



Health & Safety
Executive

**OFFSHORE TECHNOLOGY
REPORT - OTO 98 100**

**A Study of the Repeatability of
Explosion Tests
Preliminary Data Report for Test 4**

Explosions in Full Scale Offshore Module Geometries

Health & Safety Executive Contract MaTSU 8847/3522

Preliminary Data Report for Test 4

| Summary of Experimental Conditions | |
|------------------------------------|-----------------------|
| Date | 26th June 1997 |
| Time | 13:44 |
| Test Series | A |
| Confinement Configuration | CI |
| Obstacle Configuration | OI |
| Ignition Position | (X:0.4, Y:6.0, Z:2.0) |
| Mean Equivalence Ratio | 1.08 |
| Water Sprays | None |

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

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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 | 492.6 |
| IP-2 | 6.0 | 0.5 | 2.0 | 523.6 |
| IP-3 | 10.0 | 0.5 | 2.0 | 558.2 |
| IP-4 | 14.0 | 0.5 | 2.0 | 598.7 |
| IP-5 | 18.0 | 0.5 | 2.0 | 613.9 |
| IP-6 | 22.0 | 0.5 | 2.0 | 622.7 |
| IP-7 | 27.5 | 0.5 | 2.0 | 635.5 |
| IP-8 | 0.5 | 4.0 | 2.0 | 334.0 |
| IP-9 | 6.0 | 4.0 | 2.0 | 510.5 |
| IP-10 | 14.0 | 4.0 | 2.0 | 594.1 |
| IP-11 | 22.0 | 4.0 | 2.0 | 613.7 |
| IP-12 | 27.5 | 4.0 | 2.0 | 630.7 |
| IP-13 | 0.5 | 8.0 | 2.0 | 327.3 |
| IP-14 | 6.0 | 8.0 | 2.0 | 500.0 |
| IP-15 | 10.0 | 8.0 | 2.0 | 553.6 |
| IP-16 | 14.0 | 8.0 | 2.0 | 583.8 |
| IP-17 | 18.0 | 8.0 | 2.0 | 607.5 |
| IP-18 | 22.0 | 8.0 | 2.0 | 622.0 |
| IP-19 | 27.5 | 8.0 | 2.0 | 631.7 |
| IP-20 | 0.5 | 11.5 | 2.0 | 496.9 |
| IP-21 | 2.0 | 11.5 | 2.0 | 500.0 |
| IP-22 | 6.0 | 11.5 | 2.0 | 524.1 |
| IP-23 | 10.0 | 11.5 | 2.0 | 563.4 |
| IP-24 | 14.0 | 11.5 | 2.0 | 587.2 |
| IP-25 | 18.0 | 11.5 | 2.0 | 603.7 |
| IP-26 | 22.0 | 11.5 | 2.0 | 619.1 |
| IP-27 | 26.0 | 11.5 | 2.0 | 628.4 |
| IP-28 | 27.5 | 11.5 | 2.0 | 631.0 |
| IP-29 | 0.5 | 0.5 | 4.0 | 480.4 |
| IP-30 | 6.0 | 0.5 | 4.0 | 518.7 |
| IP-31 | 10.0 | 0.5 | 4.0 | 570.6 |
| IP-32 | 14.0 | 0.5 | 4.0 | 591.6 |
| IP-33 | 18.0 | 0.5 | 4.0 | 610.9 |

| 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 | 620.4 |
| IP-35 | 26.0 | 0.5 | 4.0 | 630.2 |
| IP-36 | 27.5 | 0.5 | 4.0 | 636.0 |
| IP-37 | 0.5 | 4.0 | 4.0 | 370.7 |
| IP-38 | 6.0 | 4.0 | 4.0 | 534.9 |
| IP-39 | 14.0 | 4.0 | 4.0 | 584.1 |
| IP-40 | 22.0 | 4.0 | 4.0 | 622.0 |
| IP-41 | 26.0 | 4.0 | 4.0 | 631.2 |
| IP-42 | 27.5 | 4.0 | 4.0 | 632.5 |
| IP-43 | 0.5 | 8.0 | 4.0 | 364.8 |
| IP-44 | 2.0 | 8.0 | 4.0 | 430.9 |
| IP-45 | 6.0 | 8.0 | 4.0 | 499.2 |
| IP-46 | 10.0 | 8.0 | 4.0 | 547.0 |
| IP-47 | 14.0 | 8.0 | 4.0 | 575.9 |
| IP-48 | 18.0 | 8.0 | 4.0 | 579.5 |
| IP-49 | 22.0 | 8.0 | 4.0 | 615.5 |
| IP-50 | 26.0 | 8.0 | 4.0 | 628.4 |
| IP-51 | 27.5 | 8.0 | 4.0 | 631.3 |
| IP-52 | 26.0 | 10.0 | 4.0 | 630.9 |
| IP-53 | 27.5 | 10.0 | 4.0 | 631.5 |
| IP-54 | 0.5 | 11.5 | 4.0 | 470.8 |
| IP-55 | 2.0 | 11.5 | 4.0 | 497.8 |
| IP-56 | 6.0 | 11.5 | 4.0 | 534.9 |
| IP-57 | 10.0 | 11.5 | 4.0 | 565.2 |
| IP-58 | 14.0 | 11.5 | 4.0 | 584.6 |
| IP-59 | 18.0 | 11.5 | 4.0 | 601.9 |
| IP-60 | 22.0 | 11.5 | 4.0 | 615.3 |
| IP-61 | 26.0 | 11.5 | 4.0 | 628.0 |
| IP-62 | 27.5 | 11.5 | 4.0 | 629.8 |
| IP-63 | 0.5 | 0.5 | 6.0 | 509.5 |
| IP-64 | 6.0 | 0.5 | 6.0 | 556.0 |
| IP-65 | 10.0 | 0.5 | 6.0 | 578.6 |
| IP-66 | 14.0 | 0.5 | 6.0 | 607.1 |
| IP-67 | 18.0 | 0.5 | 6.0 | 607.1 |

| 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 | 624.9 |
| IP-69 | 27.5 | 0.5 | 6.0 | 638.0 |
| IP-70 | 0.5 | 4.0 | 6.0 | 446.1 |
| IP-71 | 6.0 | 4.0 | 6.0 | 529.9 |
| IP-72 | 14.0 | 4.0 | 6.3 | 599.5 |
| IP-73 | 22.0 | 4.0 | 6.0 | 623.7 |
| IP-74 | 27.5 | 4.0 | 6.0 | 633.9 |
| IP-75 | 0.5 | 8.0 | 6.0 | 415.8 |
| IP-76 | 6.0 | 8.0 | 6.0 | 523.3 |
| IP-77 | 10.0 | 8.0 | 6.0 | 557.5 |
| IP-78 | 14.0 | 8.0 | 6.0 | 584.0 |
| IP-79 | 18.0 | 8.0 | 6.0 | 606.2 |
| IP-80 | 22.0 | 8.0 | 6.0 | 620.7 |
| IP-81 | 27.5 | 8.0 | 6.0 | 633.6 |
| IP-82 | 0.5 | 11.5 | 6.0 | 497.7 |
| IP-83 | 2.0 | 11.5 | 6.0 | 512.7 |
| IP-84 | 6.0 | 11.5 | 6.0 | 541.6 |
| IP-85 | 10.0 | 11.5 | 6.0 | 563.2 |
| IP-86 | 14.0 | 11.5 | 6.0 | 593.9 |
| IP-87 | 18.0 | 11.5 | 6.0 | 610.1 |
| IP-88 | 22.0 | 11.5 | 6.0 | 619.7 |
| IP-89 | 26.0 | 11.5 | 6.0 | 629.9 |
| IP-90 | 27.5 | 11.5 | 6.0 | 634.3 |

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 | 0.5 | 0.0 | 238 | 205 | 643.8 | 202.4 | 231.8 |
| PI-2 | 6.0 | 0.5 | 0.0 | 385 | 213 | 630.0 | 165.7 | 186.4 |
| PI-3 | 12.5 | 0.5 | 0.0 | 588 | 436 | 634.1 | 96.9 | 106.7 |
| PI-4 | 22.0 | 0.5 | 0.0 | 2642 | 1758 | 628.8 | 12.6 | 33.6 |
| PI-5 | 27.5 | 0.5 | 0.0 | 7698 | 5248 | 637.7 | 7.8 | 16.4 |
| PI-6 | 0.5 | 6.0 | 0.0 | 289 | 225 | 659.0 | 204.2 | 213.0 |
| PI-7 | 9.0 | 6.0 | 0.0 | 666 | 509 | 631.4 | 11.0 | 37.3 |
| PI-8 | 14.0 | 6.0 | 0.0 | 1031 | 648 | 614.5 | 80.9 | 108.9 |
| PI-9 | 21.0 | 6.0 | 0.0 | 2786 | 1937 | 621.7 | 23.4 | 50.6 |
| PI-10 | 27.5 | 6.0 | 0.0 | 17096 | 7171 | 634.8 | 6.6 | 10.9 |
| PI-11 | 0.5 | 11.5 | 0.0 | 333 | 282 | 657.8 | 190.3 | 194.7 |
| PI-12 | 12.3 | 11.5 | 0.0 | 528 | 512 | 582.3 | 46.1 | 49.5 |
| PI-13 | 27.5 | 11.5 | 0.0 | 7357 | 3678 | 633.7 | 7.8 | 19.9 |
| PI-14 | 0.5 | 0.5 | 4.0 | 230 | 188 | 650.3 | 202.6 | 226.0 |
| PI-15 | 4.5 | 0.6 | 4.0 | 325 | 235 | 640.9 | 178.5 | 196.5 |
| PI-16 | 11.2 | 0.0 | 5.5 | 472 | 396 | 622.8 | 99.3 | 109.7 |
| PI-17 | 12.0 | 0.5 | 4.0 | 704 | 453 | 623.7 | 87.9 | 111.7 |
| PI-18 | 22.0 | 0.5 | 4.0 | 2808 | 1603 | 633.2 | 24.3 | 37.0 |
| PI-19 | 27.5 | 0.5 | 4.0 | 5196 | 3540 | 636.3 | 7.1 | 9.2 |
| PI-20 | 10.2 | 4.0 | 4.0 | 814 | 338 | 634.8 | 135.2 | 147.8 |
| PI-21 | 0.5 | 7.0 | 4.0 | 287 | 211 | 655.3 | 195.6 | 206.7 |
| PI-22 | 18.0 | 8.0 | 4.0 | 1340 | 833 | 643.8 | 73.3 | 74.9 |
| PI-23 | 27.5 | 6.0 | 4.0 | 6774 | 3648 | 633.2 | 6.8 | 16.6 |
| PI-24 | 0.5 | 11.5 | 4.0 | 328 | 213 | 658.3 | 196.6 | 209.3 |
| PI-25 | 10.0 | 11.5 | 4.0 | 419 | 232 | 566.1 | 68.9 | 133.8 |
| PI-26 | 18.0 | 11.5 | 4.0 | 666 | 425 | 603.8 | 50.6 | 95.9 |
| PI-27 | 27.5 | 11.5 | 4.0 | 6082 | 4043 | 632.9 | 7.2 | 23.0 |
| PI-28 | 0.8 | 0.8 | 8.0 | 346 | 209 | 649.5 | 187.4 | 209.8 |
| PI-29 | 13.9 | 1.7 | 8.0 | 767 | 717 | 611.6 | 41.8 | 75.1 |
| PI-30 | 26.1 | 1.7 | 8.0 | 9892 | 3425 | 635.1 | 8.6 | 15.0 |
| PI-31 | 5.9 | 5.0 | 8.0 | 402 | 277 | 632.3 | 161.0 | 186.1 |
| PI-32 | 18.9 | 5.0 | 8.0 | 2673 | 1439 | 619.8 | 35.2 | 399.6 |
| PI-33 | 1.1 | 11.1 | 8.0 | 258 | 152 | 650.6 | 71.6 | 77.7 |
| PI-34 | 12.8 | 11.2 | 8.0 | 707 | 326 | 595.1 | 60.8 | 111.1 |
| PI-35 | 26.1 | 11.3 | 8.0 | - | - | - | - | - |

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 | 34.0 | 6.0 | 1.0 | - | - |
| PE-2 | 40.0 | 6.0 | 1.0 | 3891 | 2327 |
| PE-3 | 52.0 | 6.0 | 1.0 | 1920 | 1443 |
| PE-4 | 76.0 | 6.0 | 1.0 | 449 | 291 |
| PE-5 | 47.2 | 25.2 | 1.0 | - | - |
| PE-6 | 61.3 | 39.3 | 1.0 | 439 | 316 |
| PE-7 | 14.0 | 18.0 | 1.0 | 3006 | 404 |
| PE-8 | 14.0 | 24.0 | 1.0 | - | - |
| PE-9 | 14.0 | 36.0 | 1.0 | 404 | 349 |
| PE-10 | 14.0 | 60.0 | 1.0 | 272 | 253 |
| PE-11 | -21.2 | 25.2 | 1.0 | 186 | 160 |

Table 4: Gas Concentrations

| Measuring Position | X Co-ord (m) | Y Co-ord (m) | Z Co-ord (m) | Natural Gas Concentration (%) |
|--------------------|--------------|--------------|--------------|-------------------------------|
| 1 | 25.7 | 4.0 | 0.7 | 9.2 |
| 2 | 12.0 | 8.0 | 0.8 | 9.6 |
| 3 | 1.2 | 3.1 | 1.5 | 9.5 |
| 4 | 7.7 | 10.9 | 3.8 | 9.6 |
| 5 | 13.5 | 5.5 | 4.5 | 9.7 |
| 6 | 25.9 | 6.0 | 5.2 | 9.8 |
| 7 | 4.0 | 8.5 | 4.9 | 9.6 |
| 8 | 19.8 | 8.0 | 7.6 | 9.8 |

Table 5: Weather Conditions

| Air Temperature (°C) | Atmospheric Pressure (mbar) | Wind Speed (ms⁻¹) | Wind Direction (° from Magnetic North) |
|-----------------------------|------------------------------------|-------------------------------------|-----------------------------------------------|
| 9.2 | 970 | 6 | 230 |

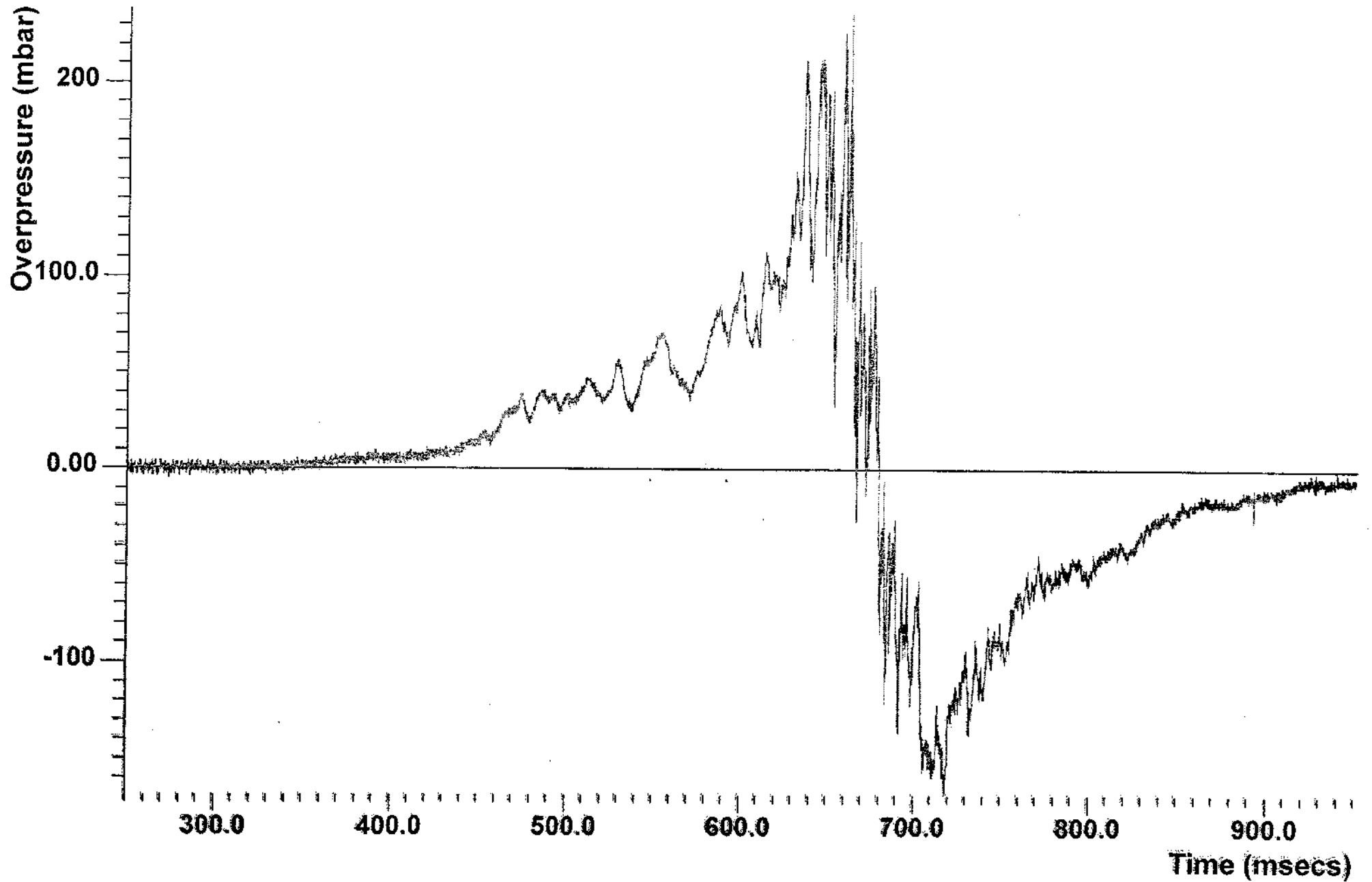
Table 6: Confinement Configuration

| Confinement Configuration | Rig Face* | Confinement |
|----------------------------------|------------------|--------------------|
| C1 | North | Open |
| | East | Open |
| | South | Open |
| | West | Open |

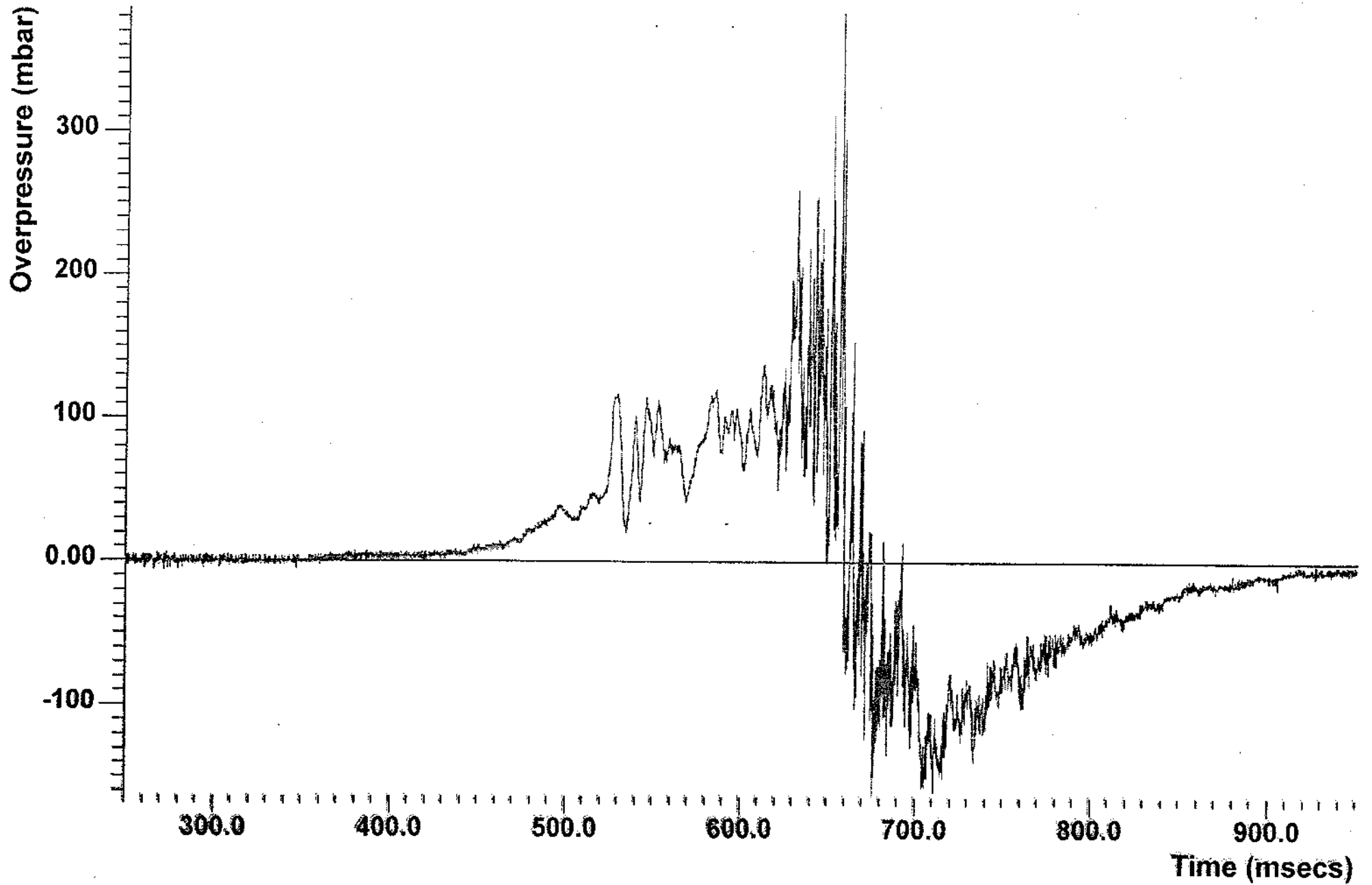
* - Origin is at the junction of the West and South faces at ground level. Roof and floor also confined.

