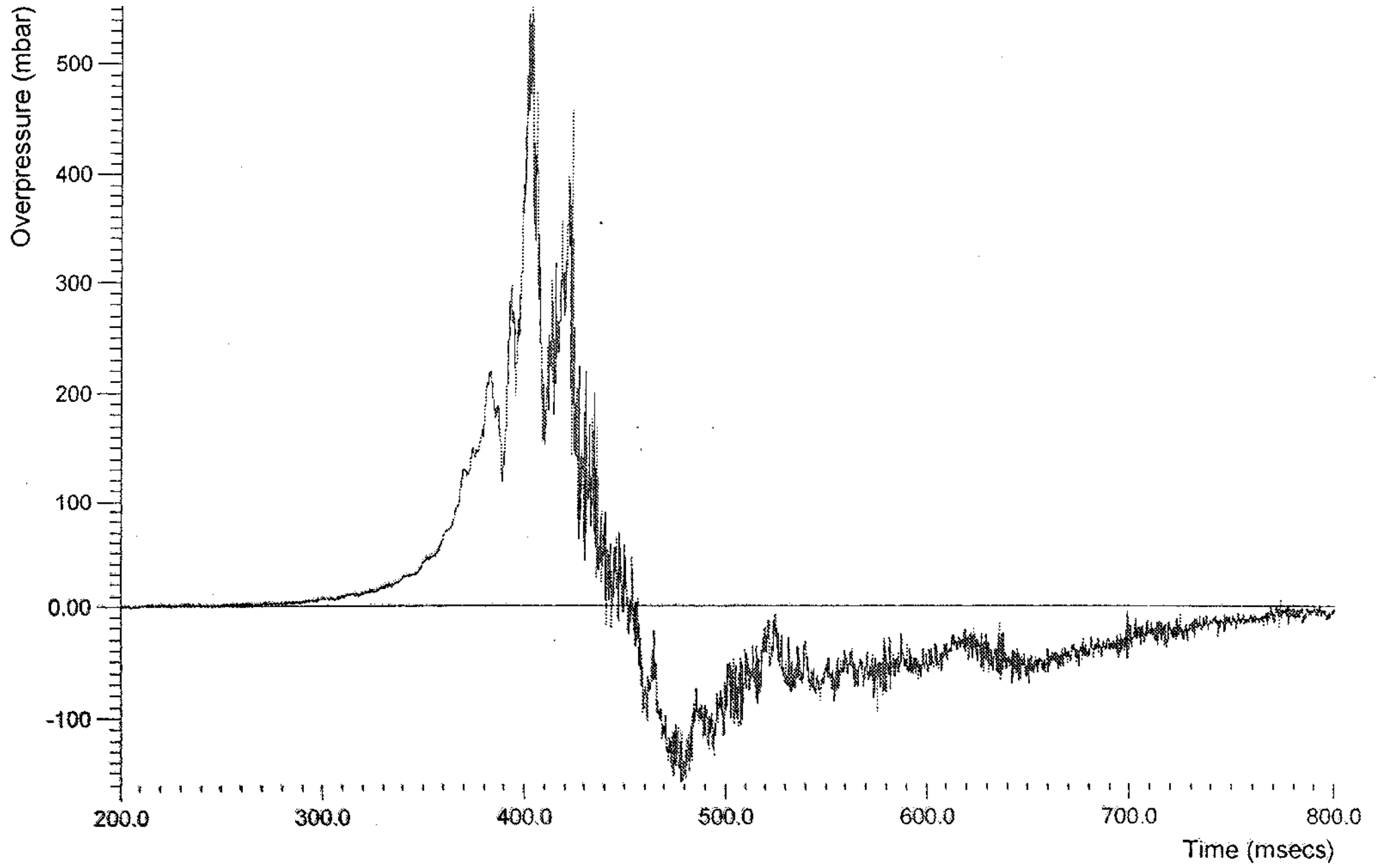
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-33



Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-34

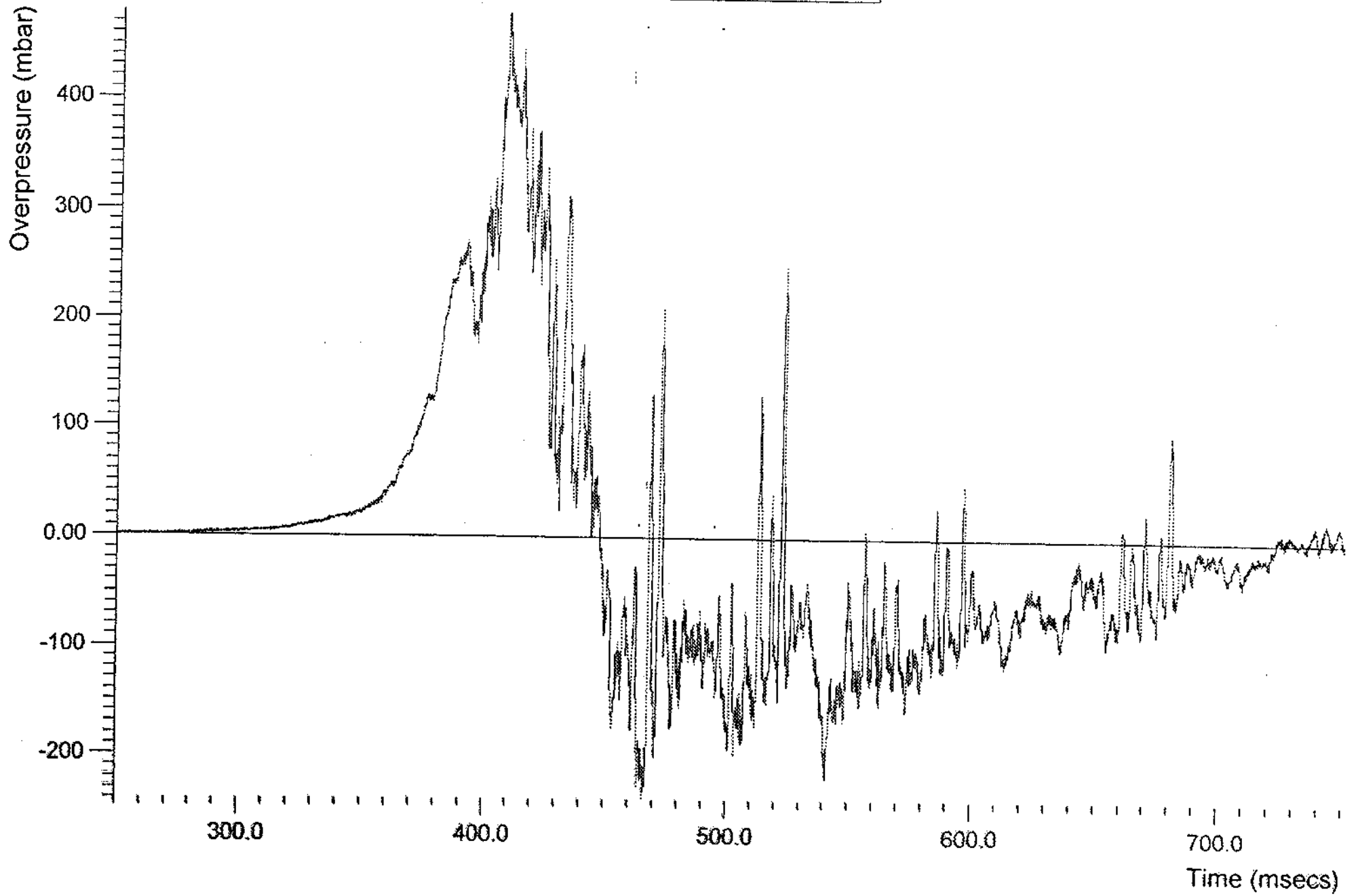


Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PI-35

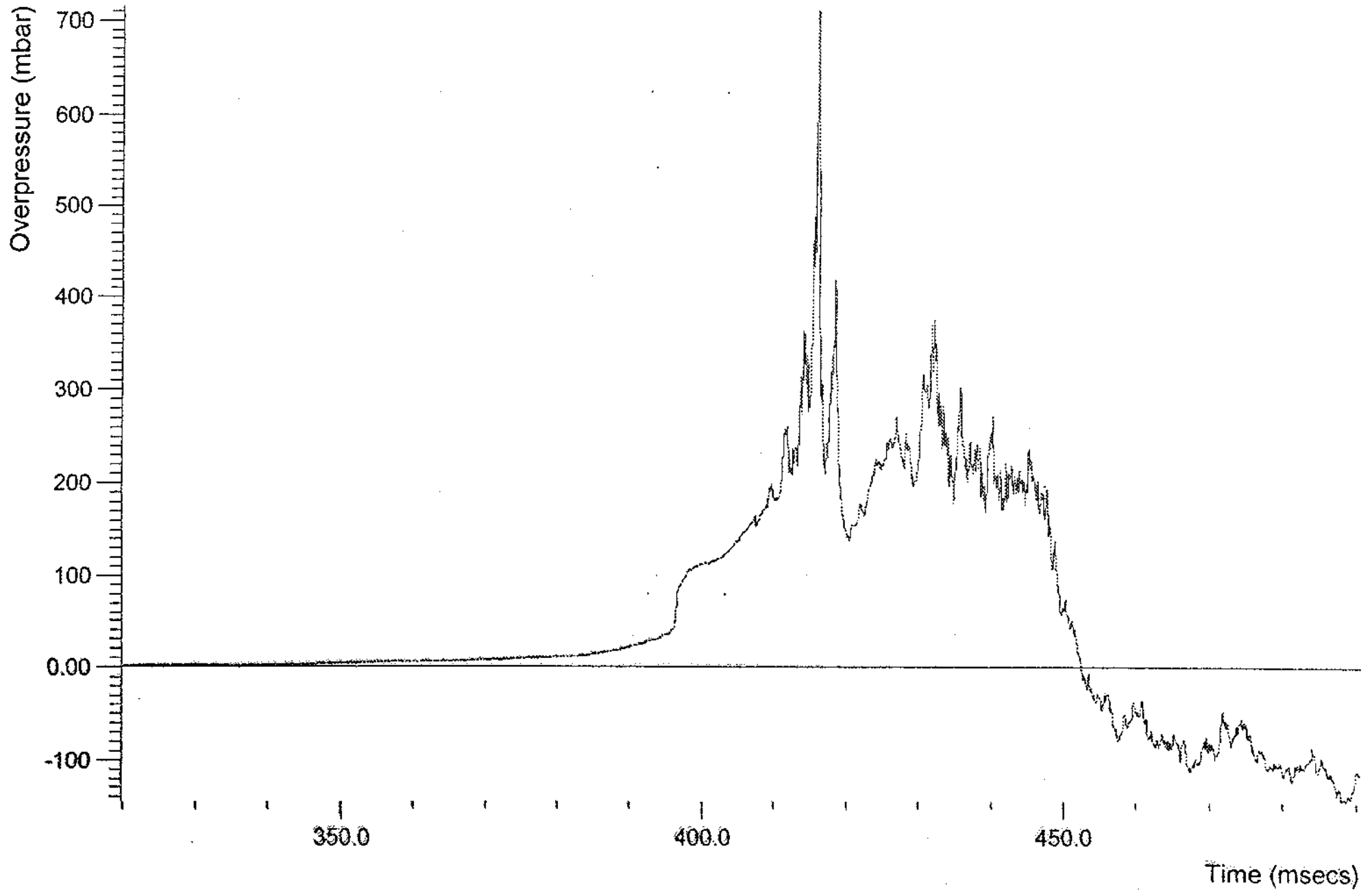


Appendix B: External Overpressure Profiles

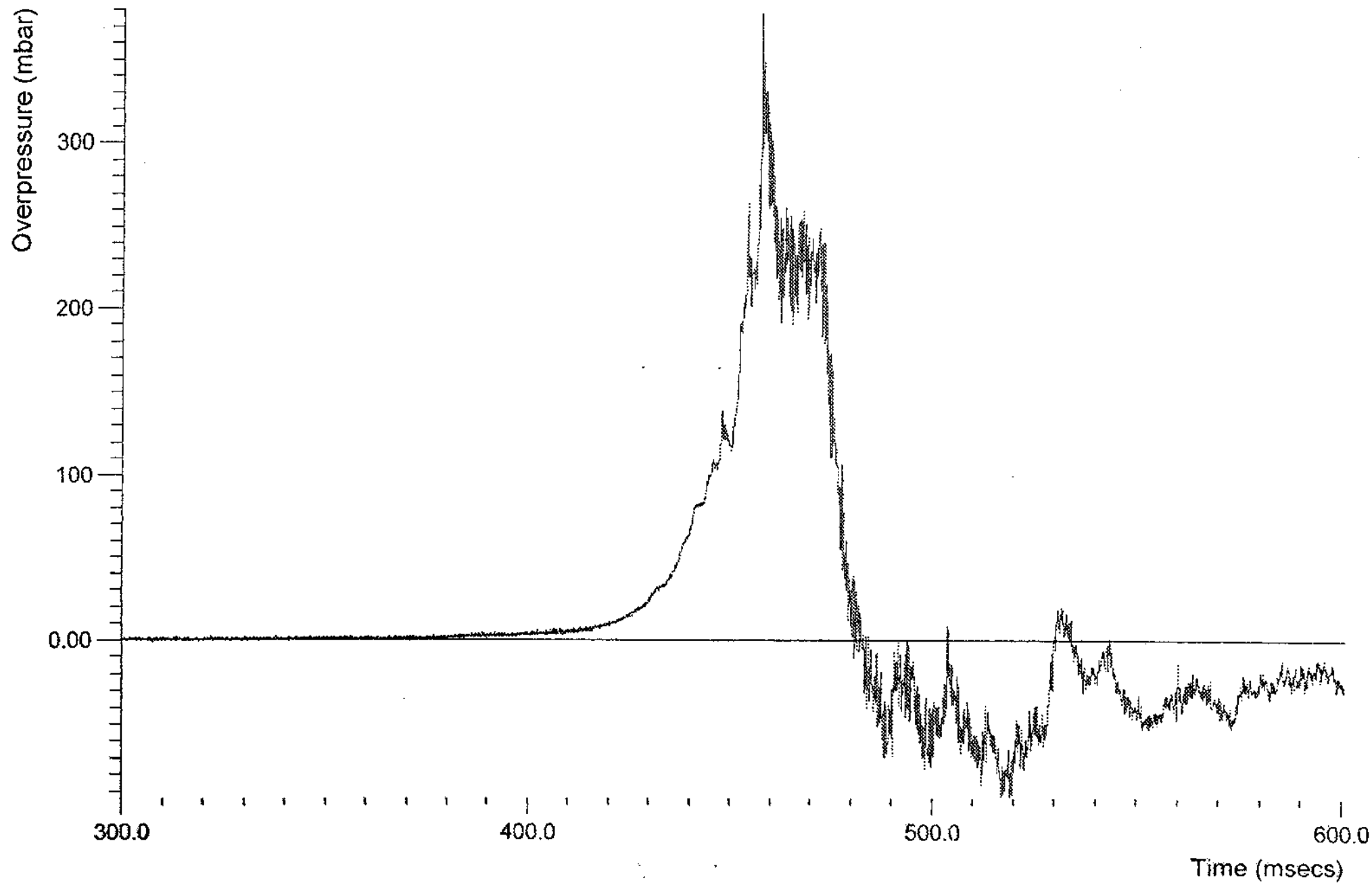
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-1