Appendix A: Internal Overpressure Profiles

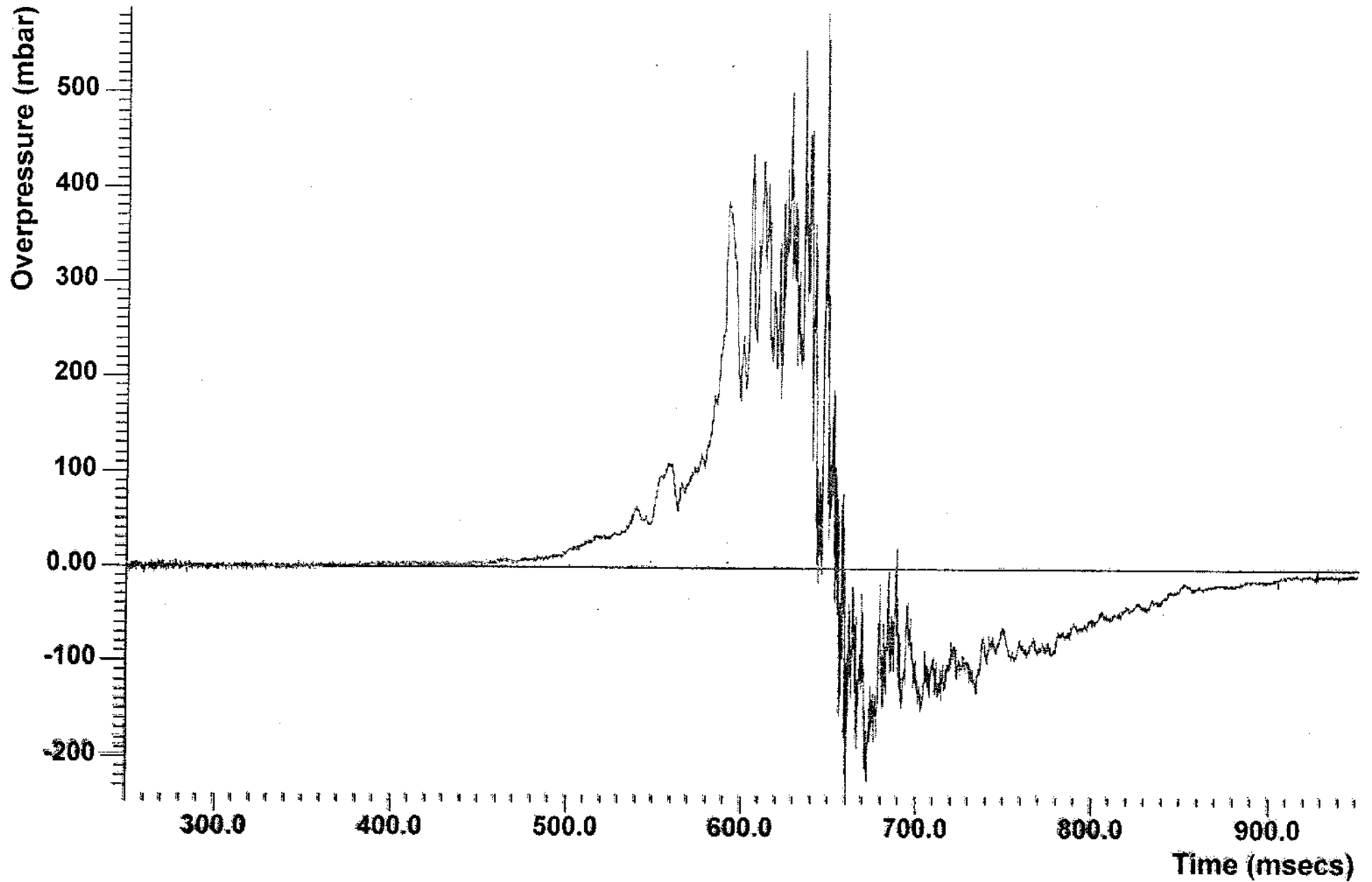
Test: HSE4 (O1, C1, I3)
Transducer no: PI-1



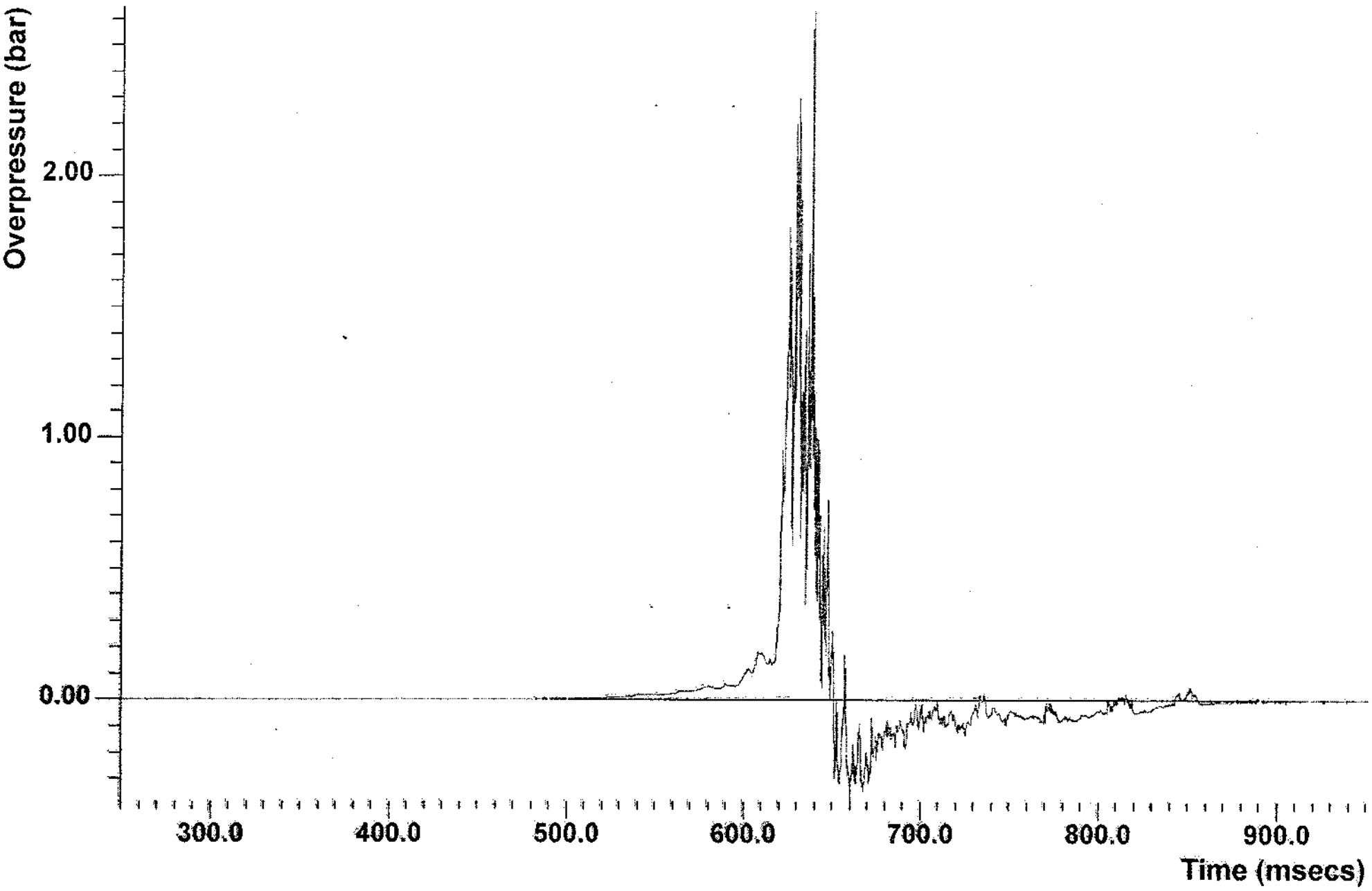
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Transducer no: PI-2



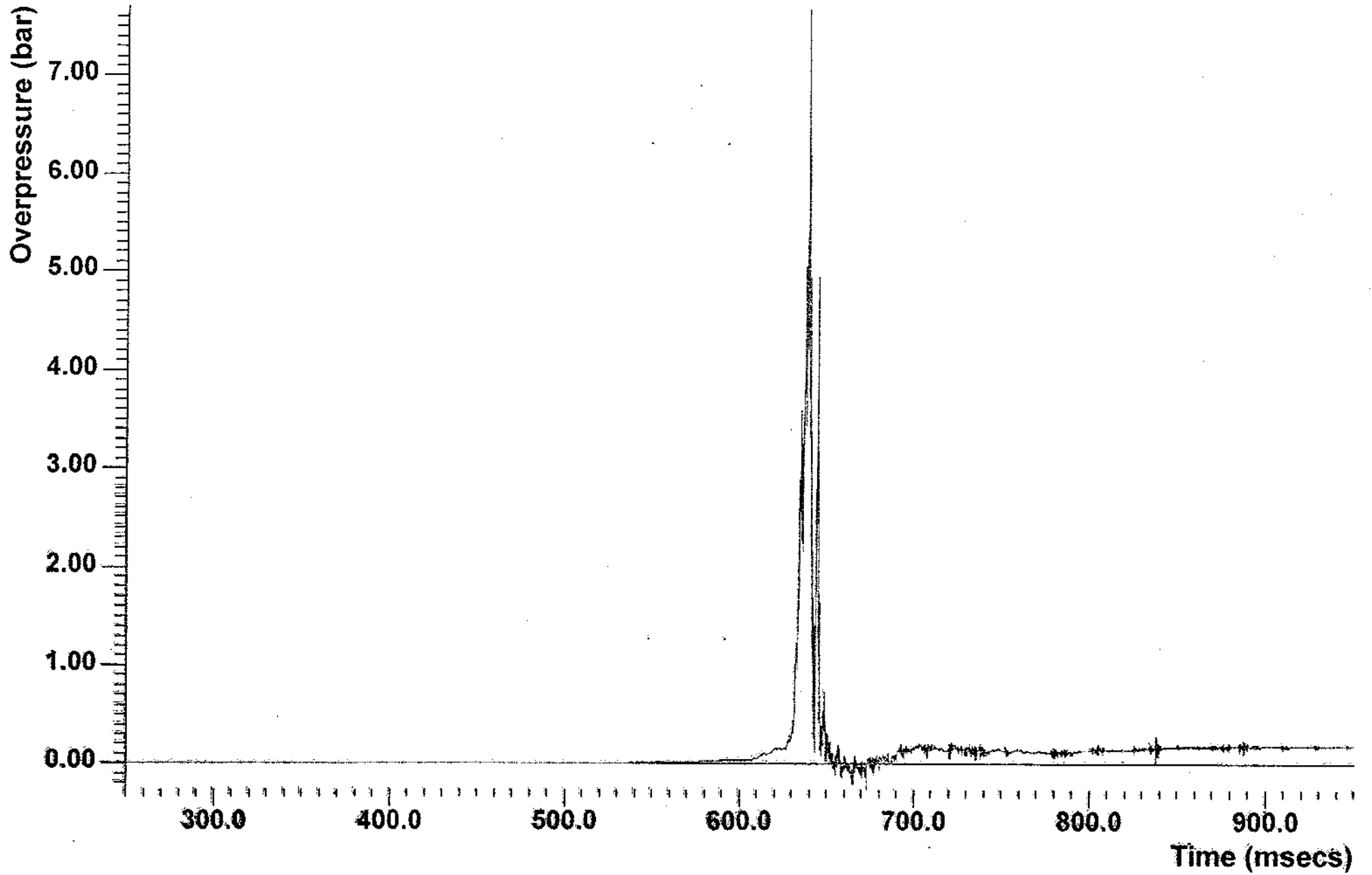
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Transducer no: PI-3



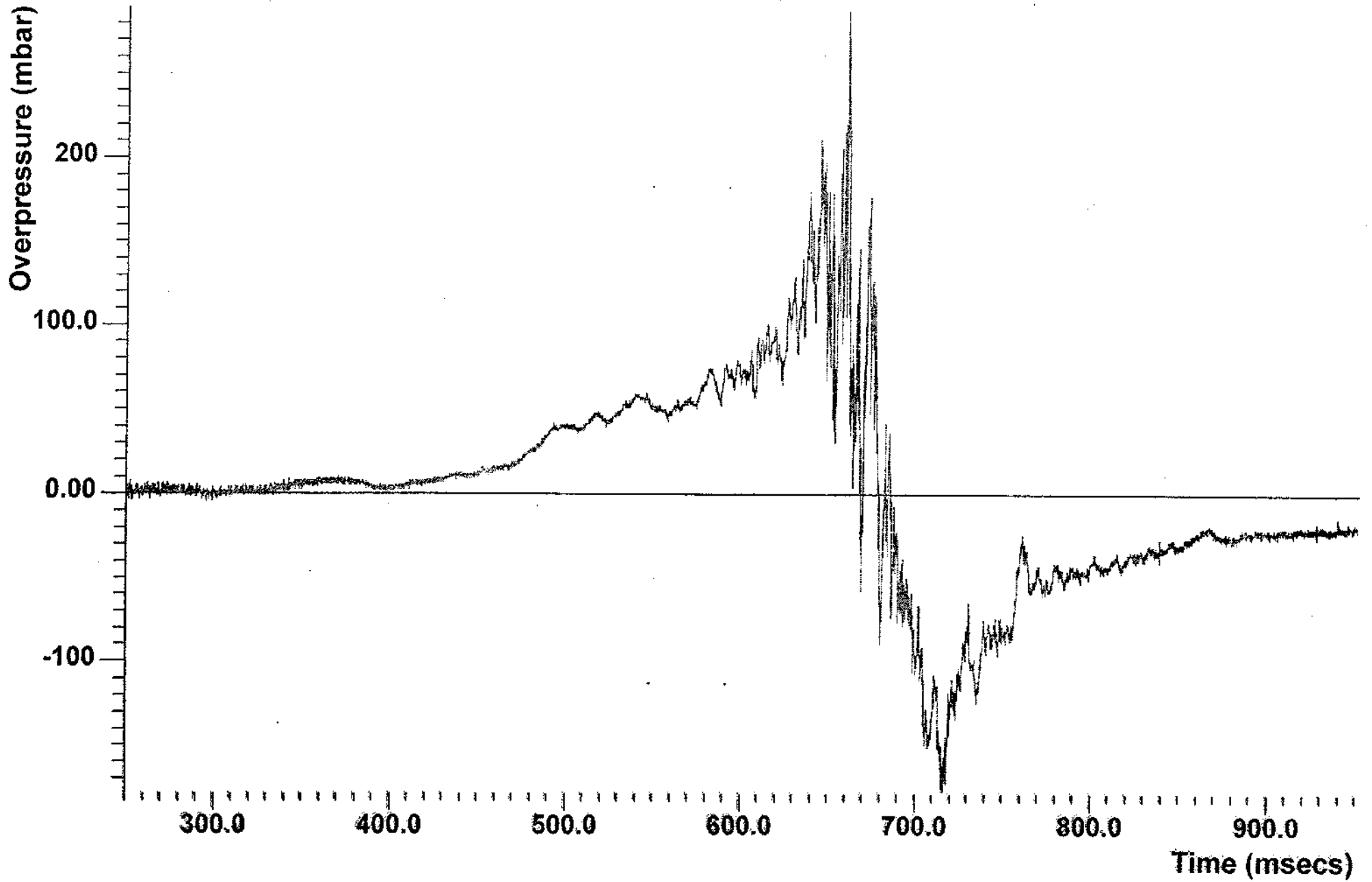
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Transducer no: PI-4



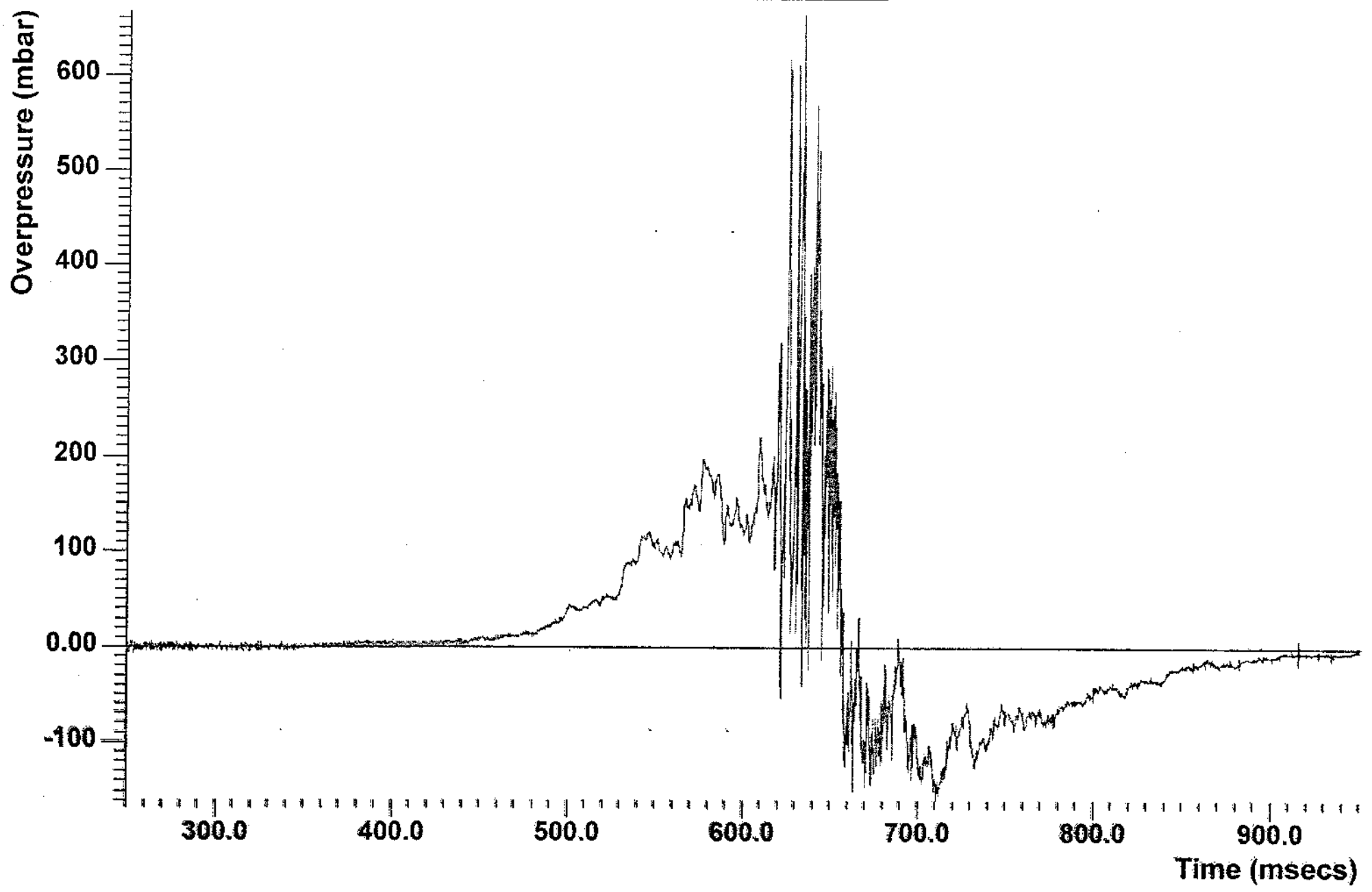
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Transducer no: PI-5



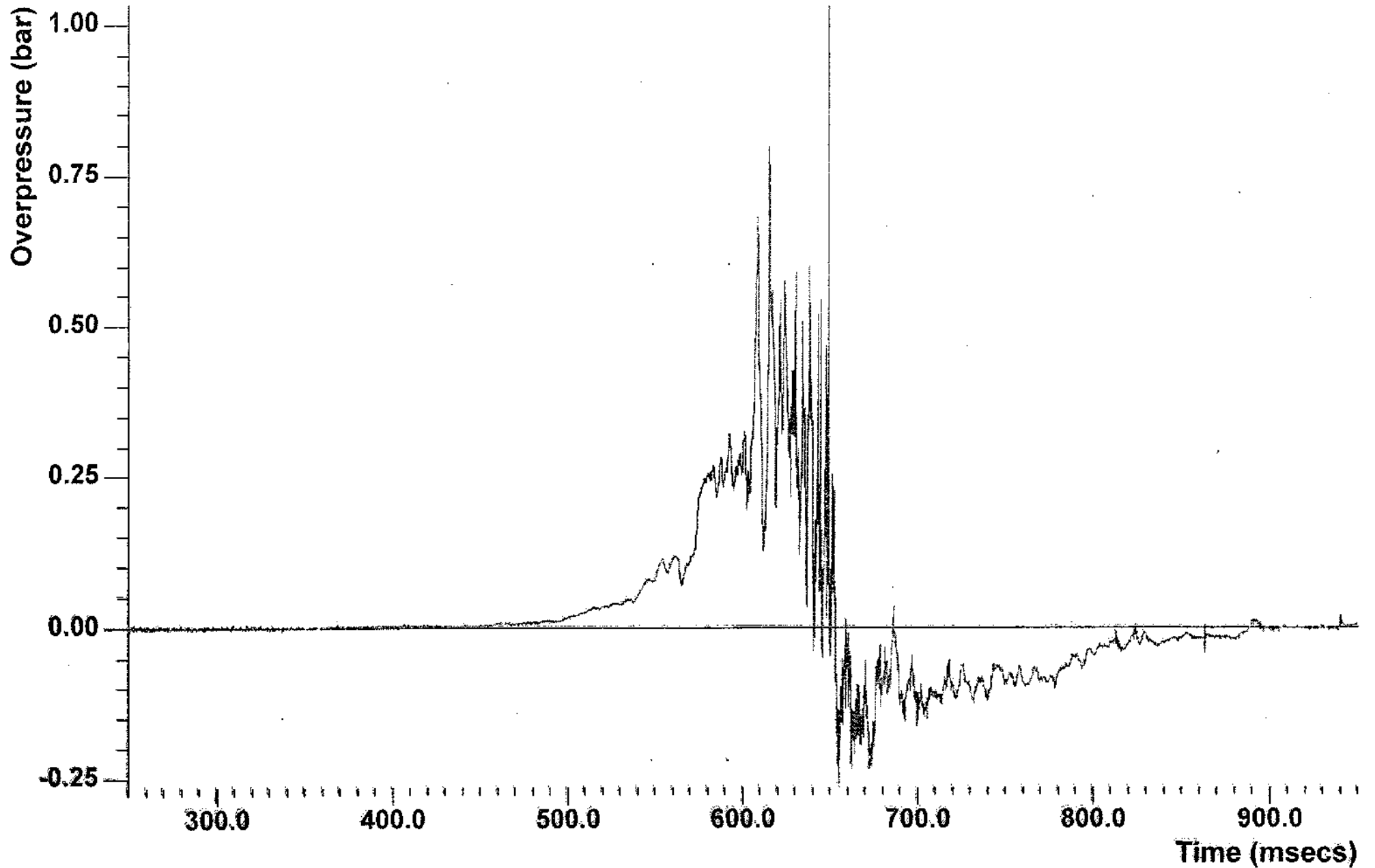
Test: HSE4 (O1, C1, I3)
Transducer no: PI-6



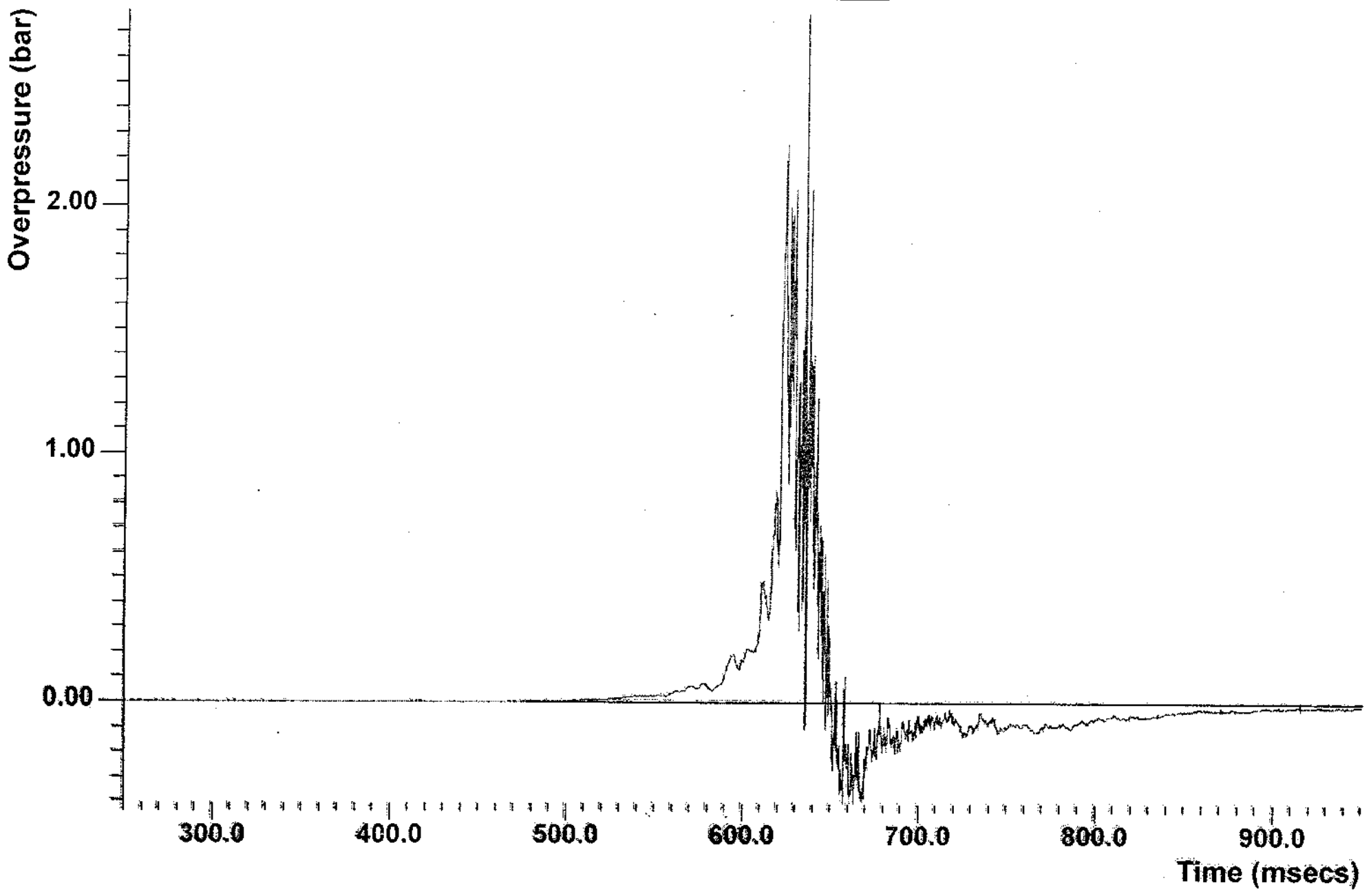
Test: HSE4 (O1, C1, I3)
Transducer no: PI-7



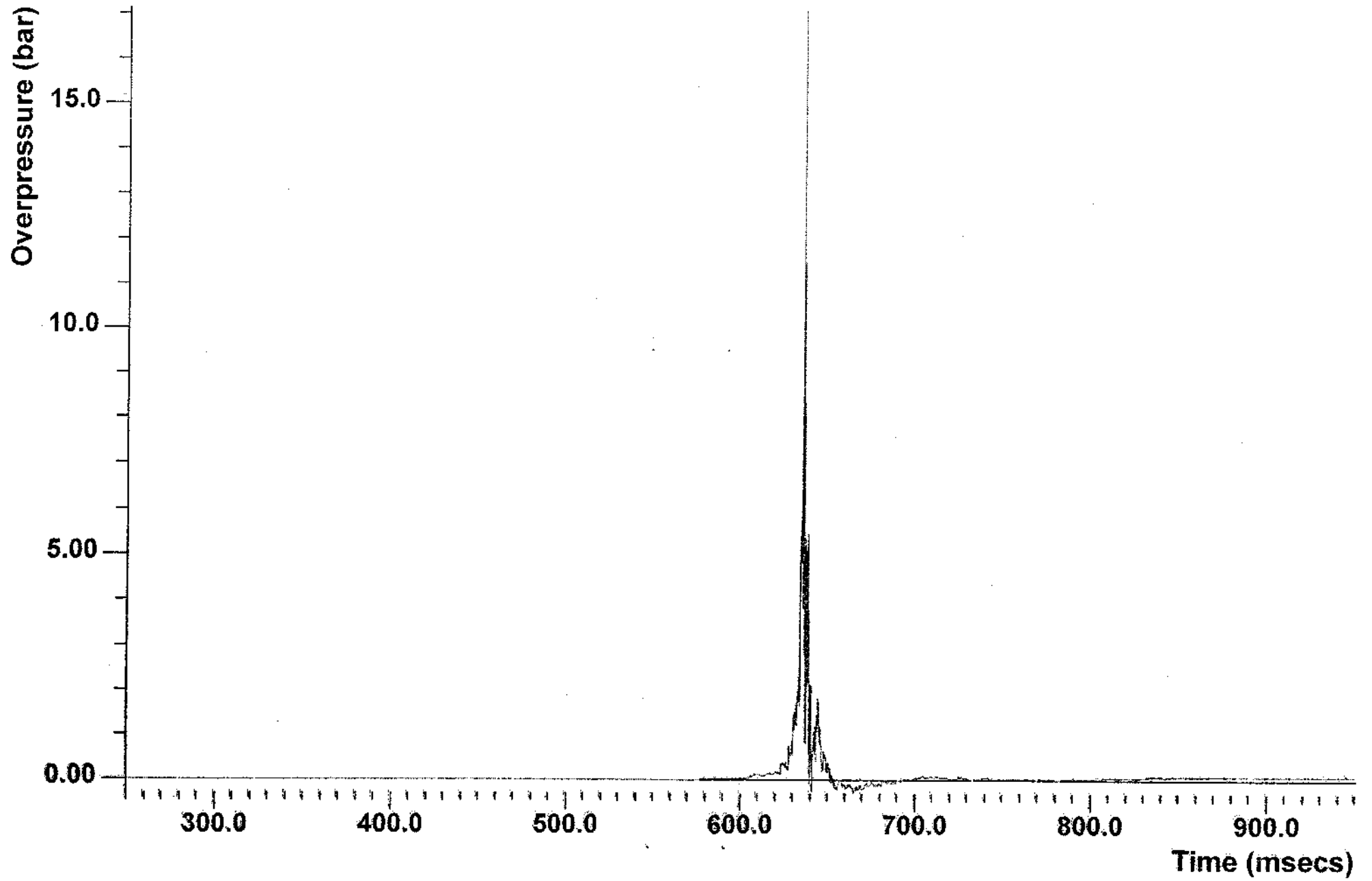
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Transducer no: PI-8



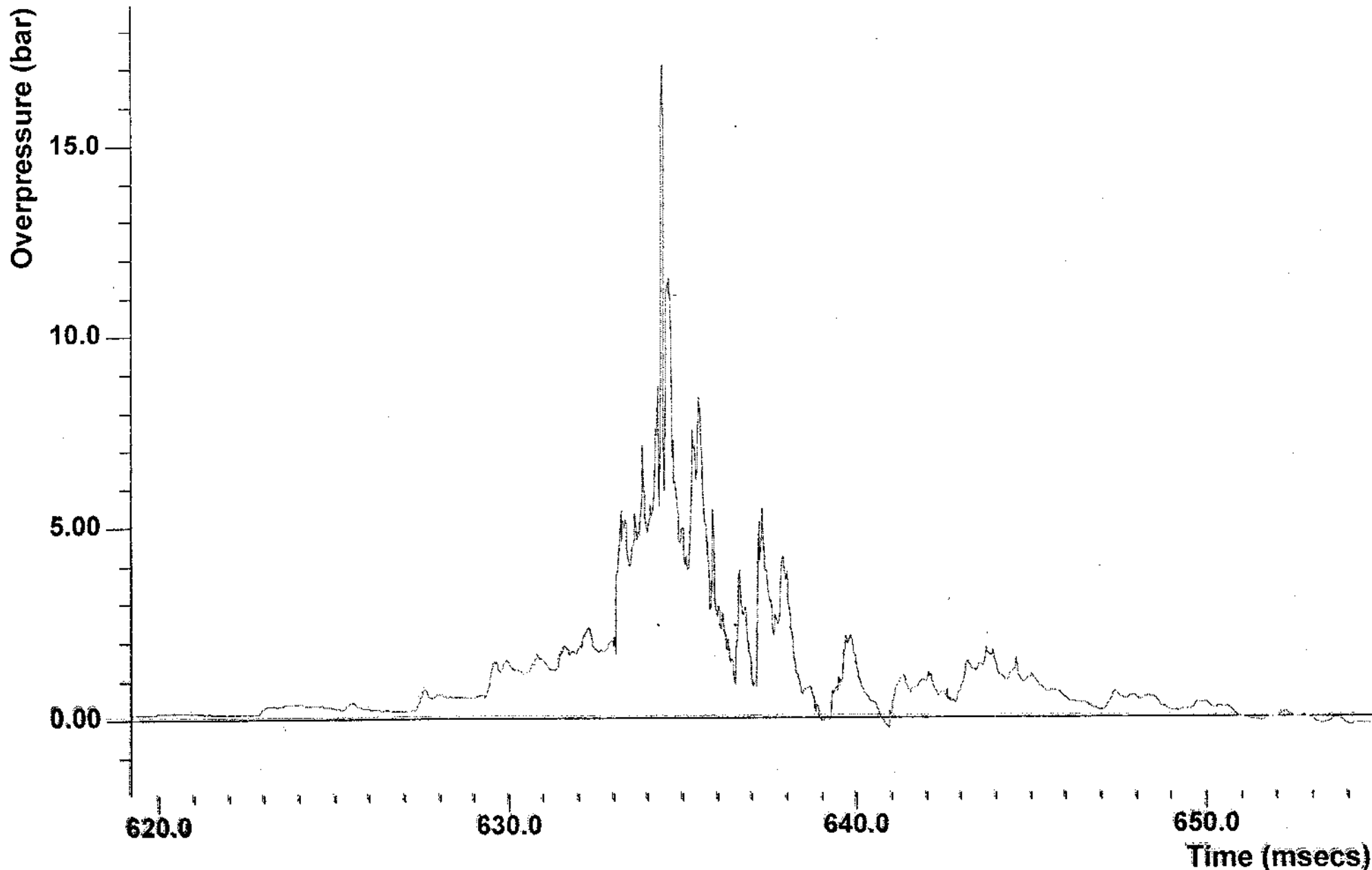
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Transducer no: PI-9



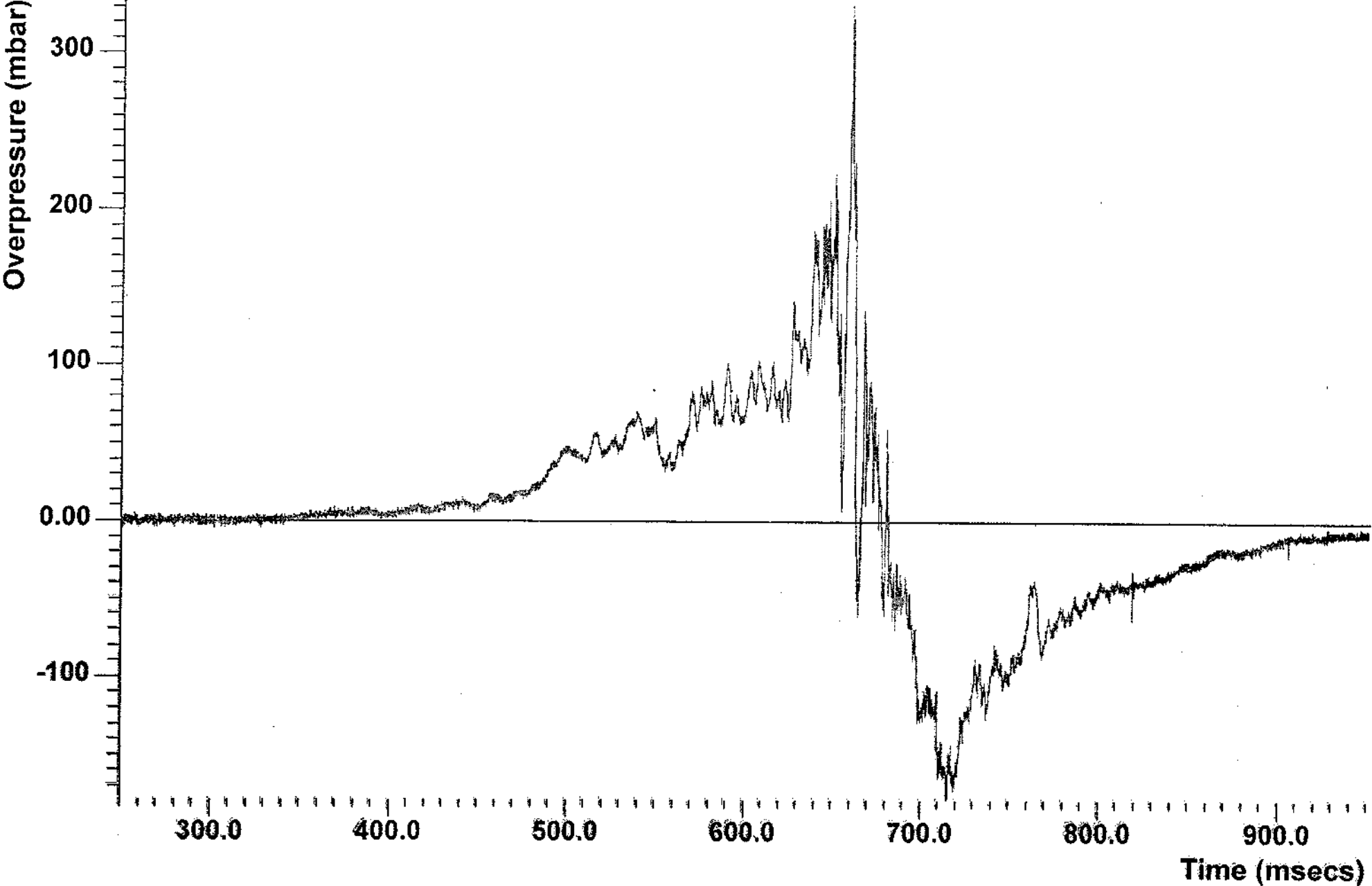
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Transducer no: PI-10



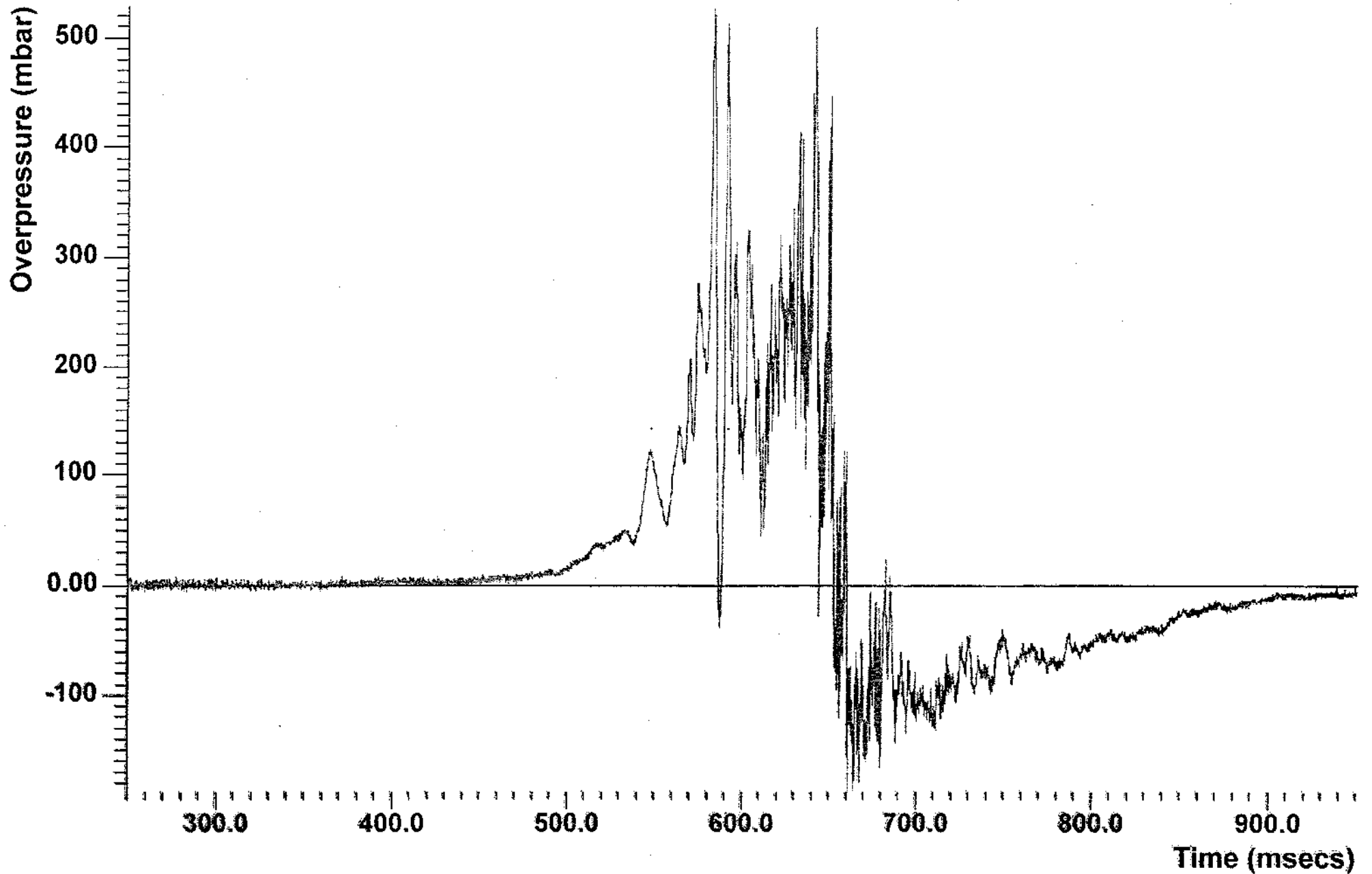
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Transducer no: PI-10