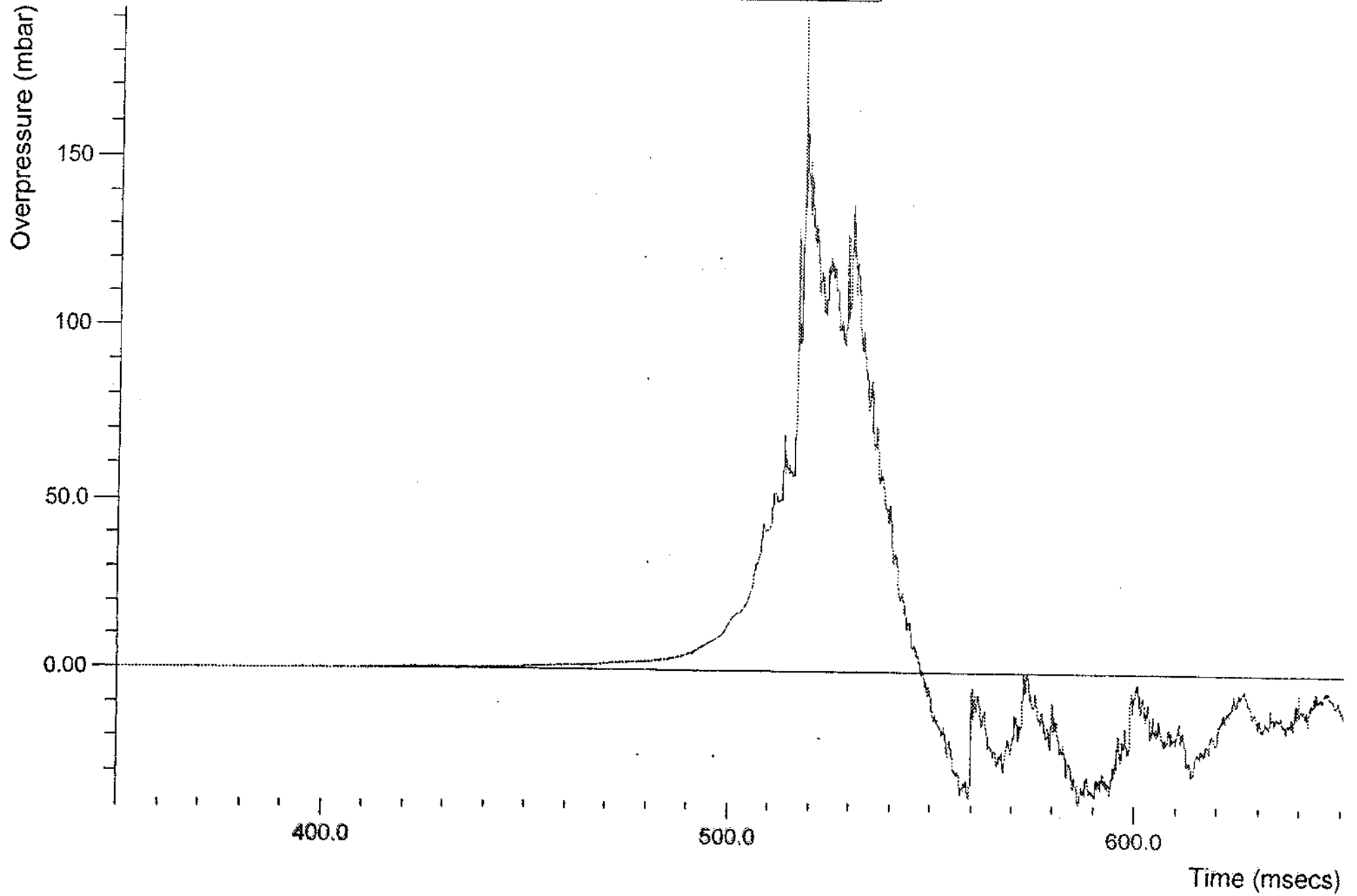
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-2



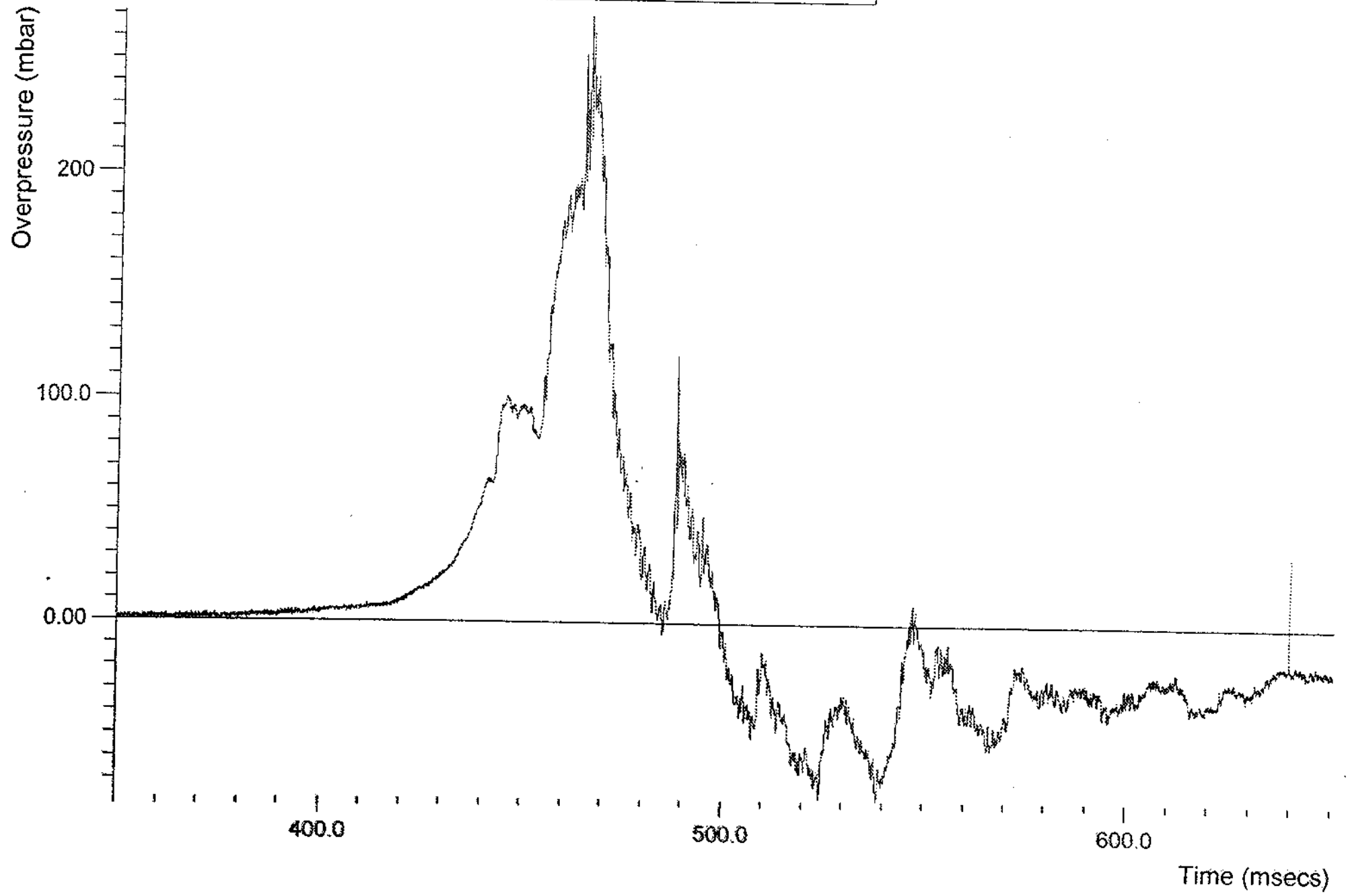
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-3



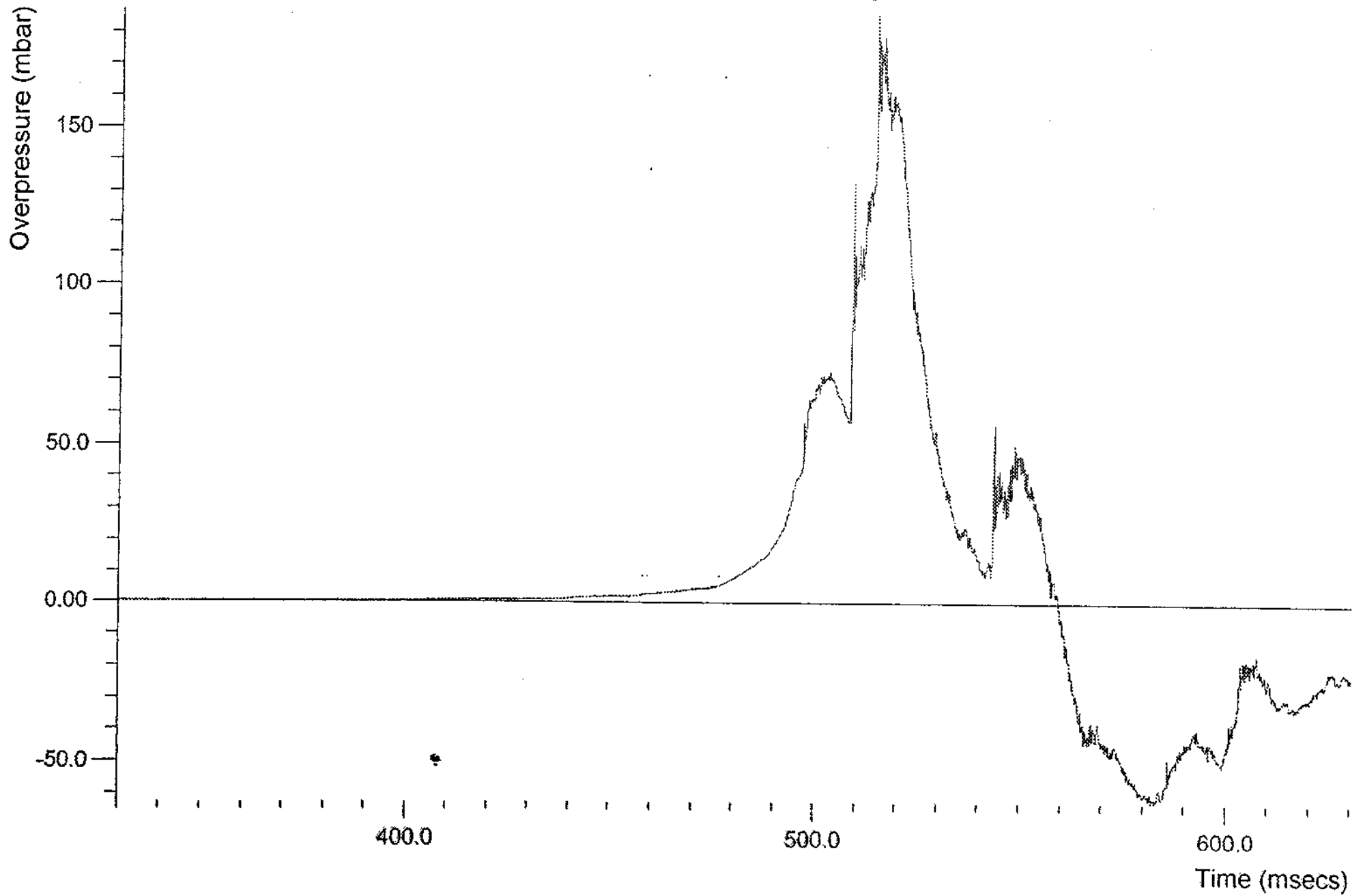
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-4