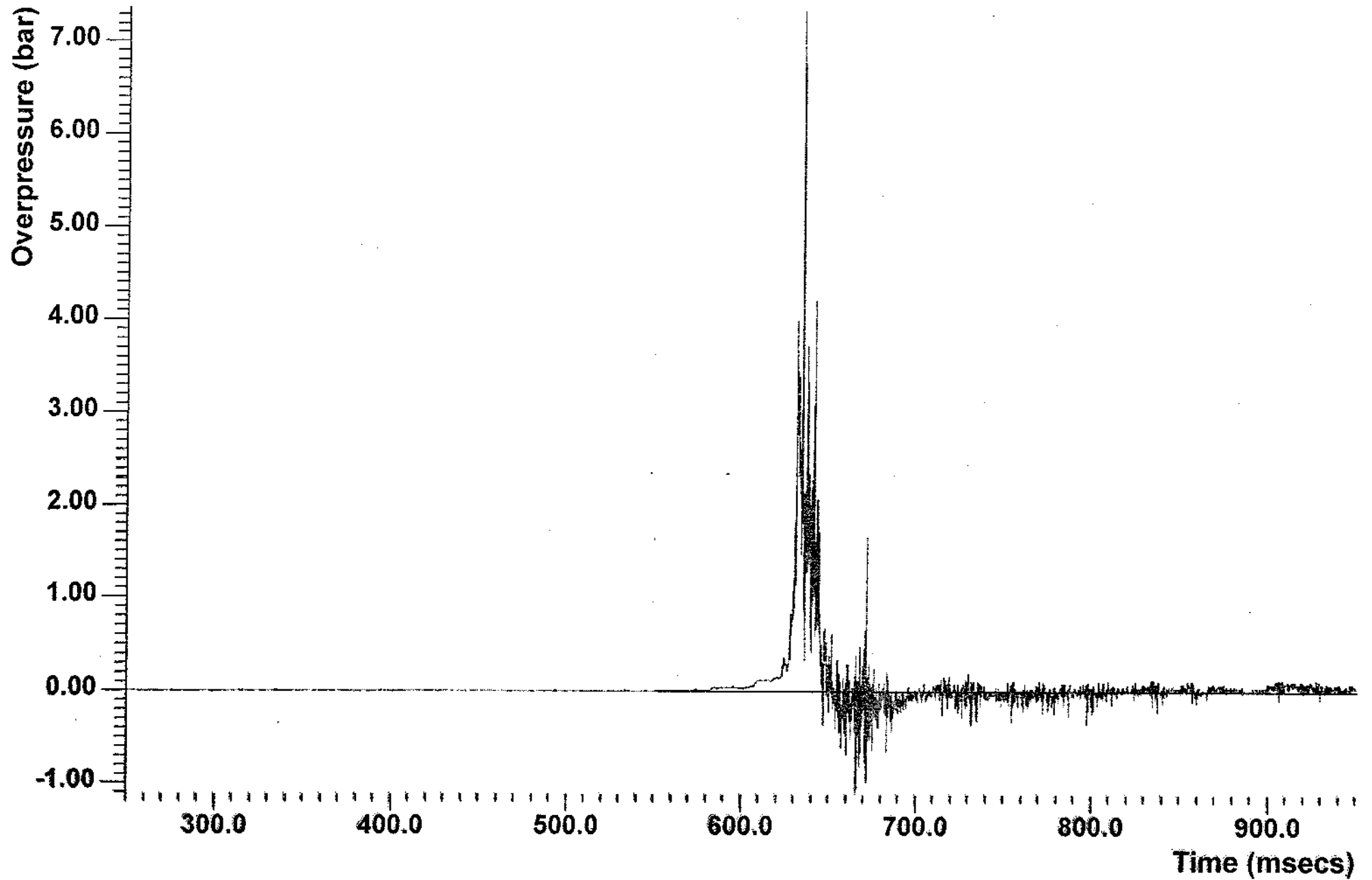
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Transducer no: PI-11



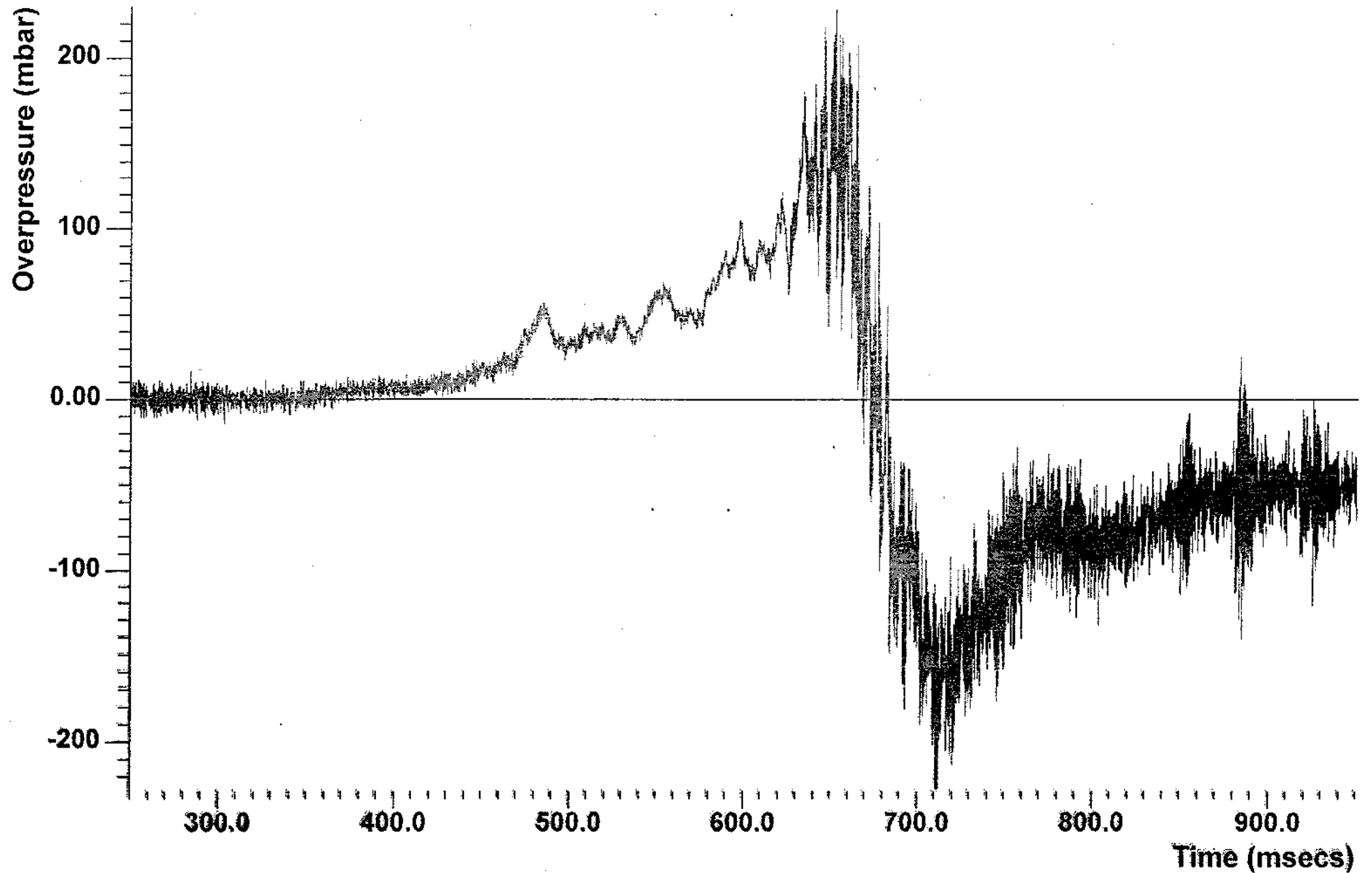
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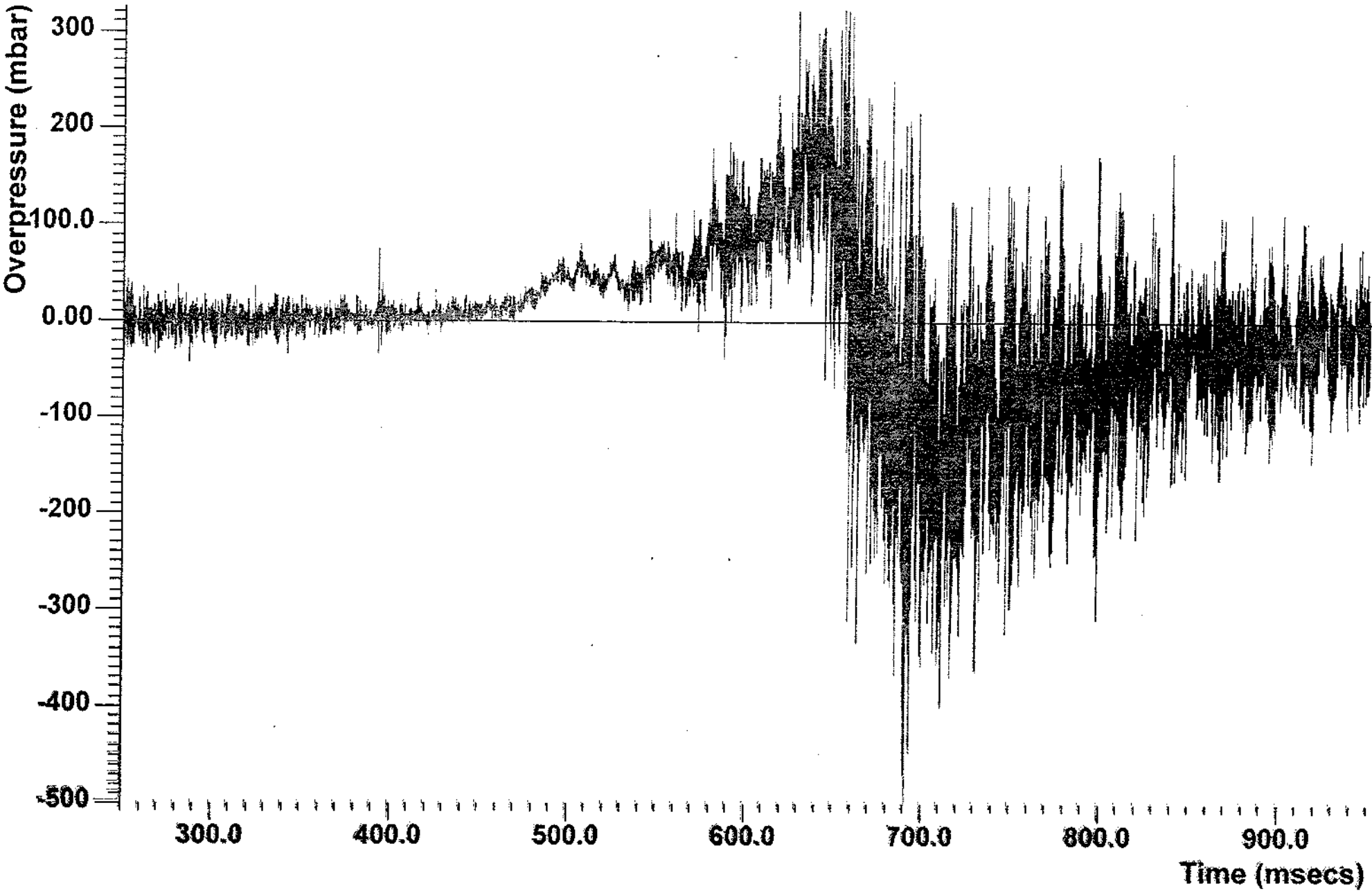
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Transducer no: PI-13



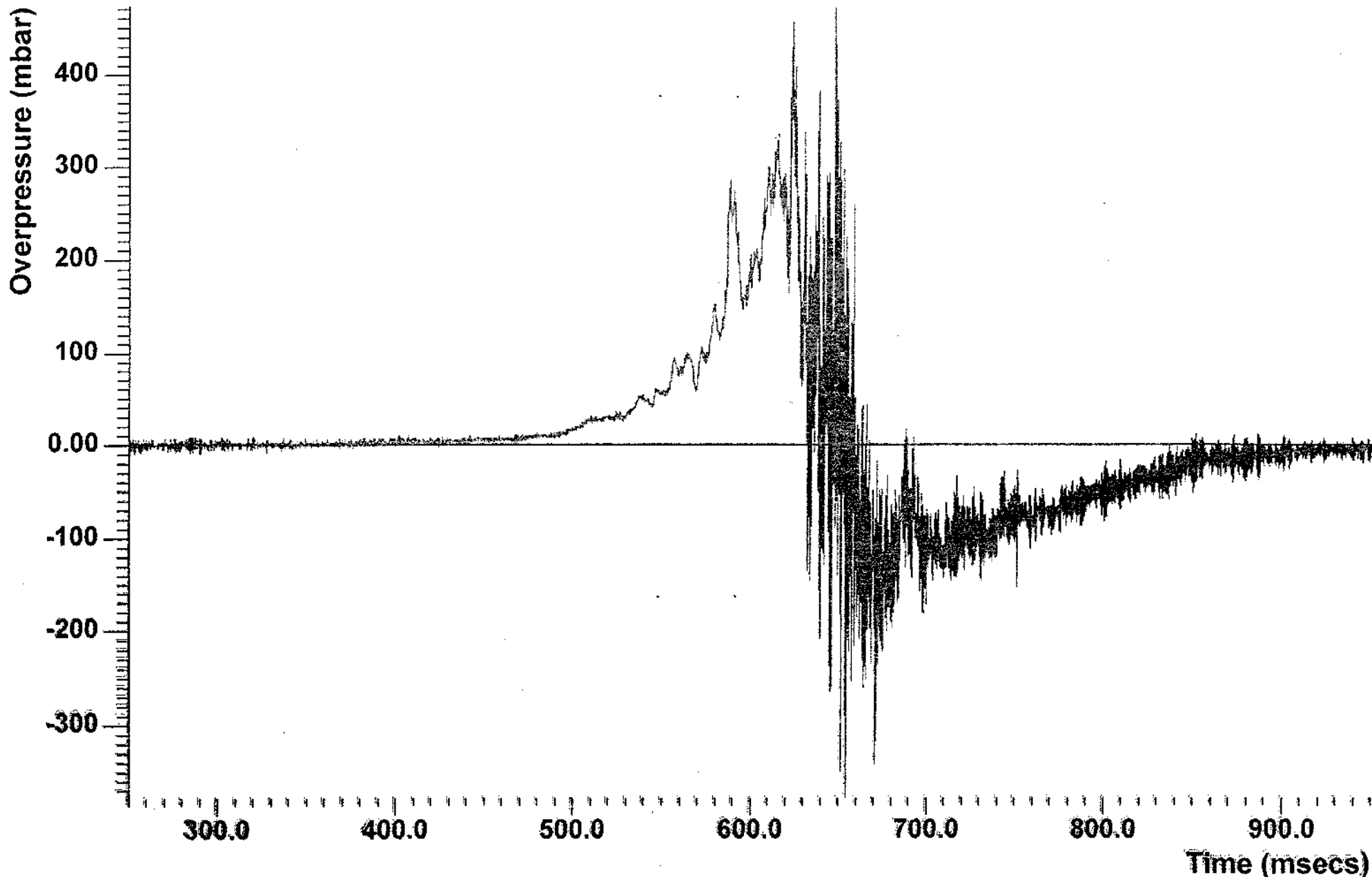
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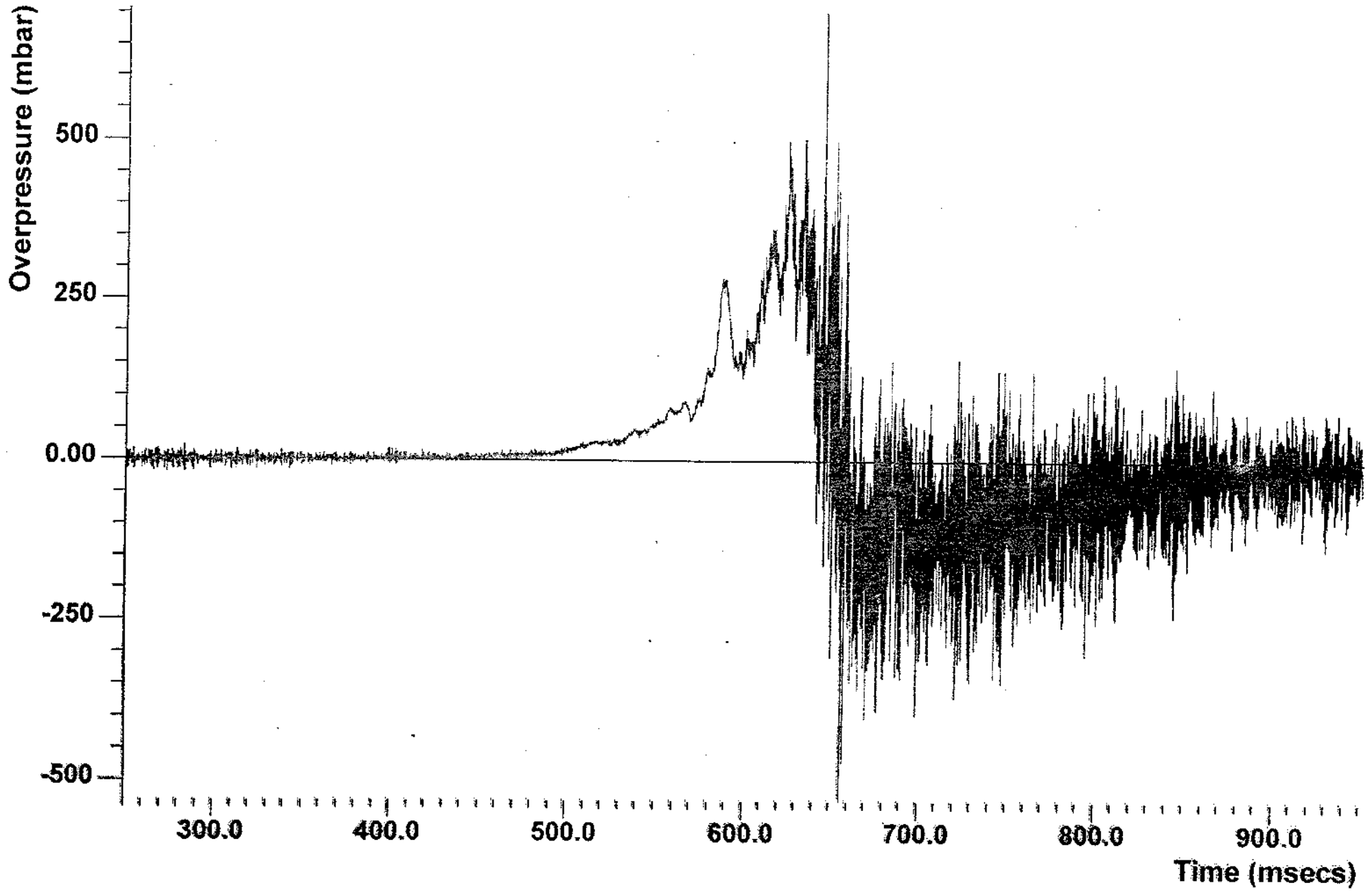
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Transducer no: PI-15



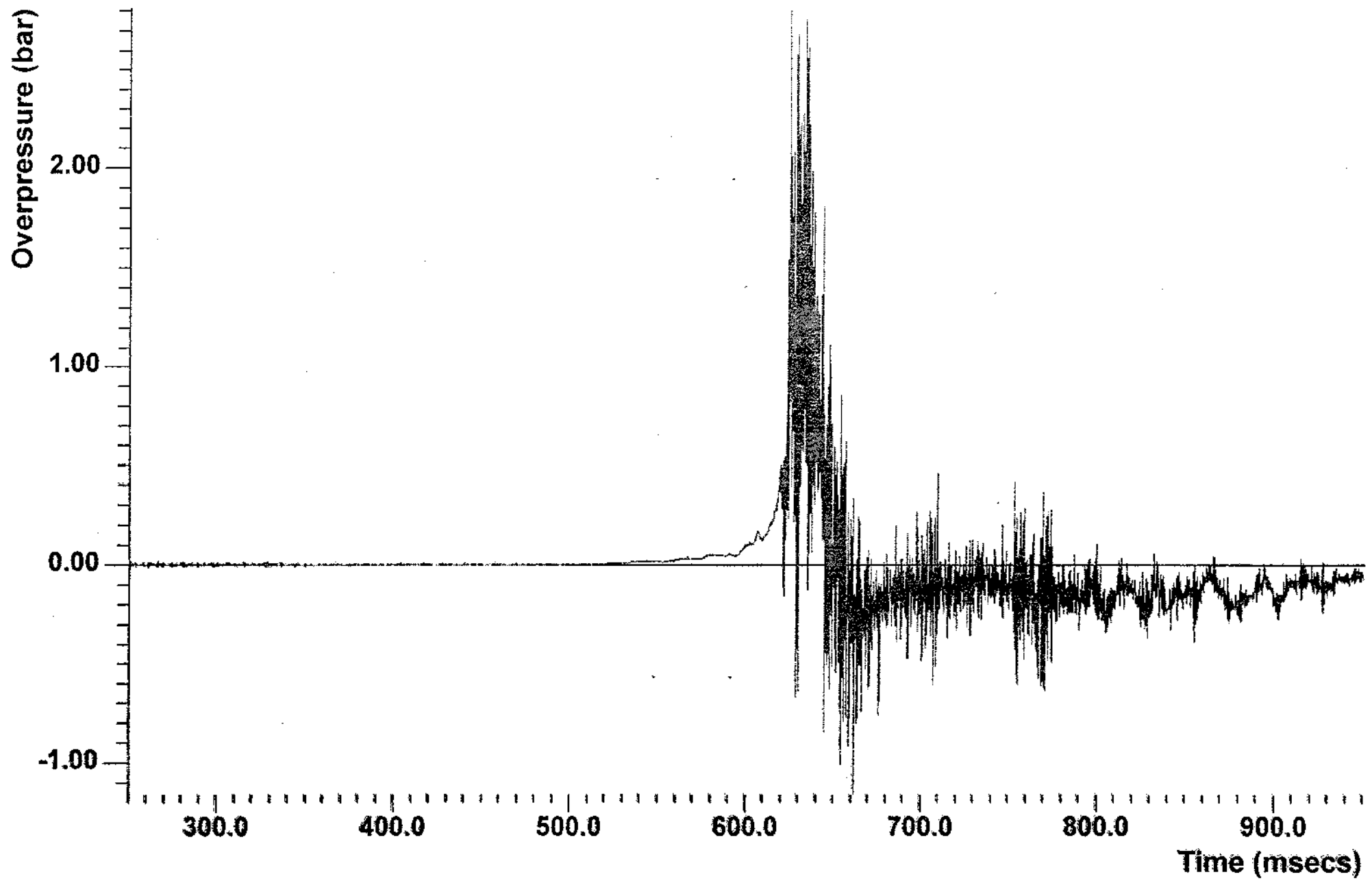
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Transducer no: PI-16



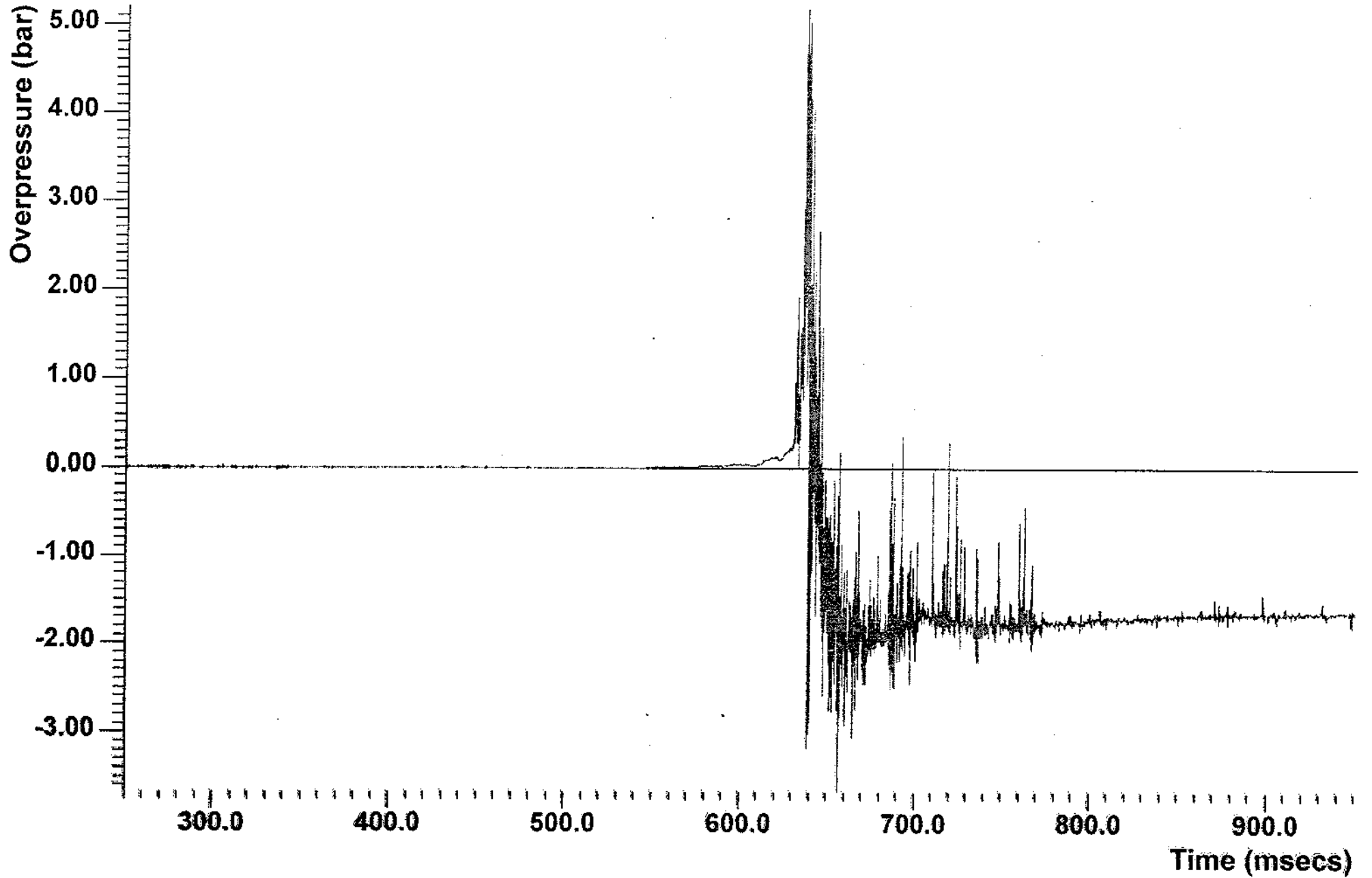
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Transducer no: PI-17



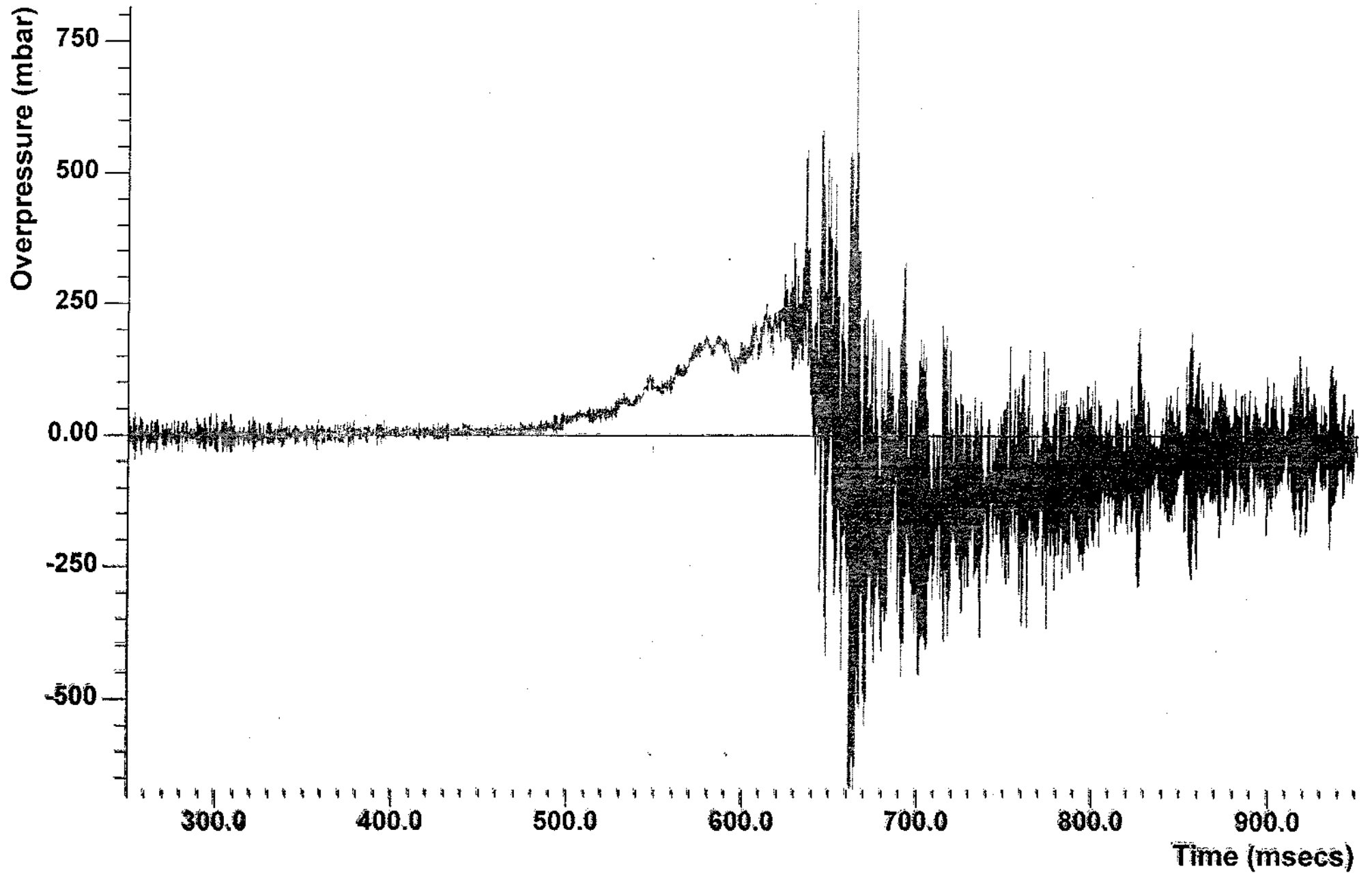
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Transducer no: PI-18



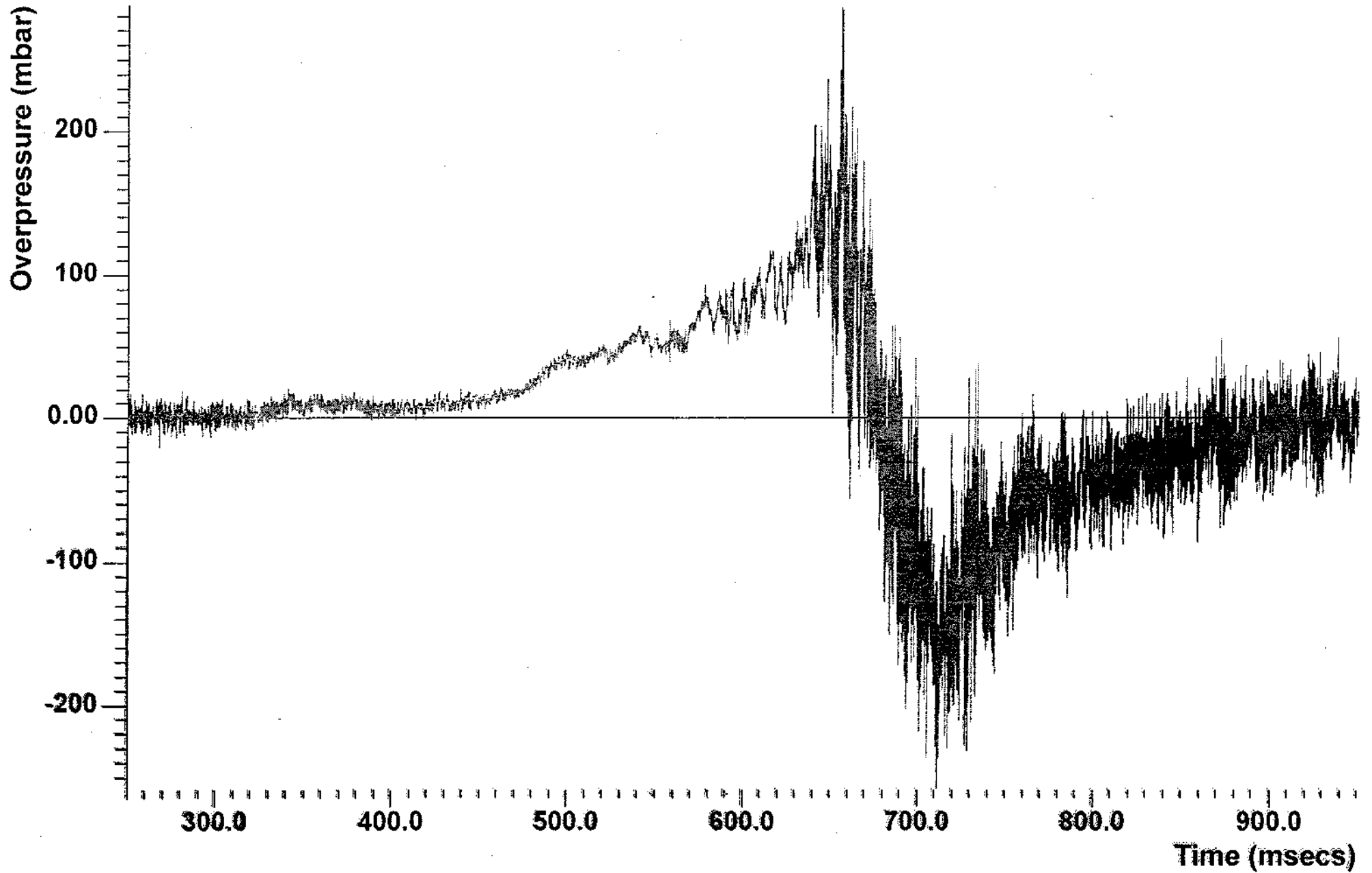
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Transducer no: PI-19



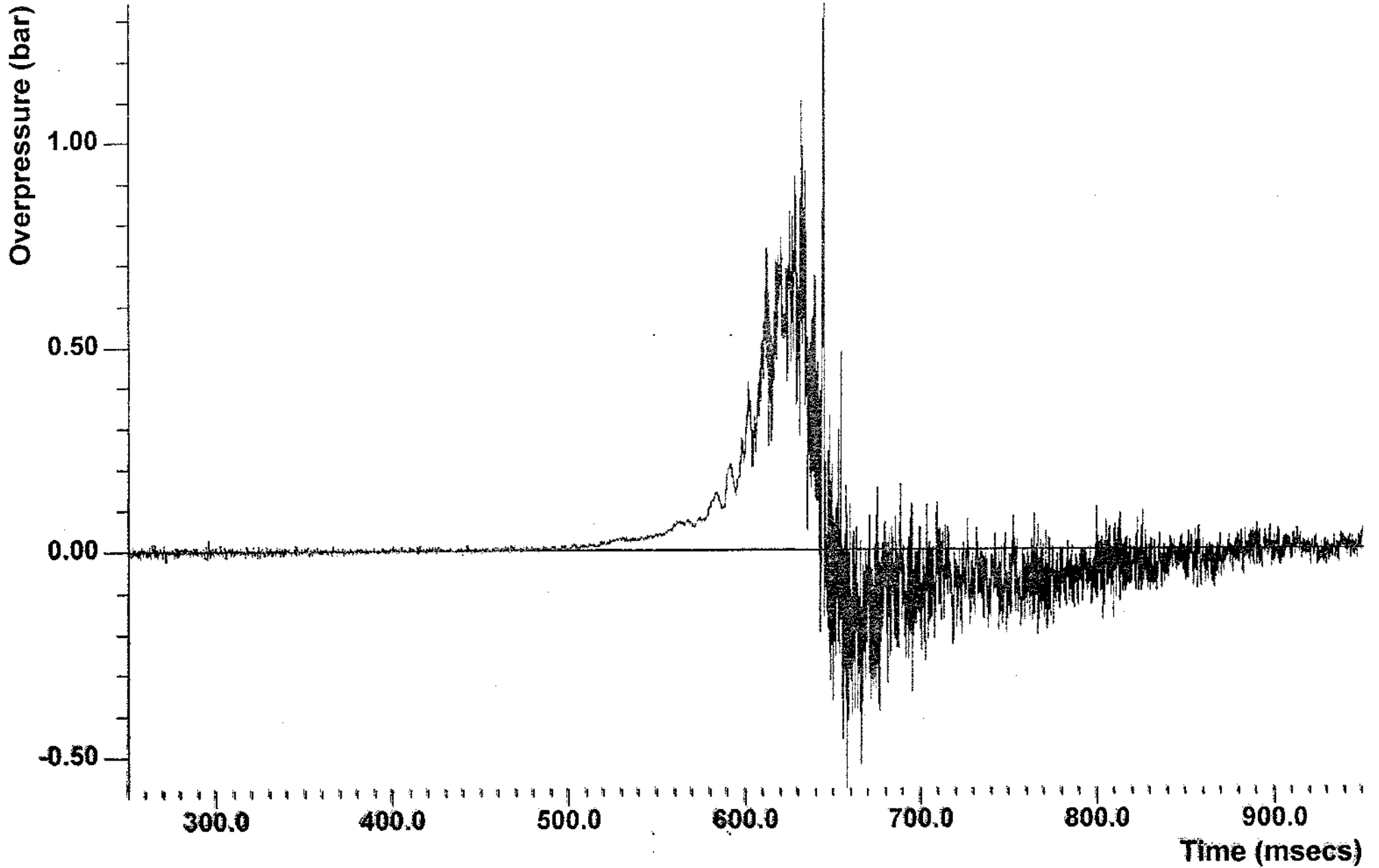
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Transducer no: PI-20



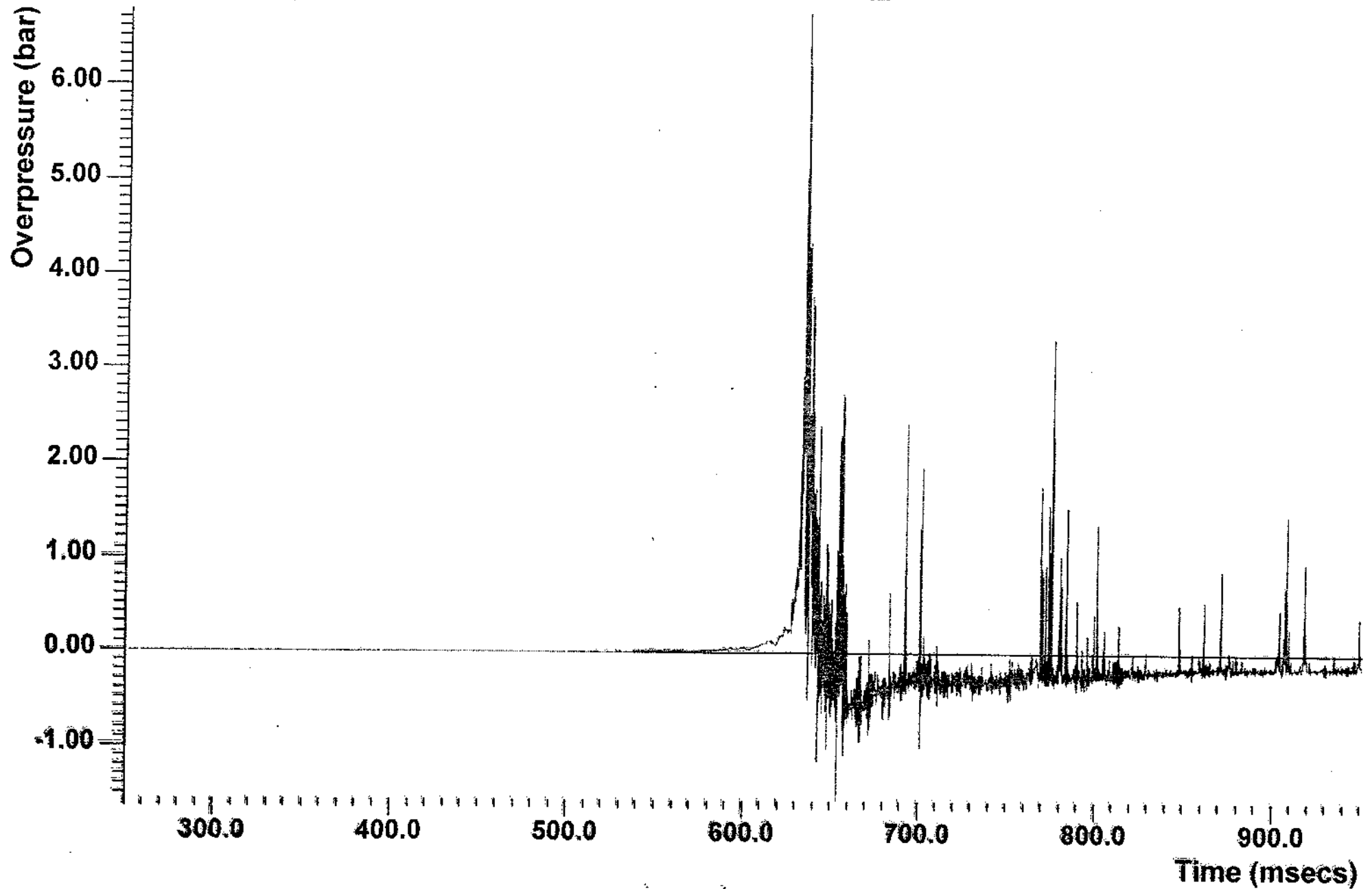
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Transducer no: PI-21