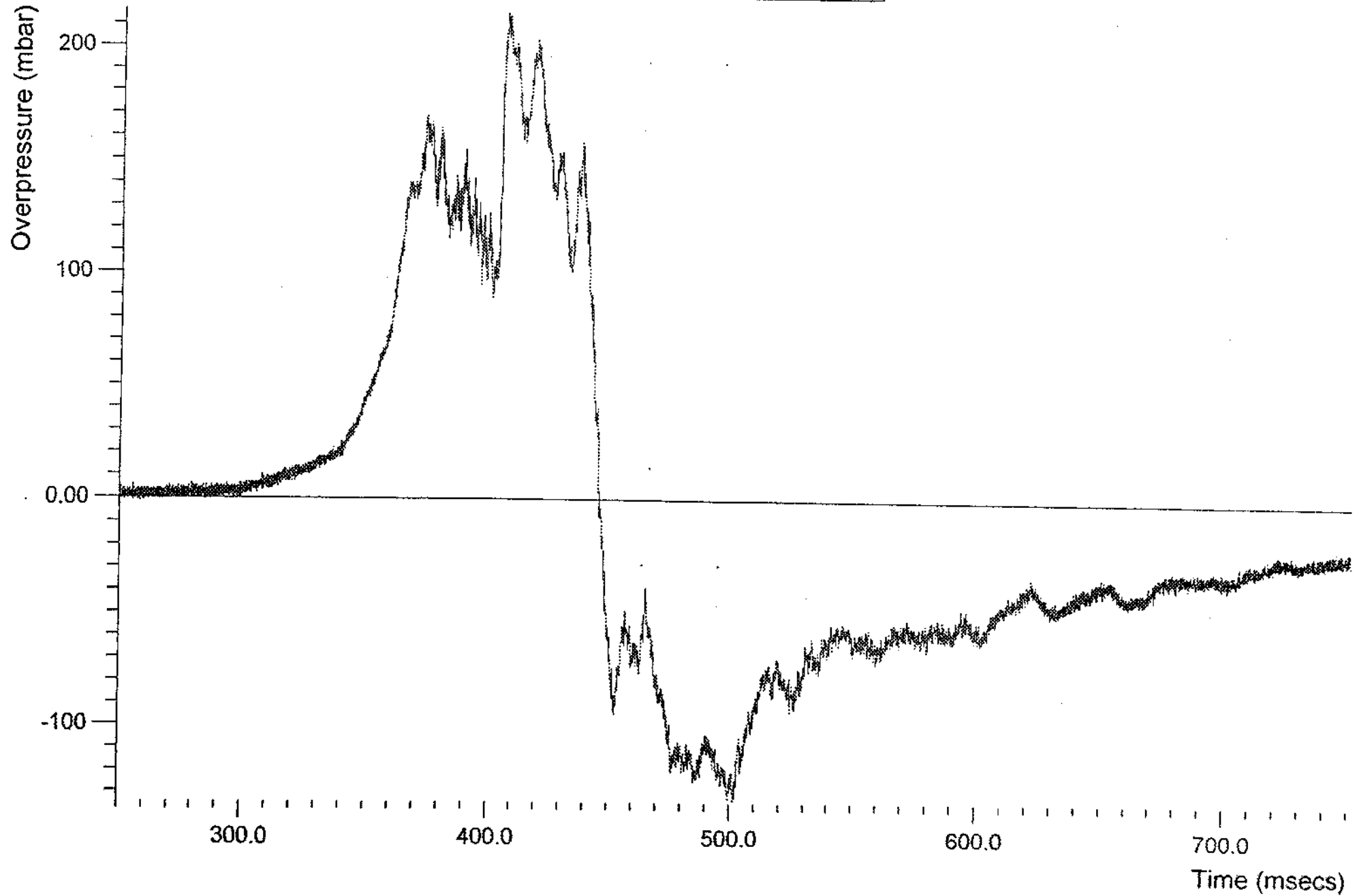
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-5



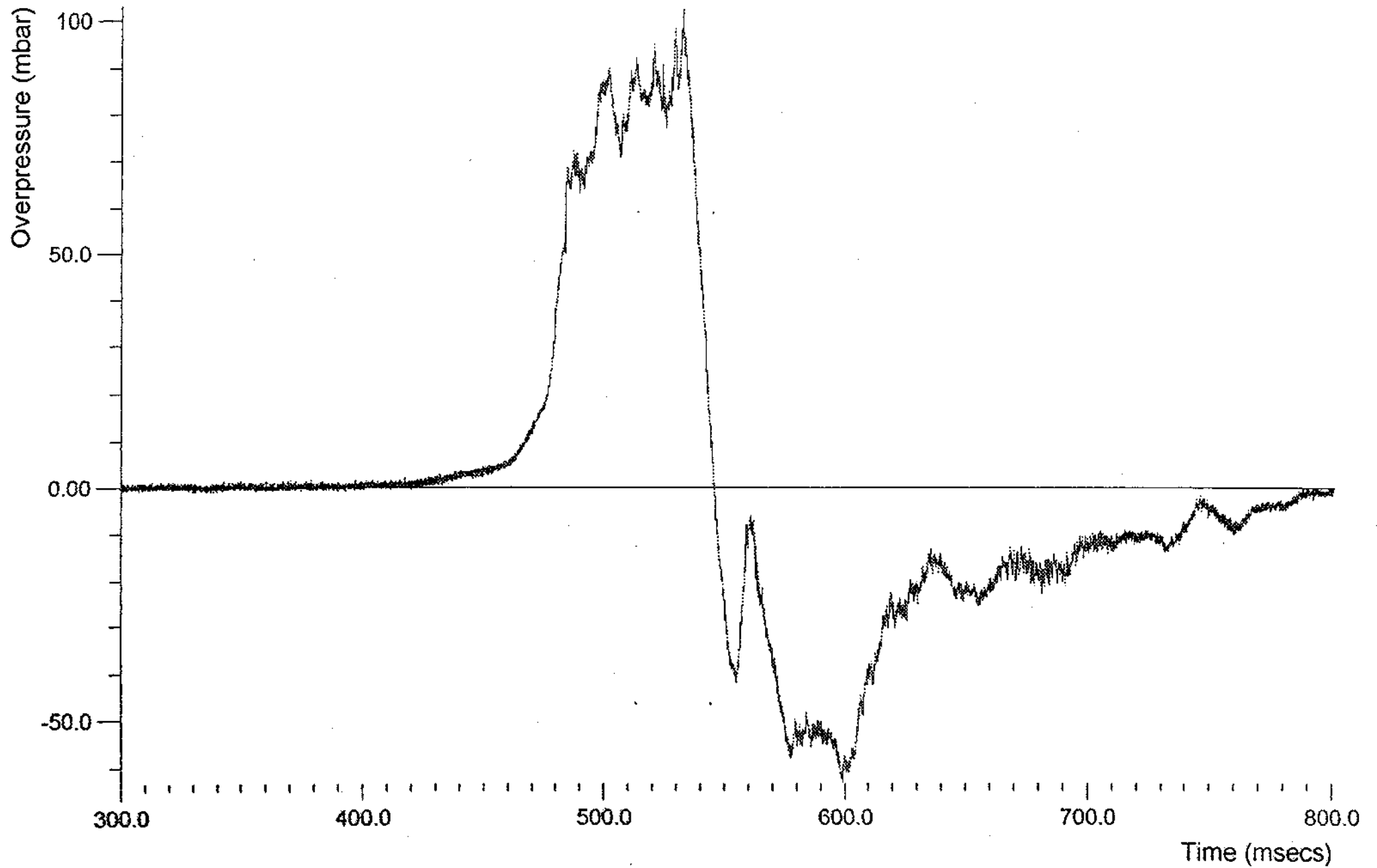
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-6



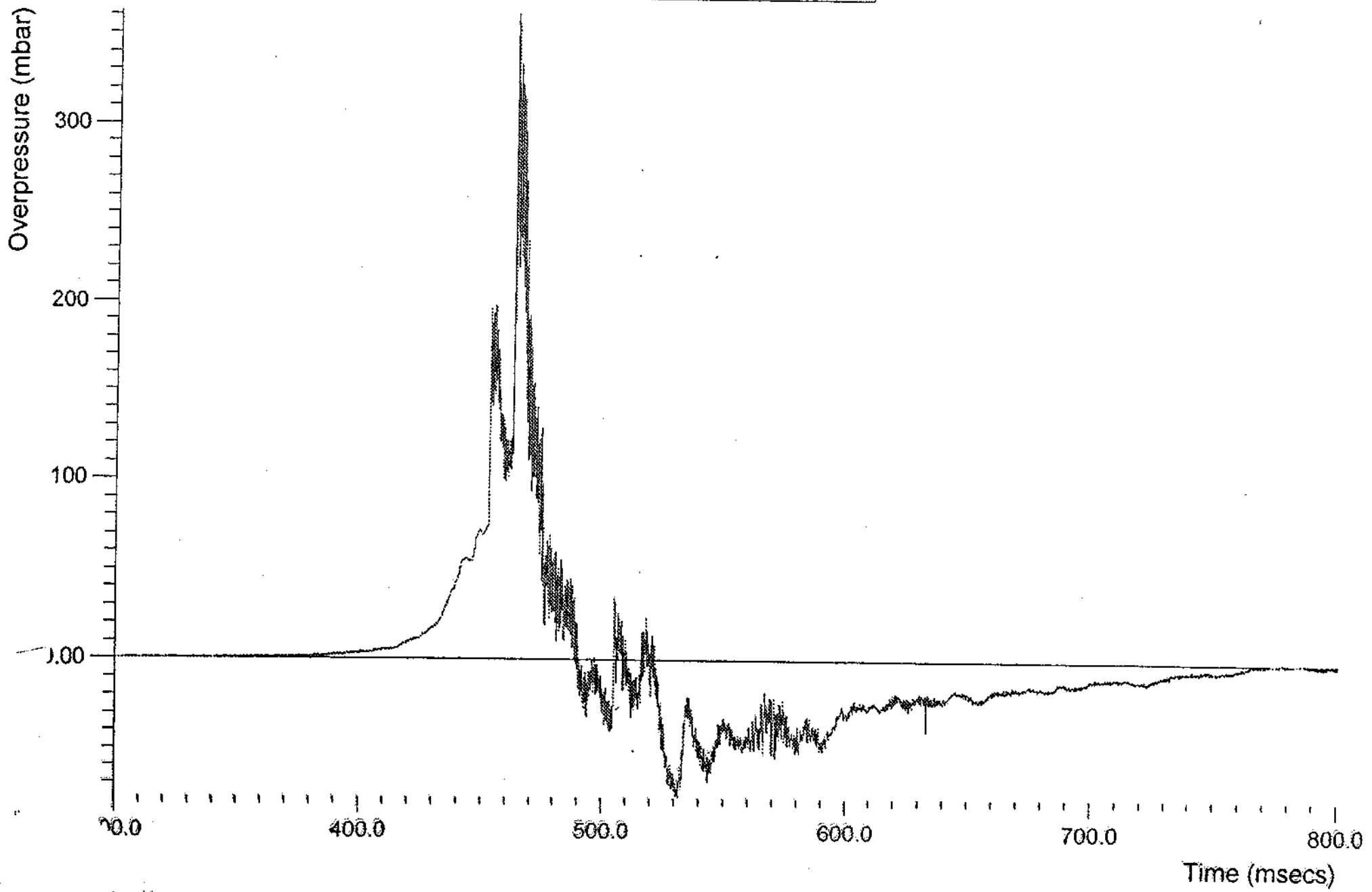
Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-7



Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-10



Test: HSE 13 (O1,C2,I2,DL)
Transducer no: PE-11

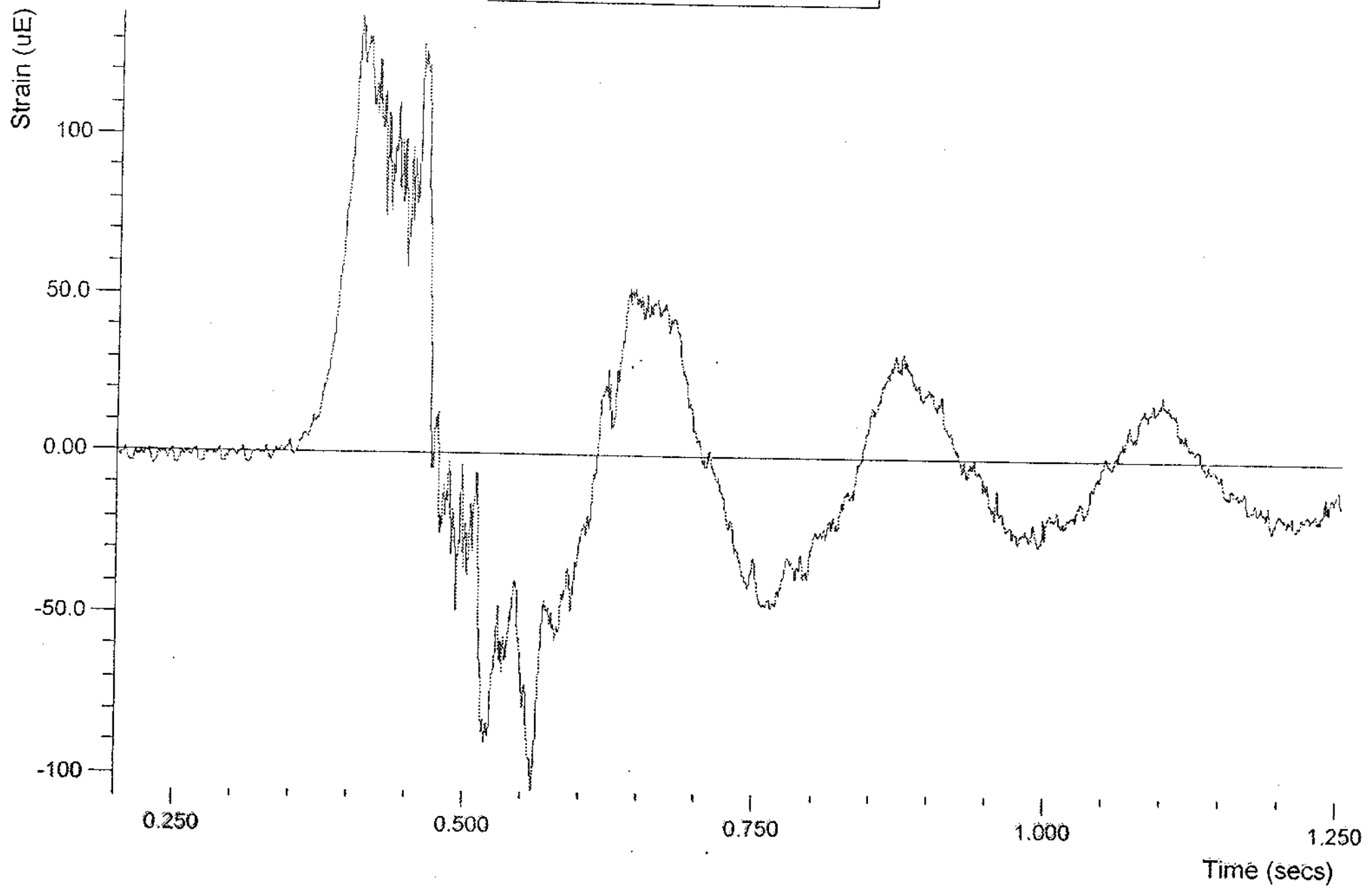


Appendix C: Strain Gauge Profiles

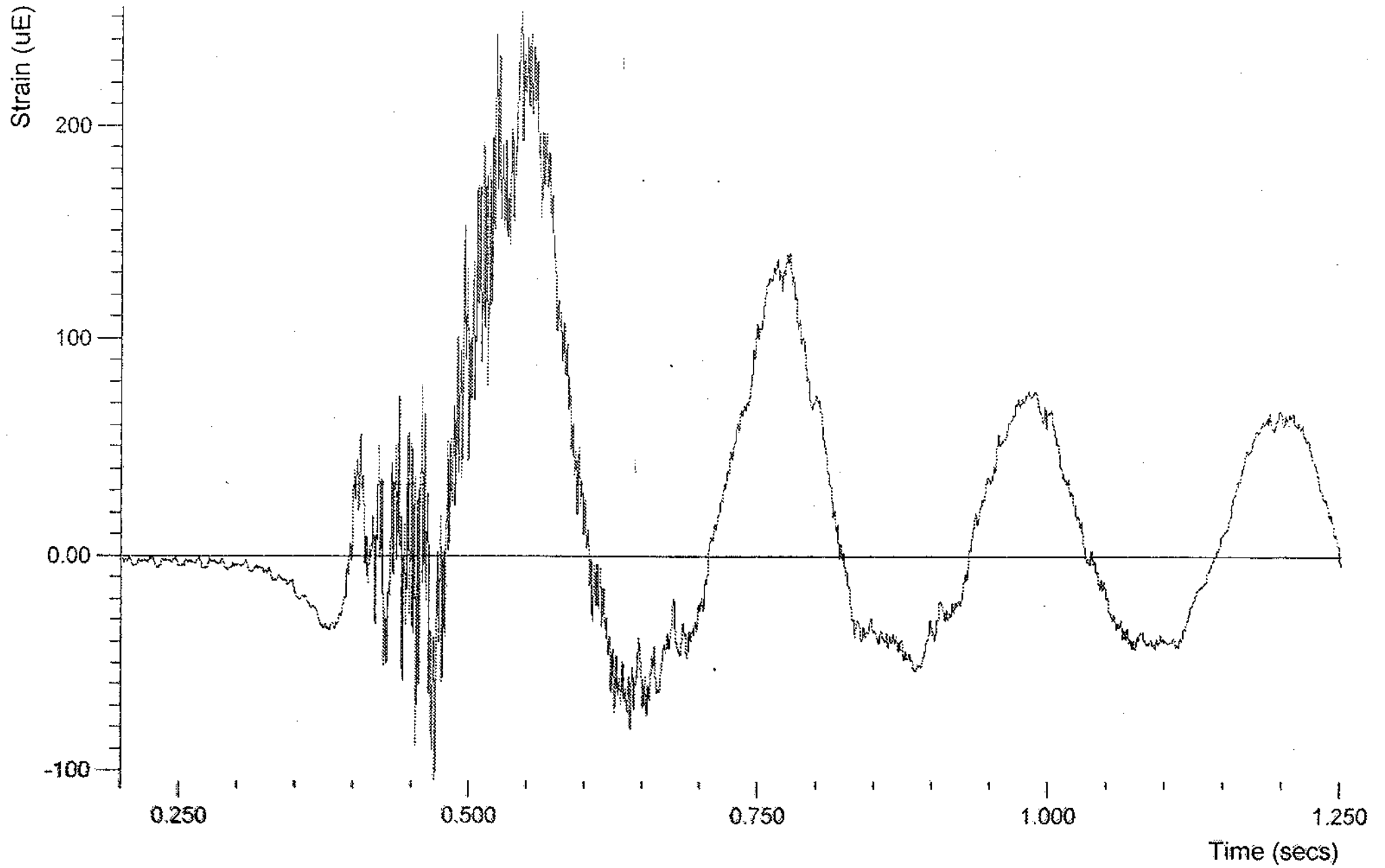
Table C1: Location of Strain Gauges

Measuring Position	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)
ST-301	28.06	-0.05	0.24
ST-302	28.01	-0.32	0.24
ST-303	28.00	-0.56	0.24
ST-304	27.90	-0.32	0.24
ST-305	20.00	-7.17	1.50
ST-306	20.00	-6.82	1.20

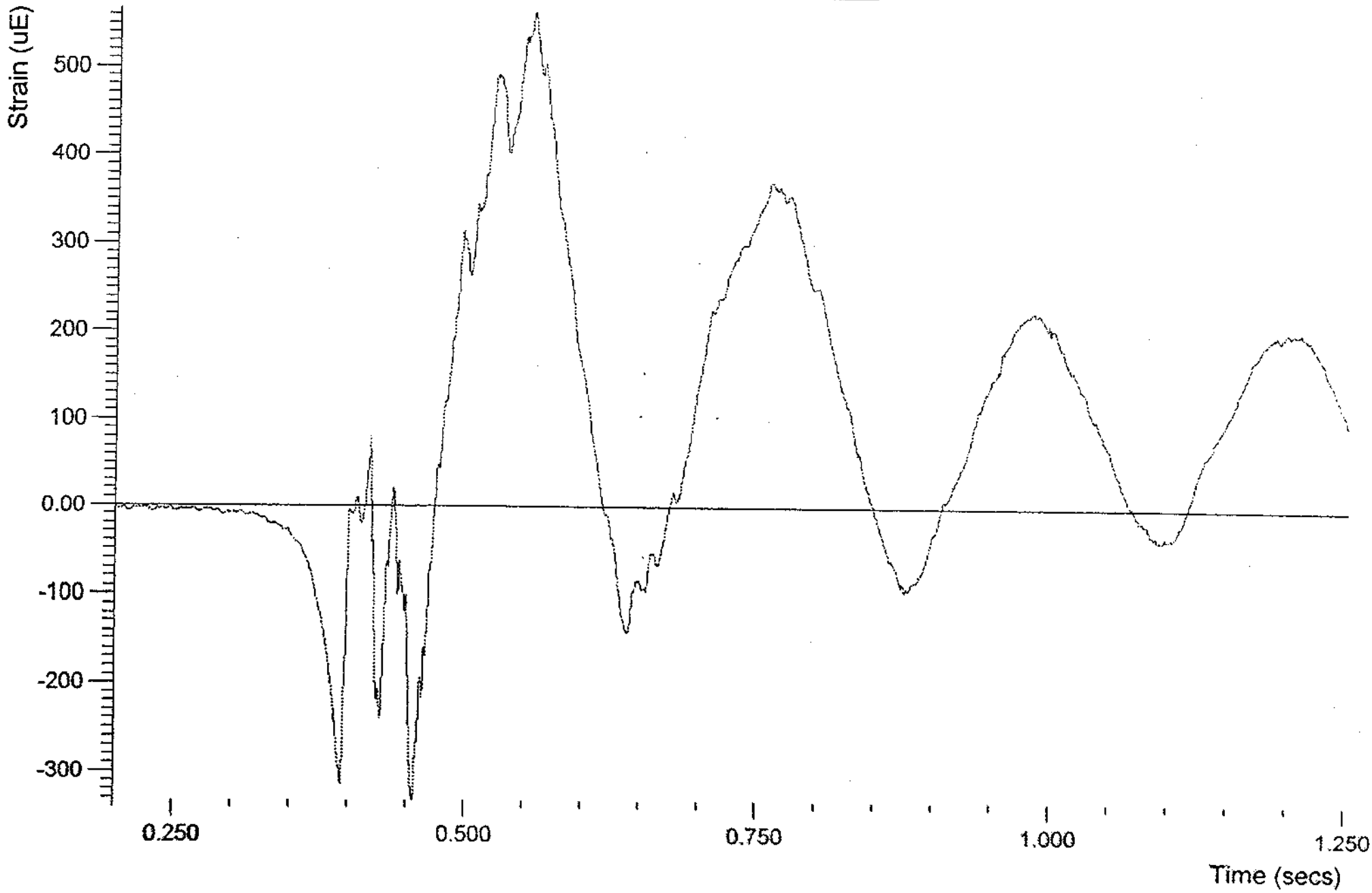
Test: HSE 13 (O1,C2,I2,DL)
Strain Gauge ST-301