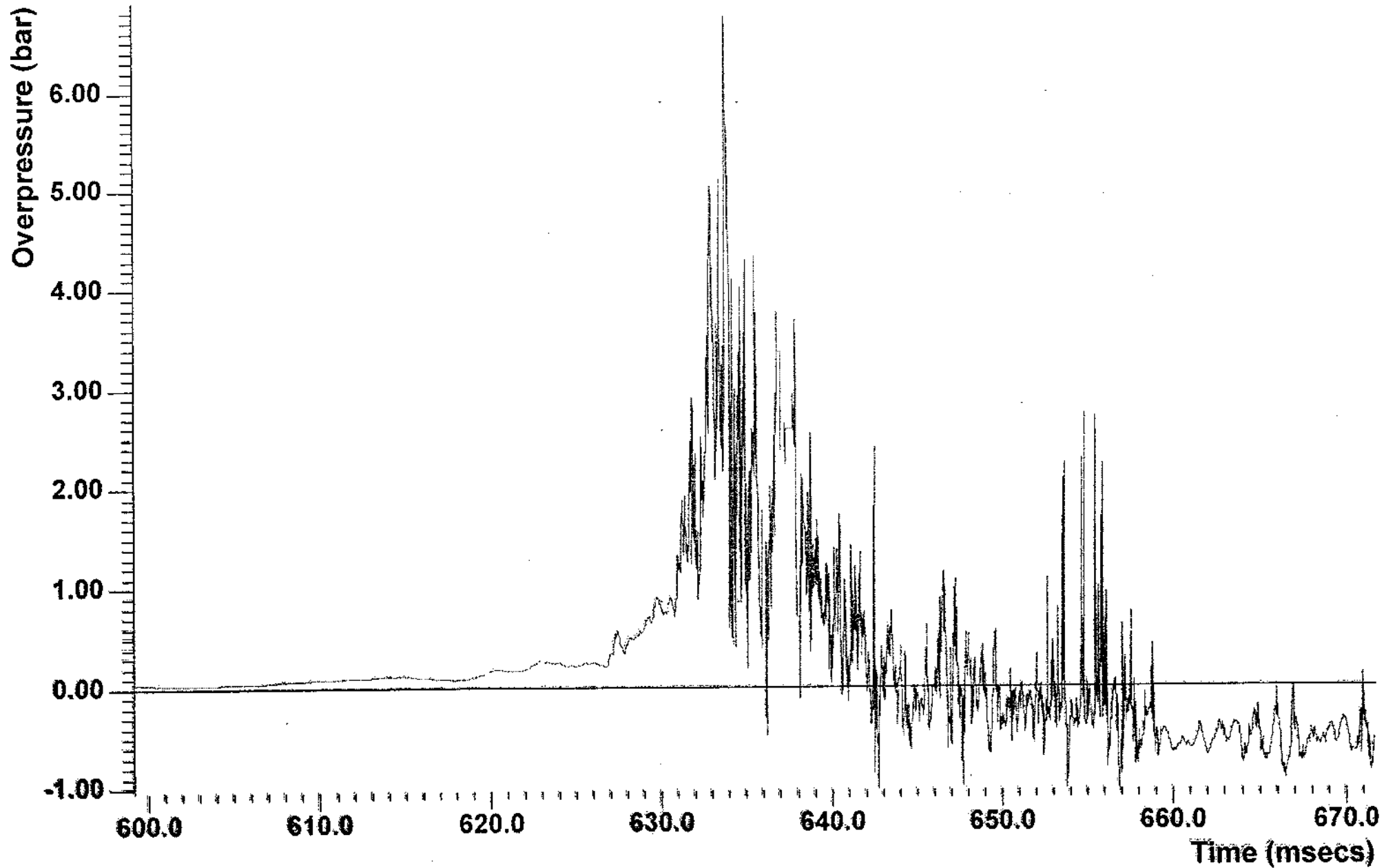
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Transducer no: PI-22



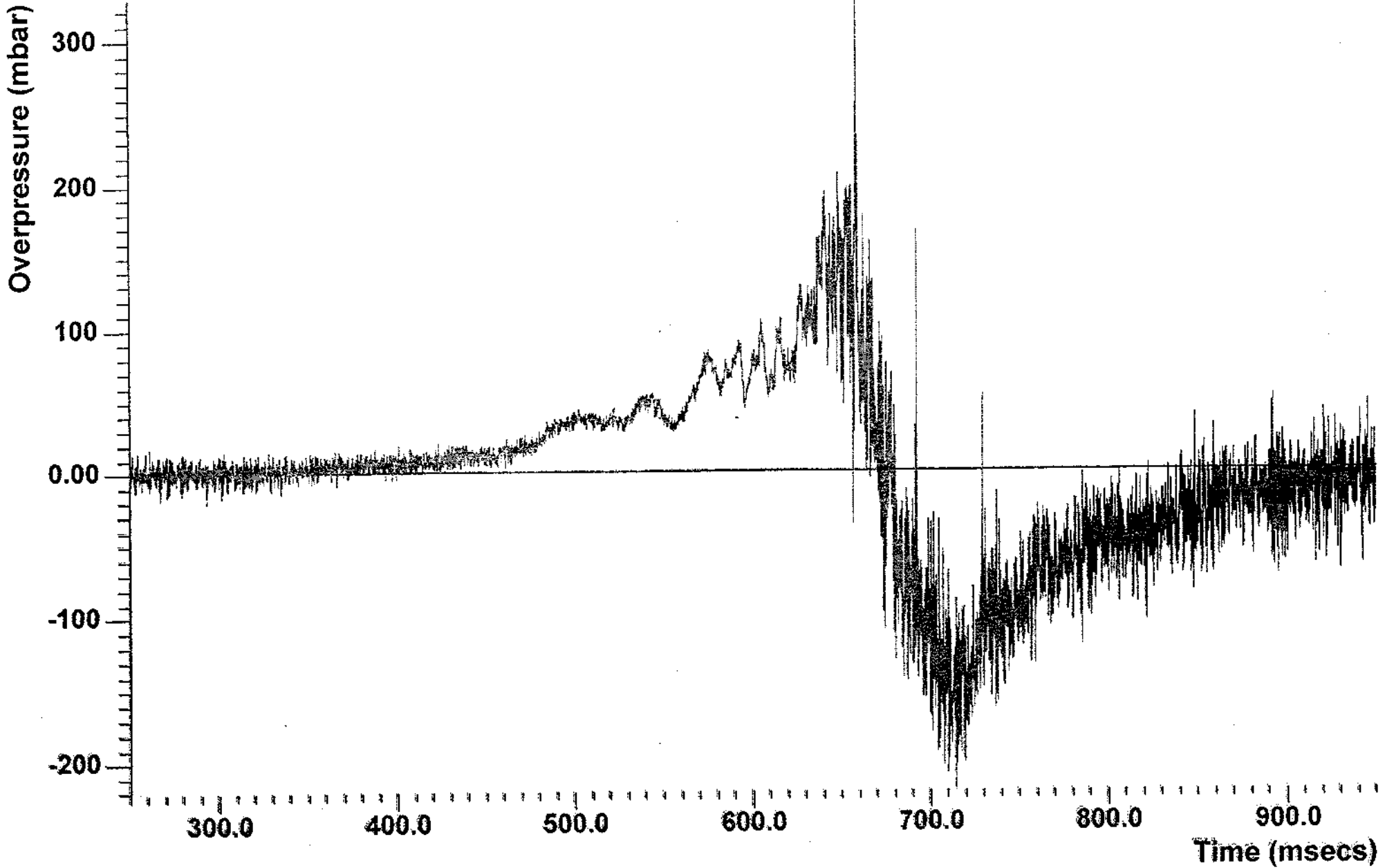
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Transducer no: PI-23



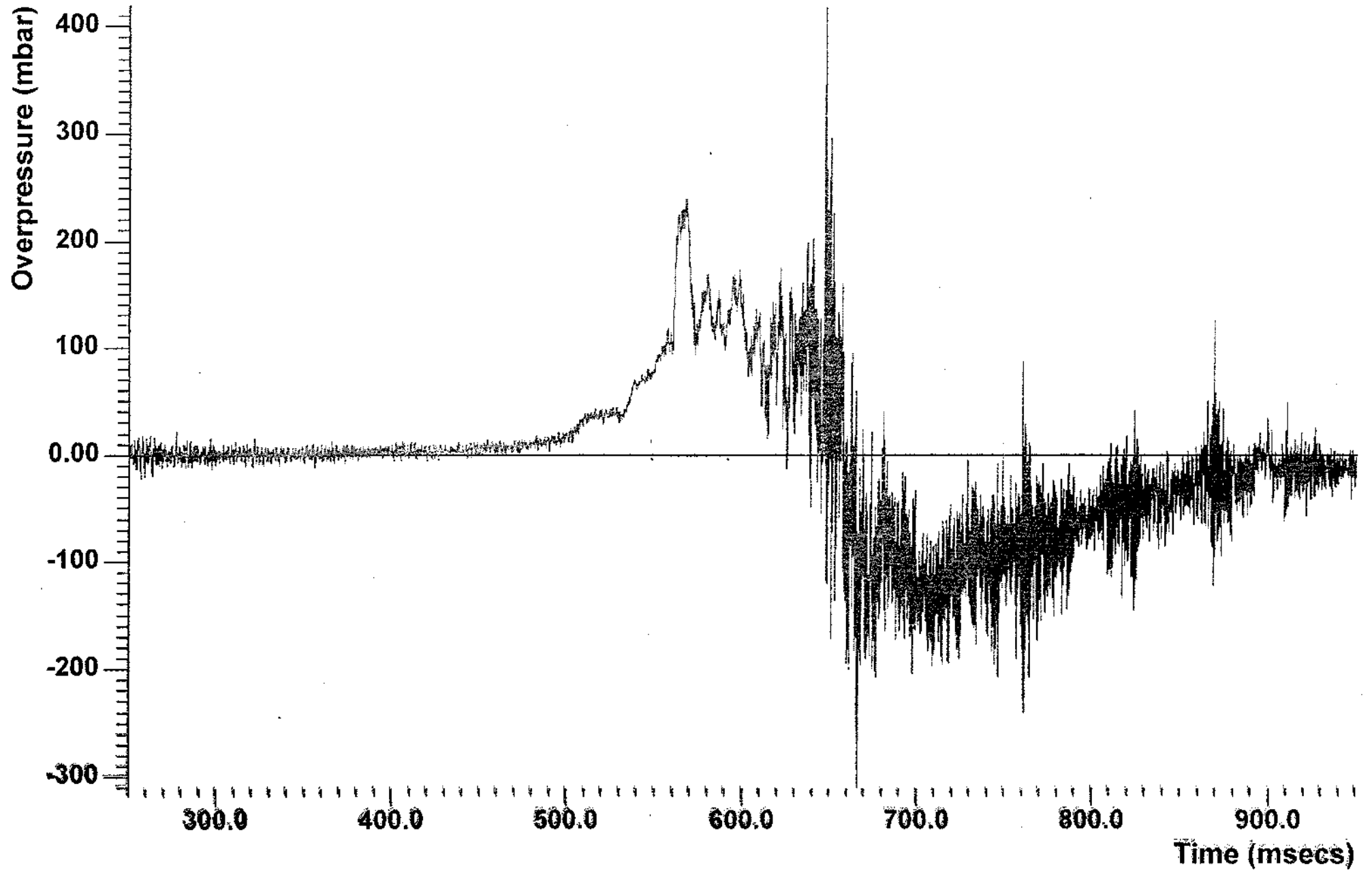
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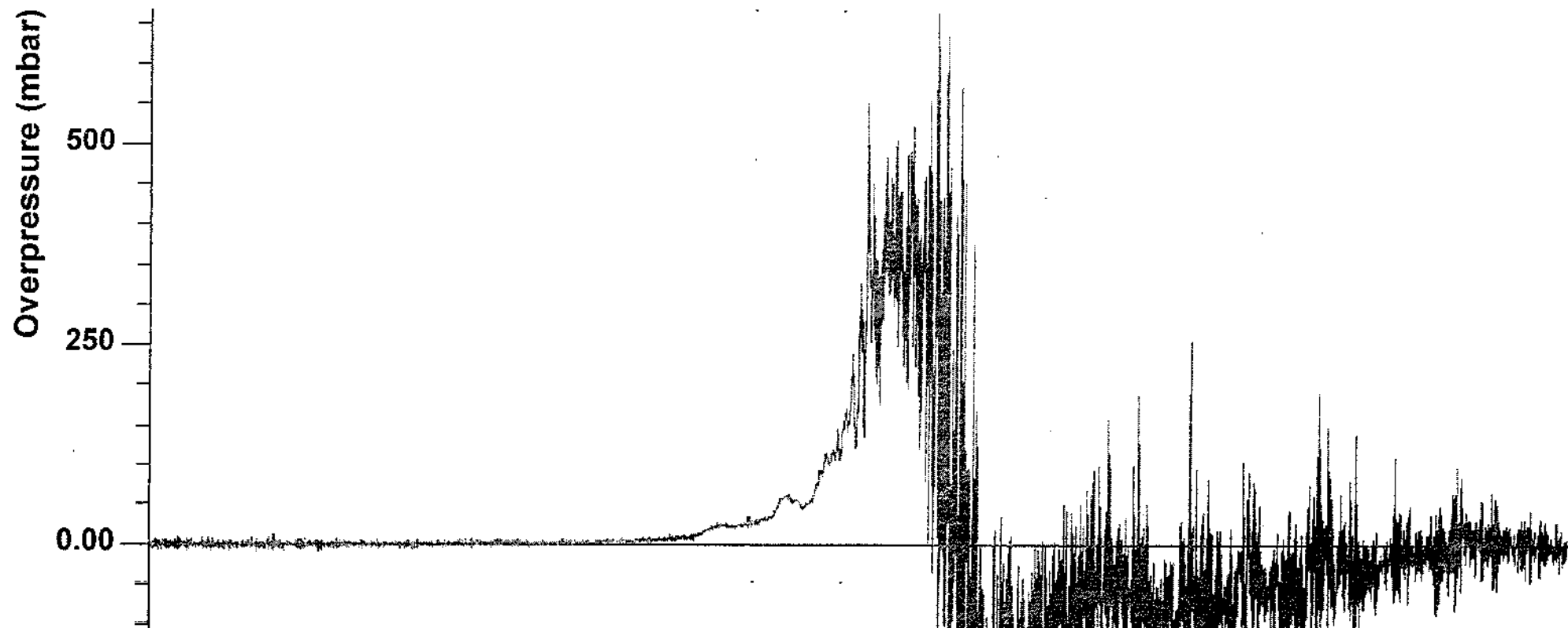
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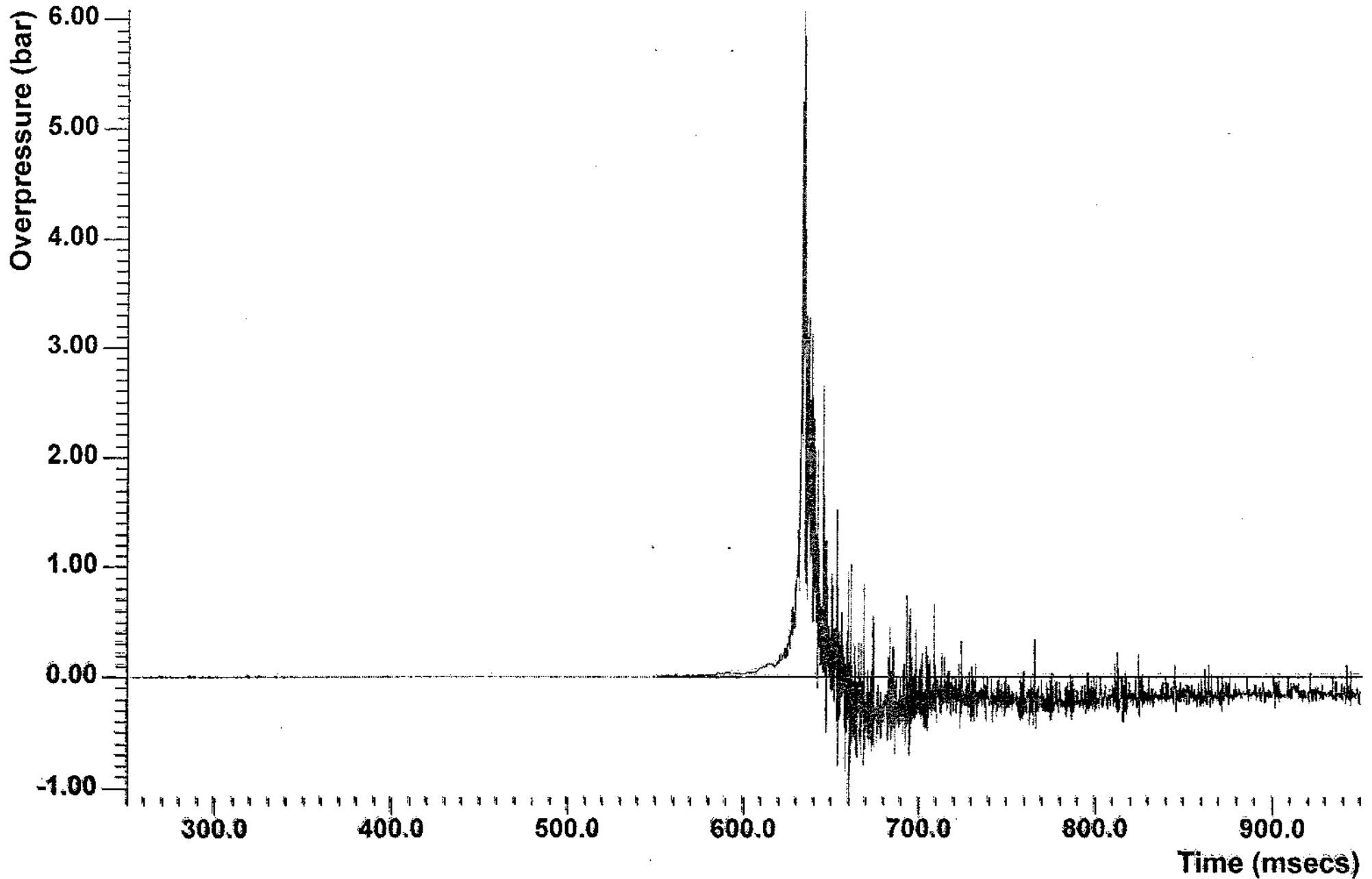
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Transducer no: PI-25



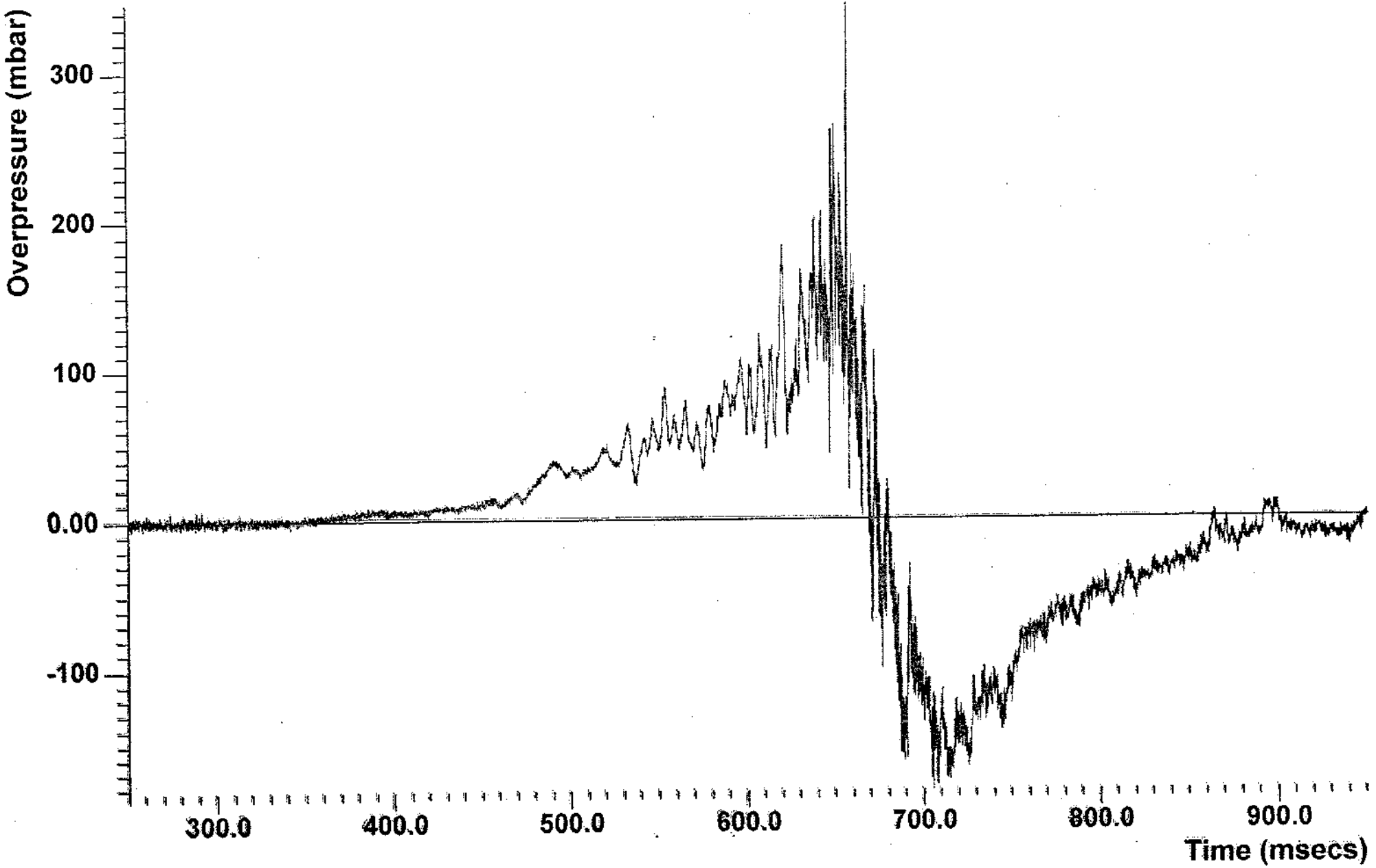
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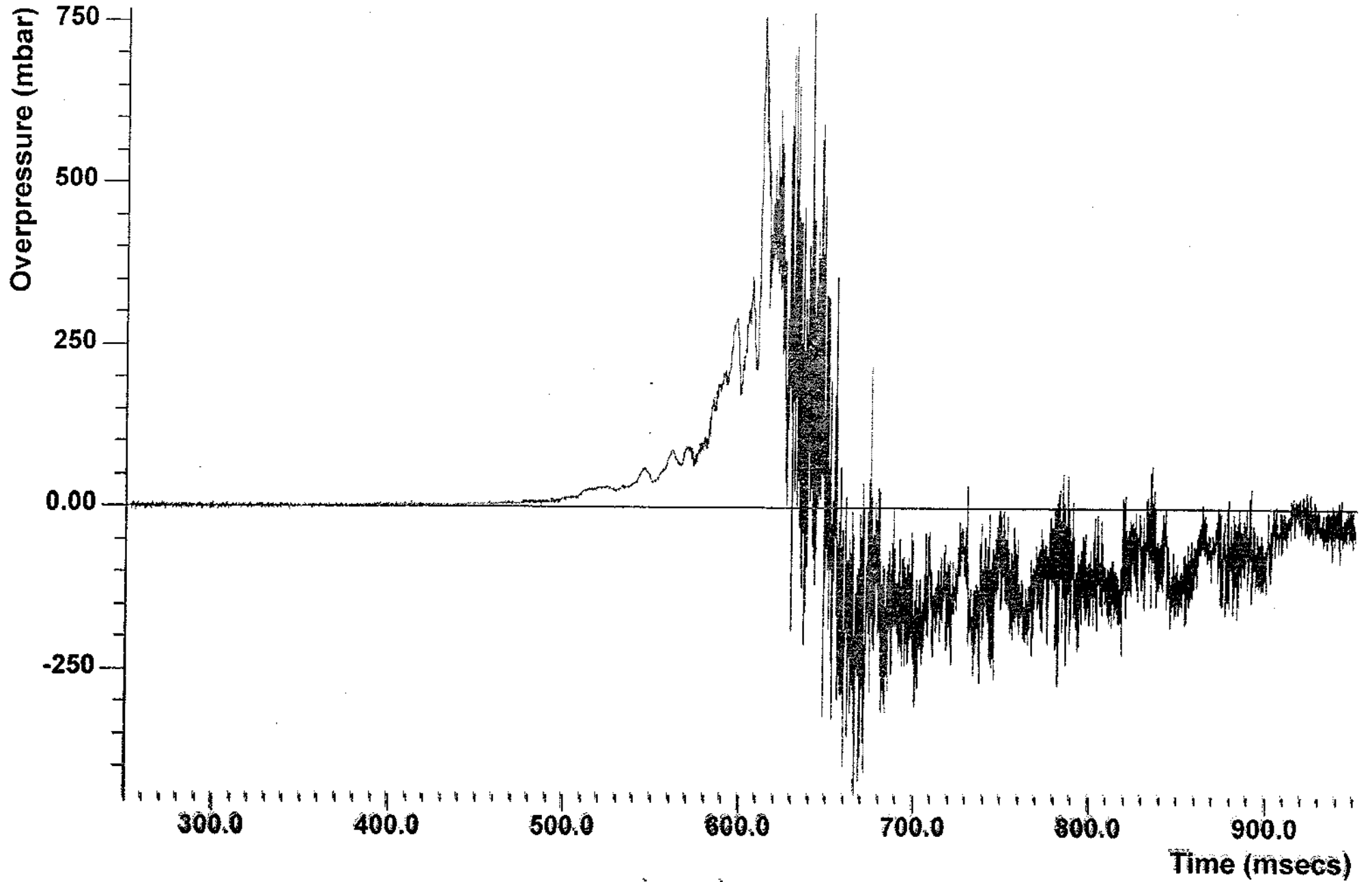
Test: HSE4 (O1, C1, I3)
Transducer no: PI-27



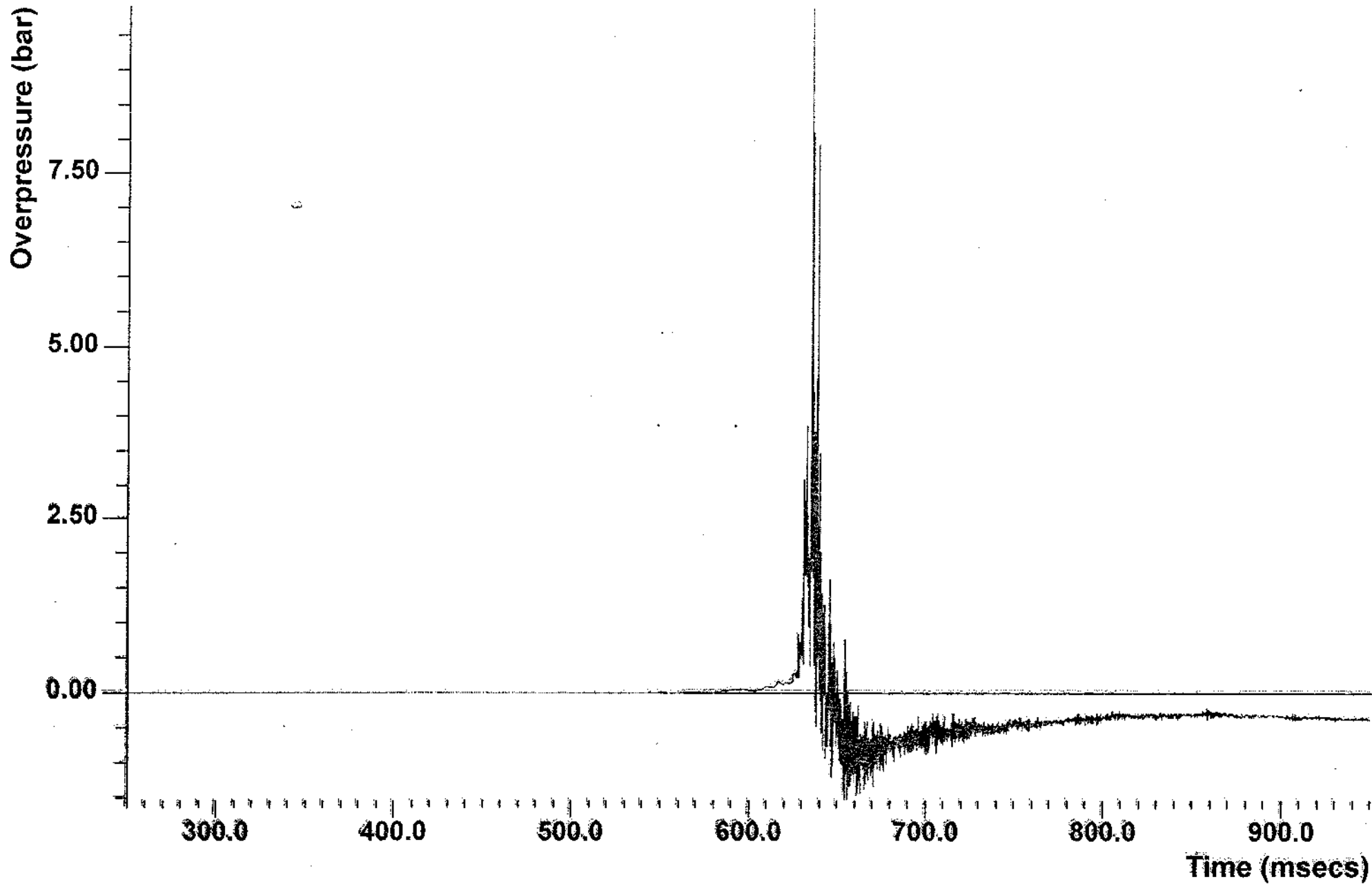
Test: HSE4 (O1, C1, I3)
Transducer no: PI-28



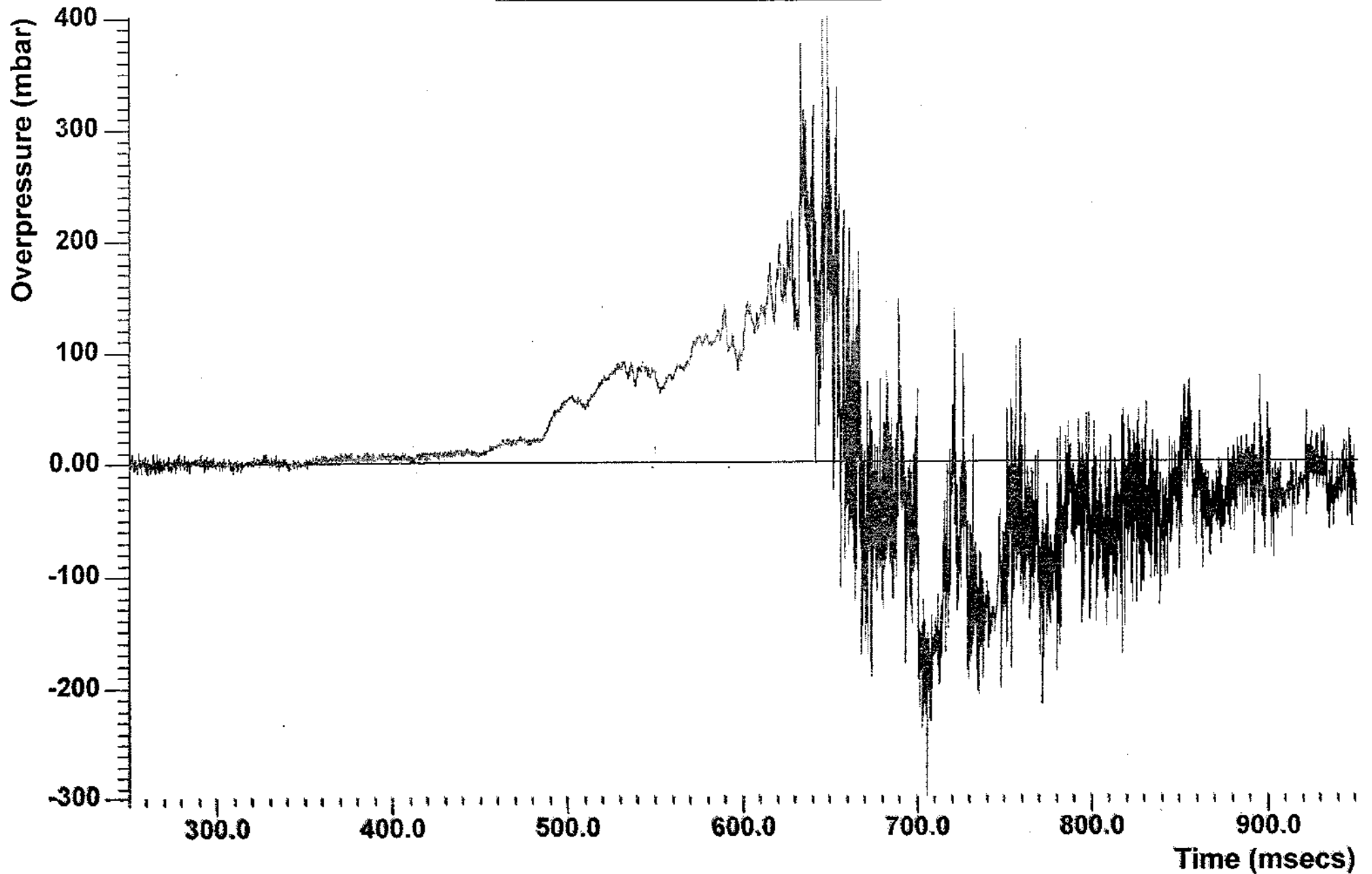
Test: HSE4 (O1, C1, I3)
Transducer no: PI-29



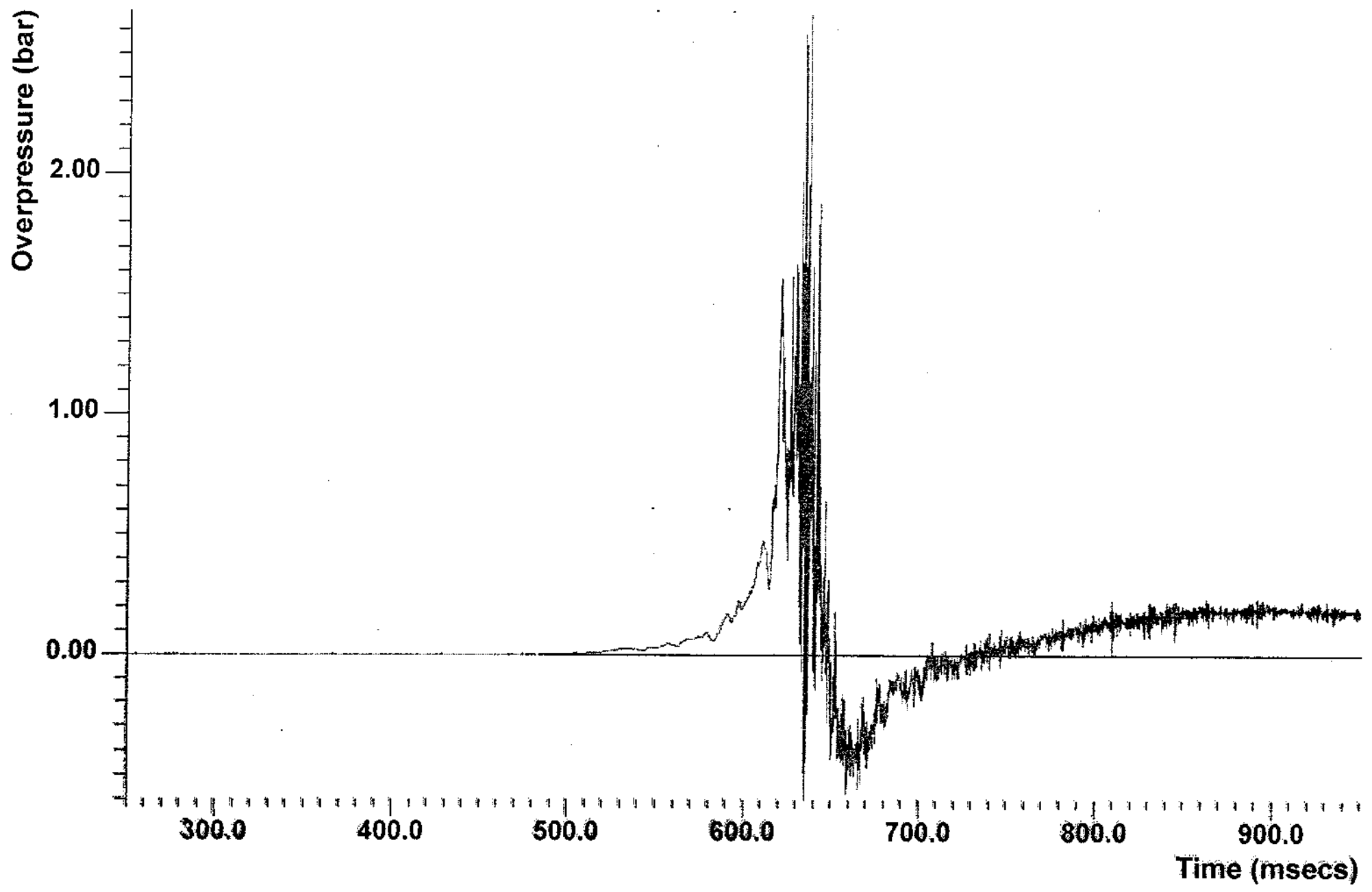
Test: HSE4 (O1, C1, I3)
Transducer no: PI-30



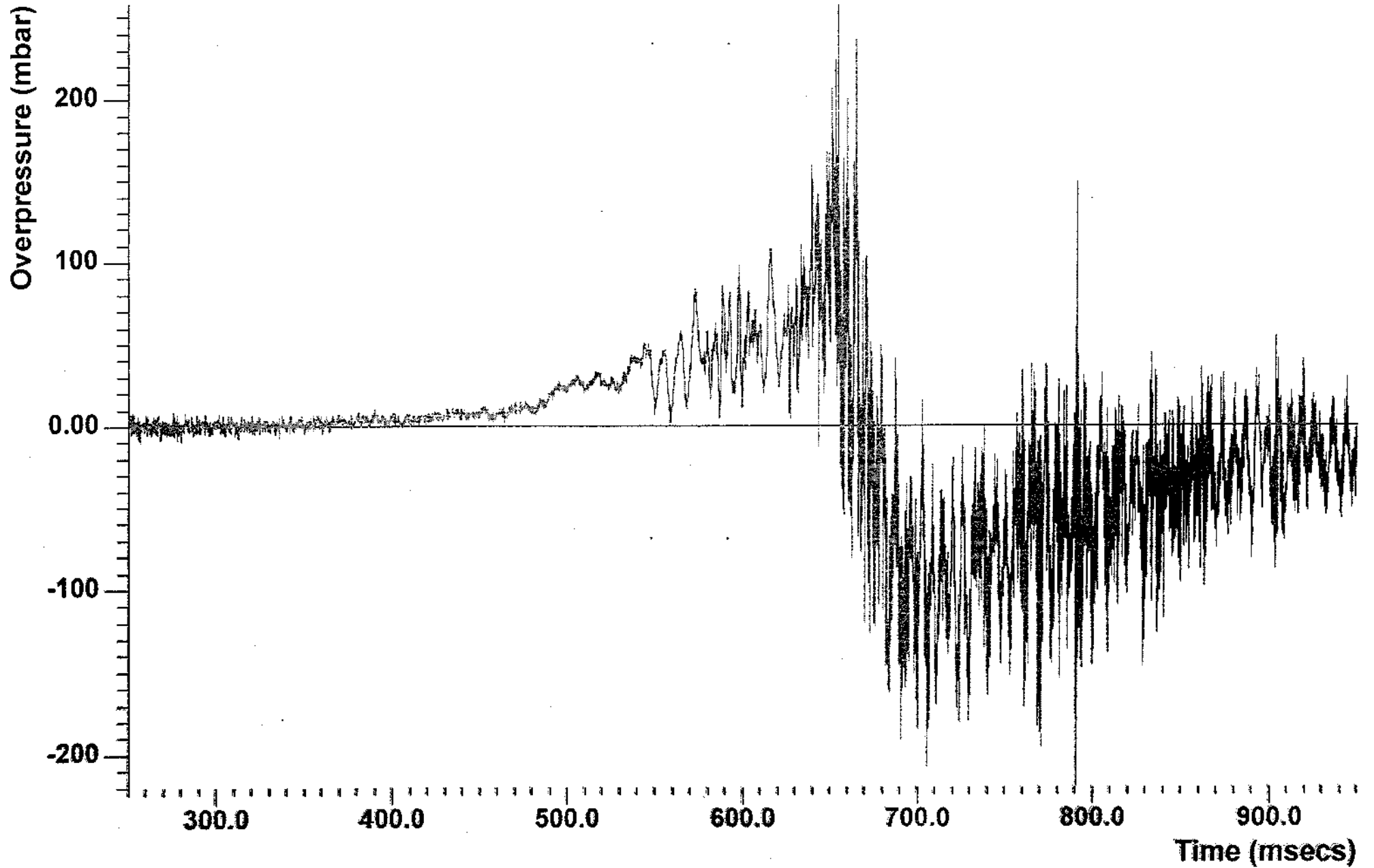
Test: HSE4 (O1, C1, I3)
Transducer no: PI-31