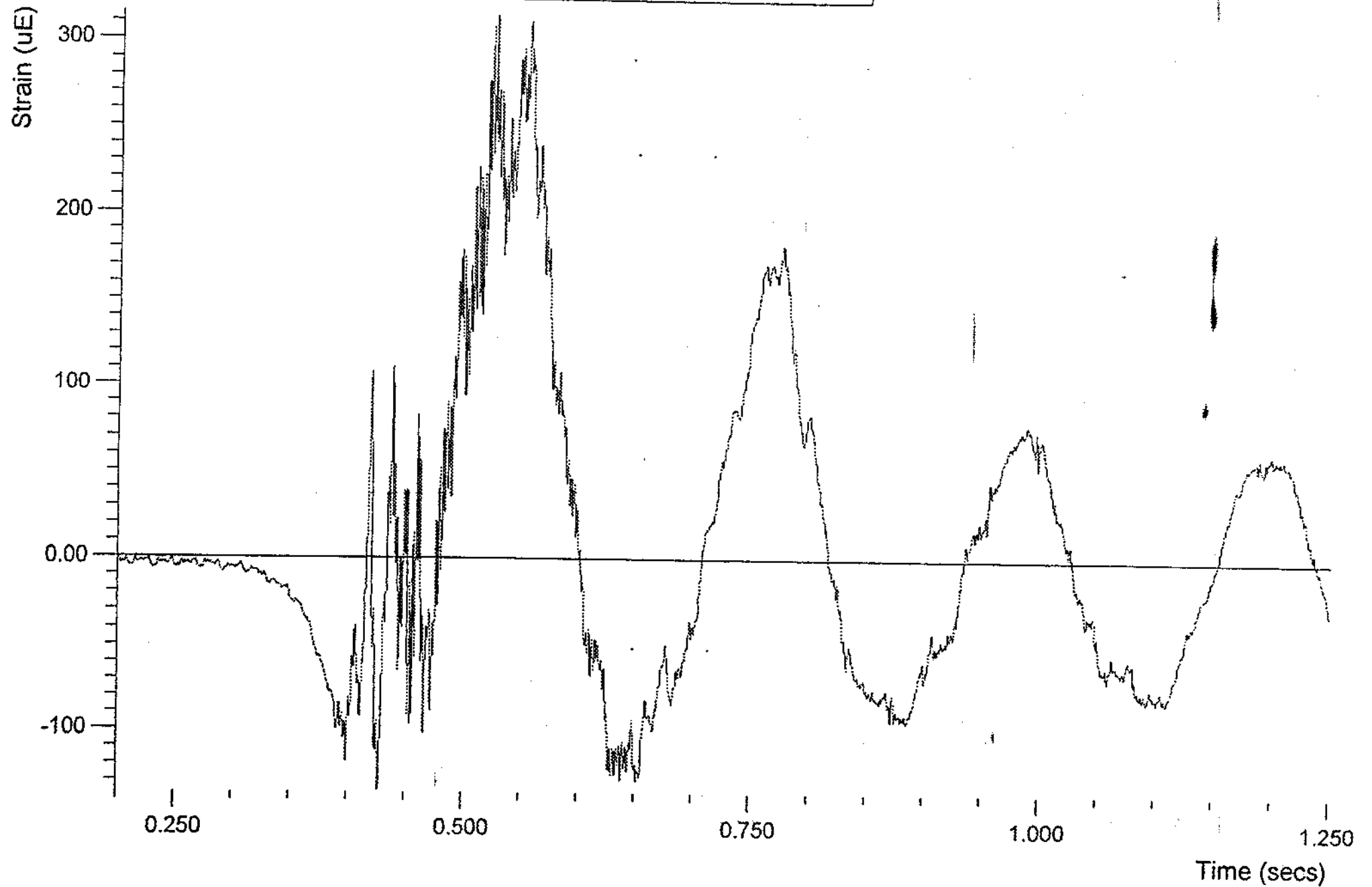
Test: HSE 13 (O1,C2,I2,DL)
Strain Gauge ST-302



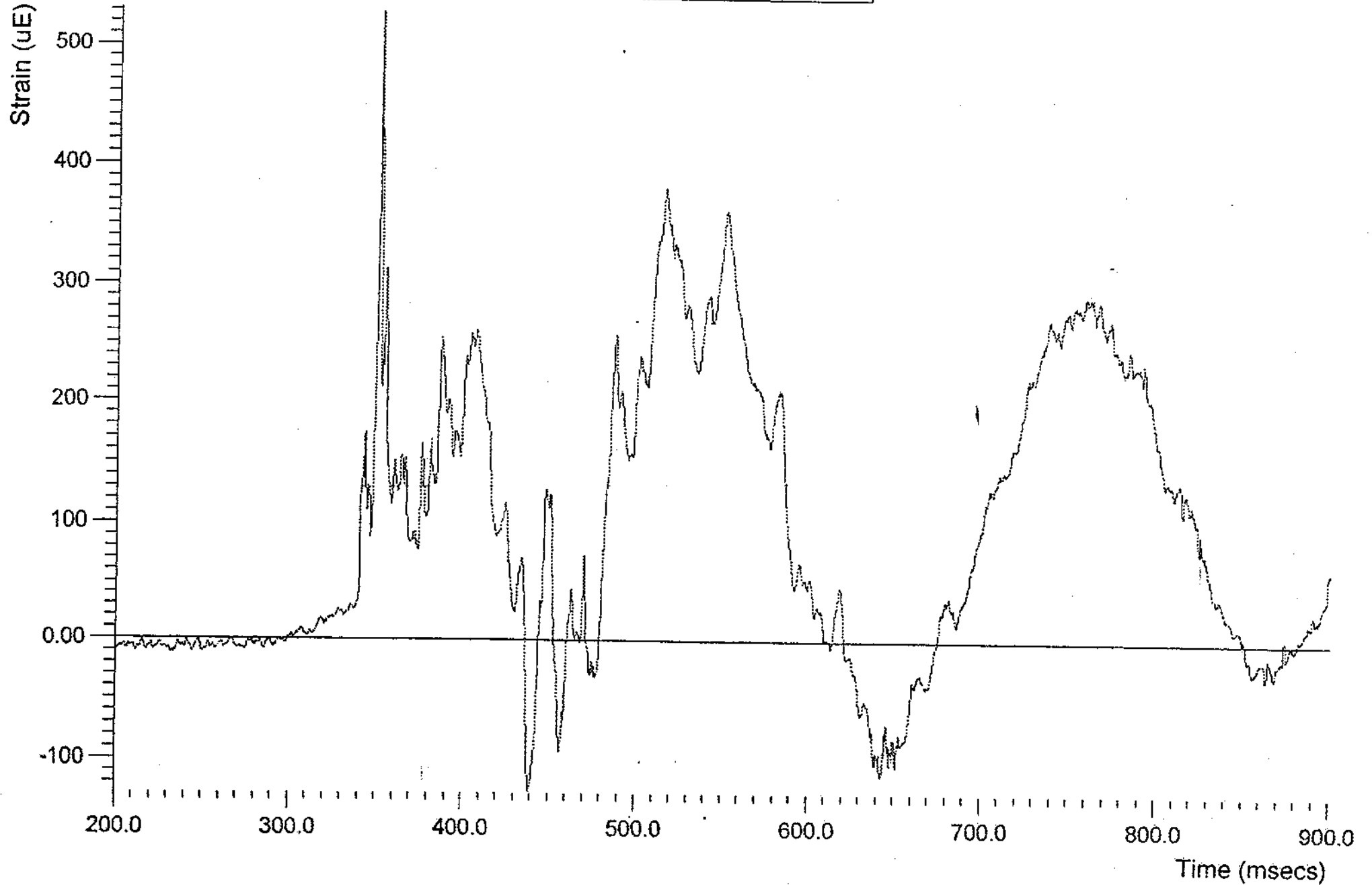
Test: HSE 13 (O1,C2,I2,DL)
Strain Gauge ST-303



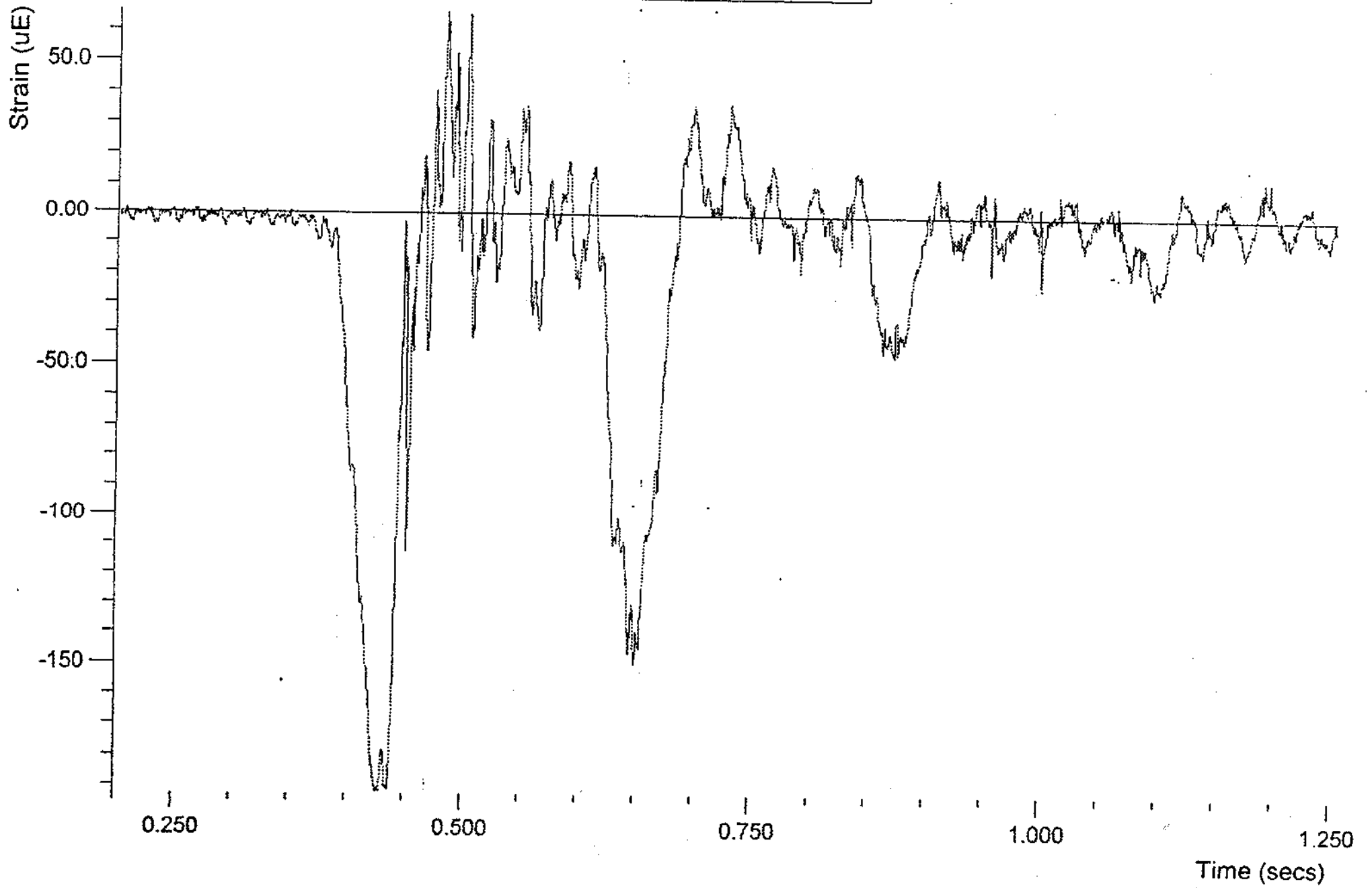
Test: HSE 13 (O1,C2,I2,DL)
Strain Gauge ST-304



Test: HSE 13 (O1,C2,I2,DL)
Strain Gauge ST-305



Test: HS 13 (O1,C2,I2,DL)
Strain Gauge ST-306



Appendix D: Linear Displacement Transducer Profiles

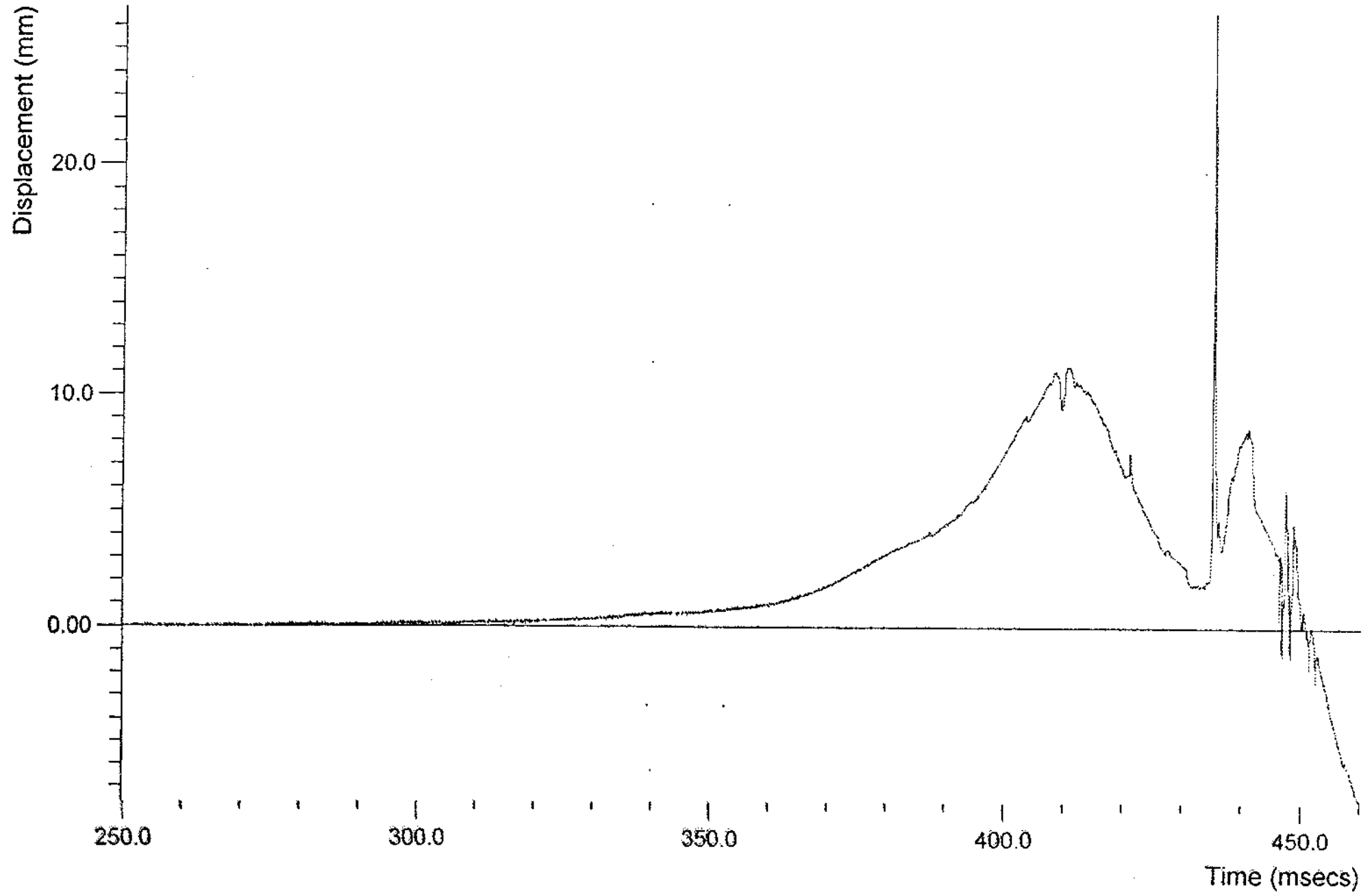
Table D1: Location of Linear Displacement Transducers

Measuring Position	X Co-ord (m)	Y Co-ord (m)	Z Co-ord (m)
LD-201	0.00	-0.66	4.00
LD-202	11.50	-0.60	4.00
LD-203	24.00	-0.66	4.00

[Embedded]00088657

[Embedded]00082189

Test: HSE 13 (O1,C2,I2,DL)
Transducer no: LD-201



Test: HSE 13 (O1,C2,I2,DL)
Transducer no: LD-202