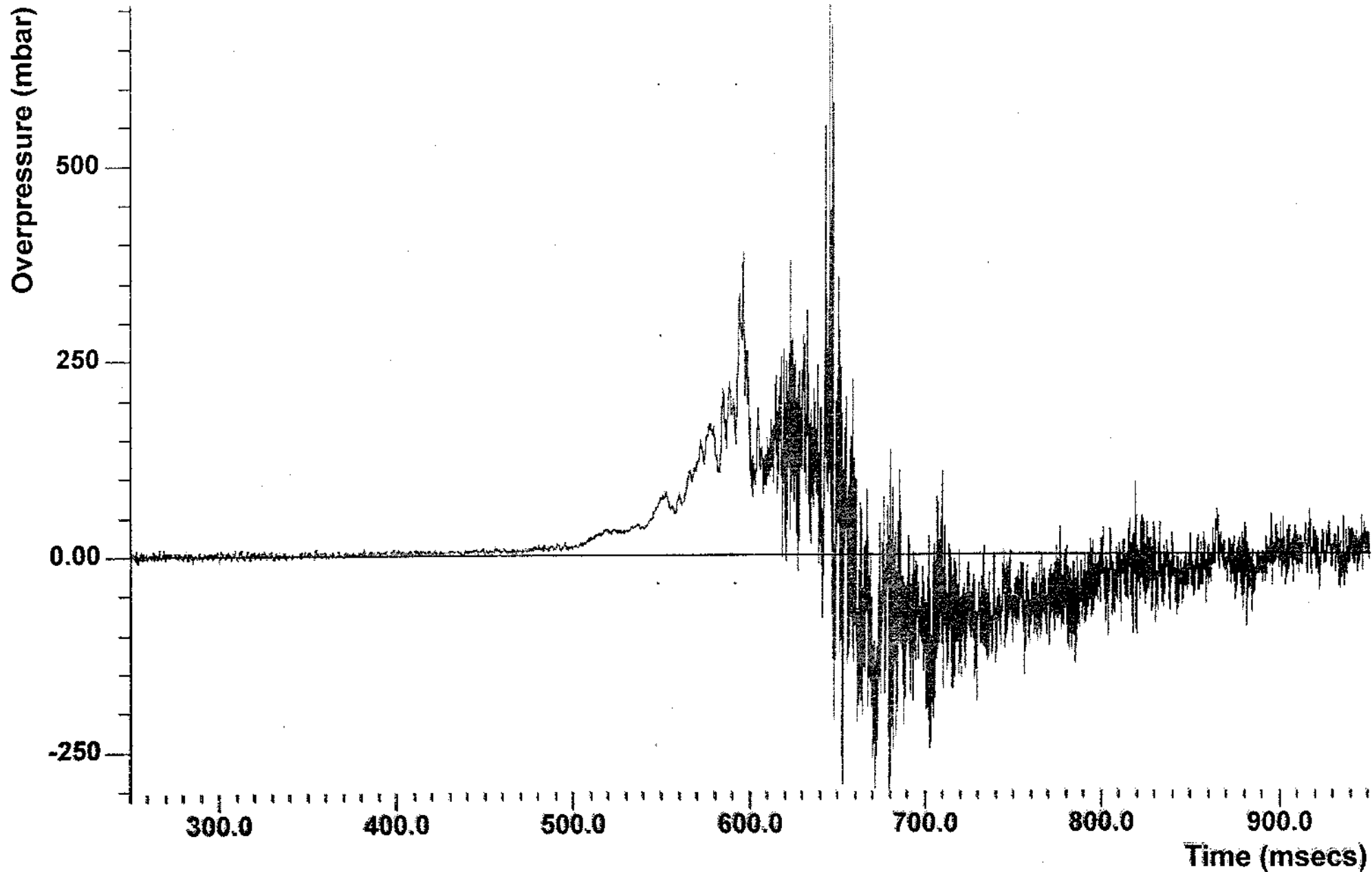
Test: HSE4 (O1, C1, I3)
Transducer no: PI-32



Test: HSE4 (O1, C1, I3)
Transducer no: PI-33



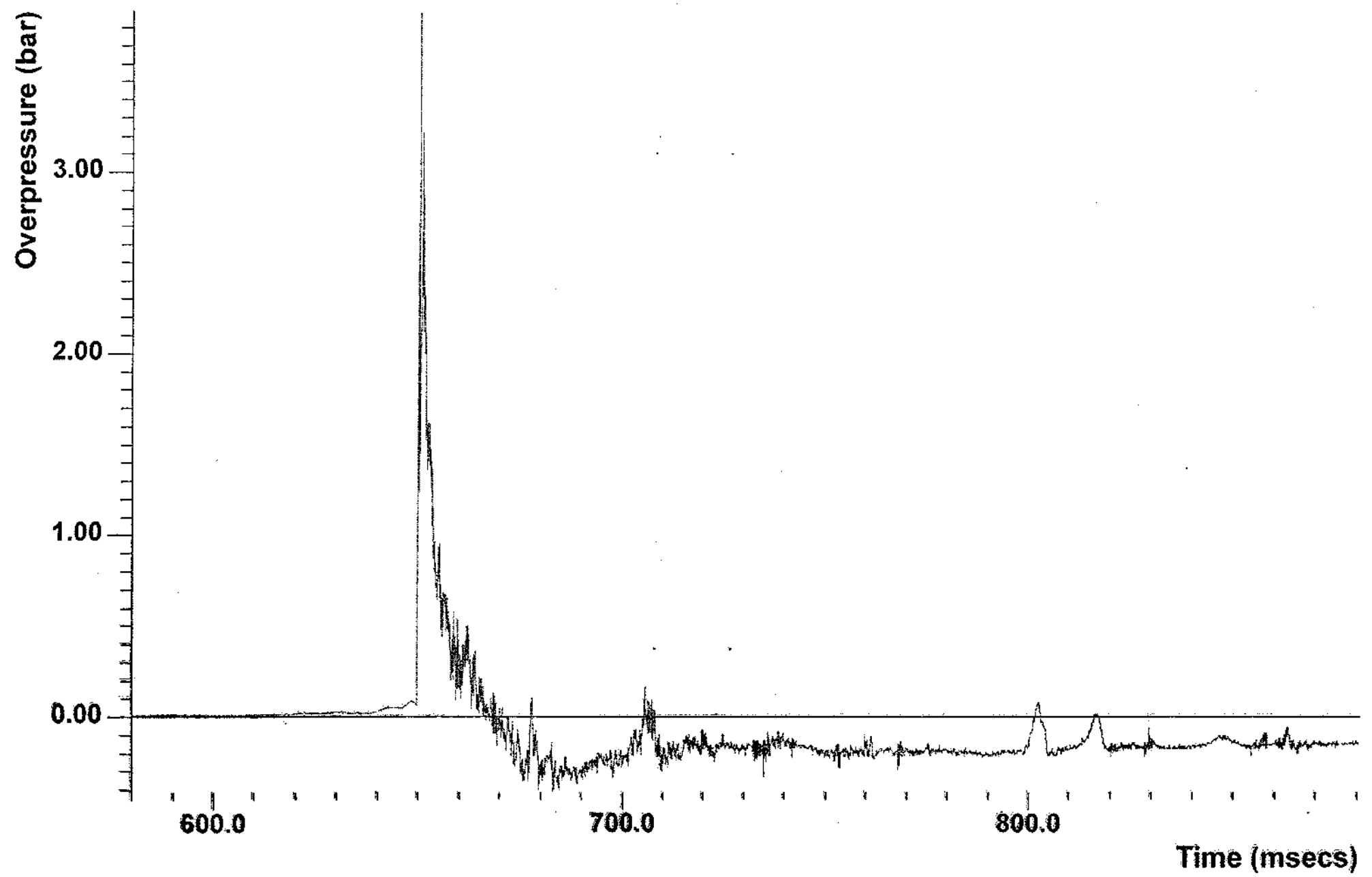
Test: HSE4 (O1, C1, I3)
Transducer no: PI-34



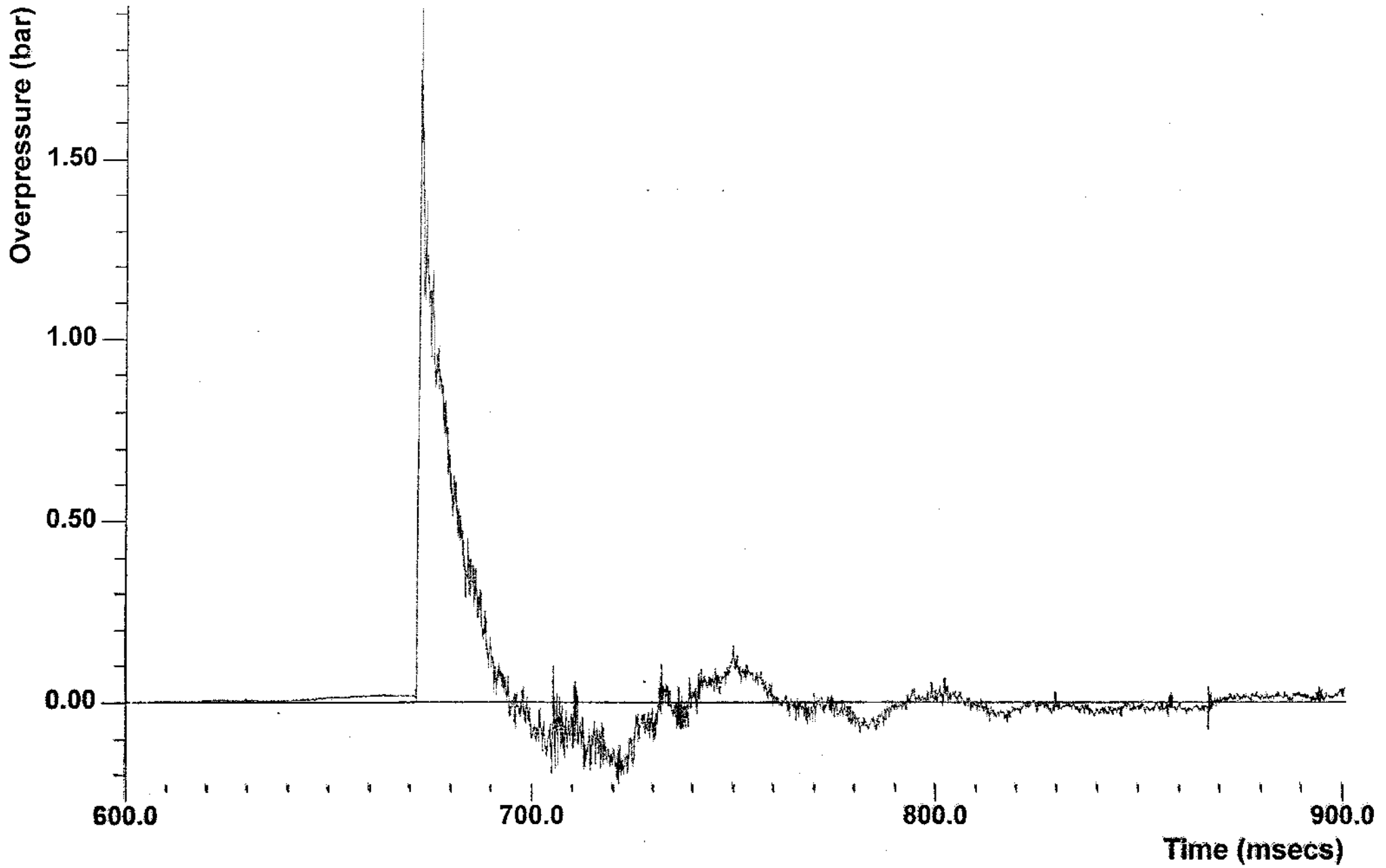
Appendix B: External Overpressure Profiles

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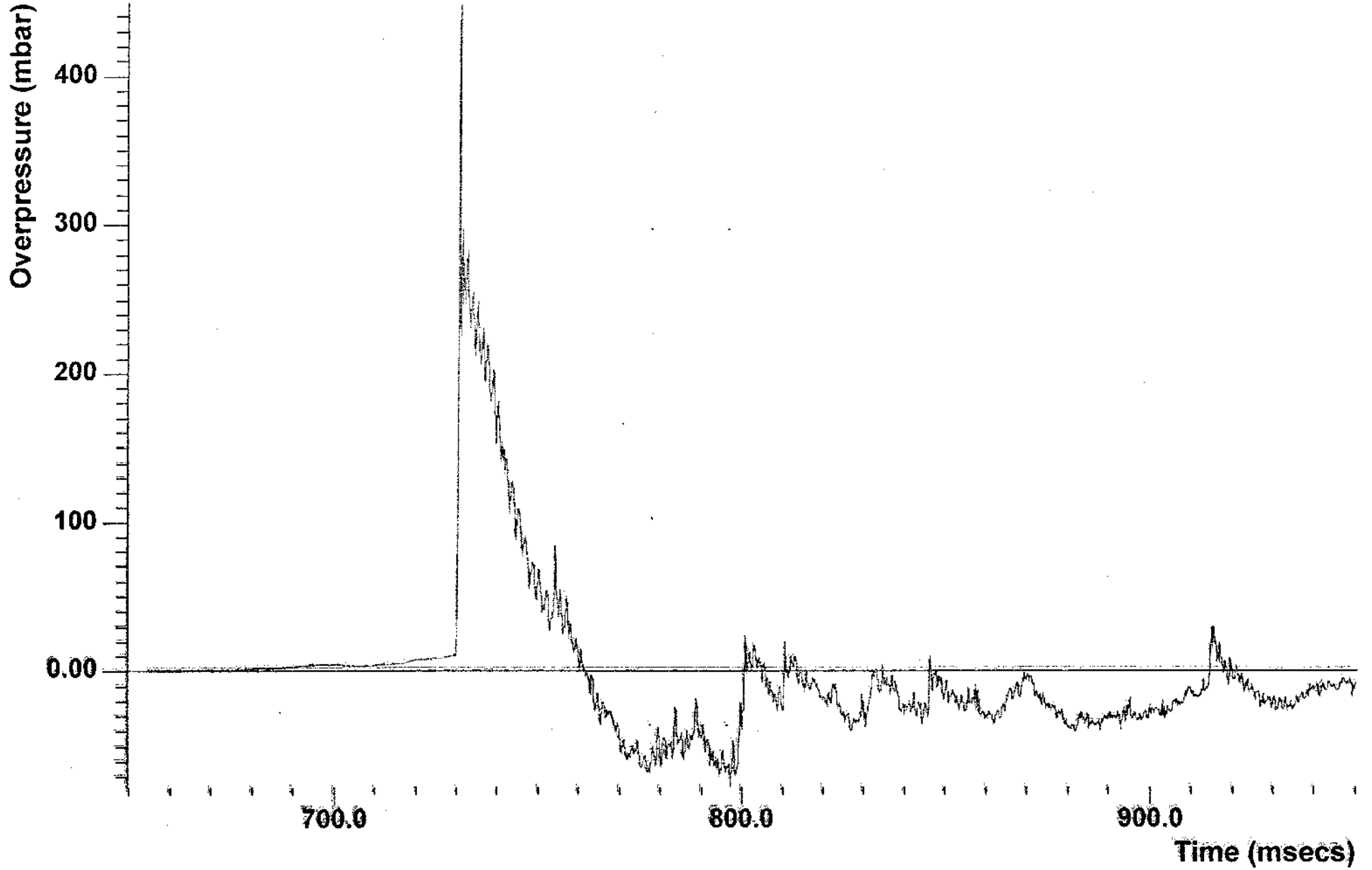
Test: HSE4 (O1, C1, I3)
Transducer no: PE-2



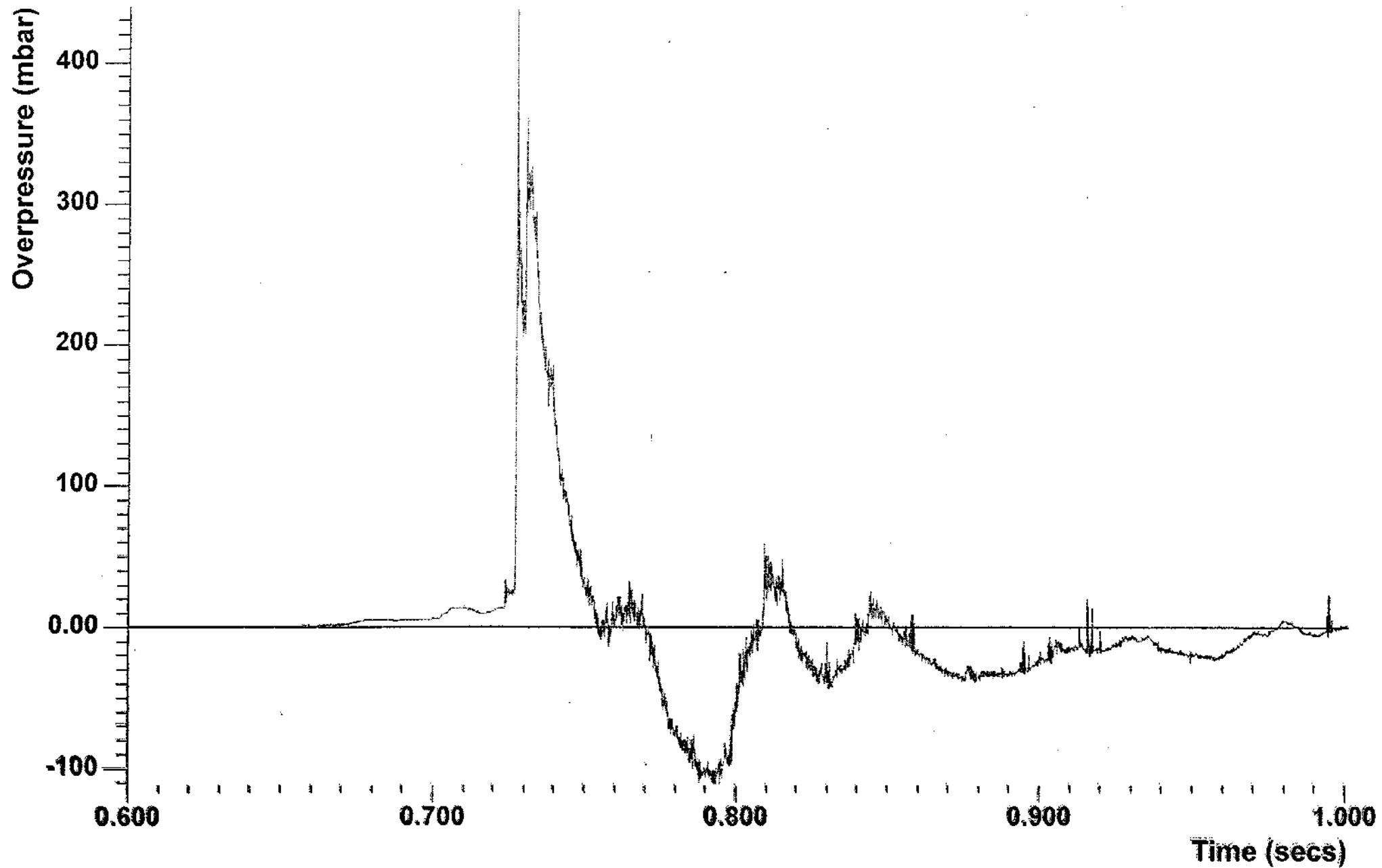
Test: HSE4 (O1, C1, I3)
Transducer no: PE-3



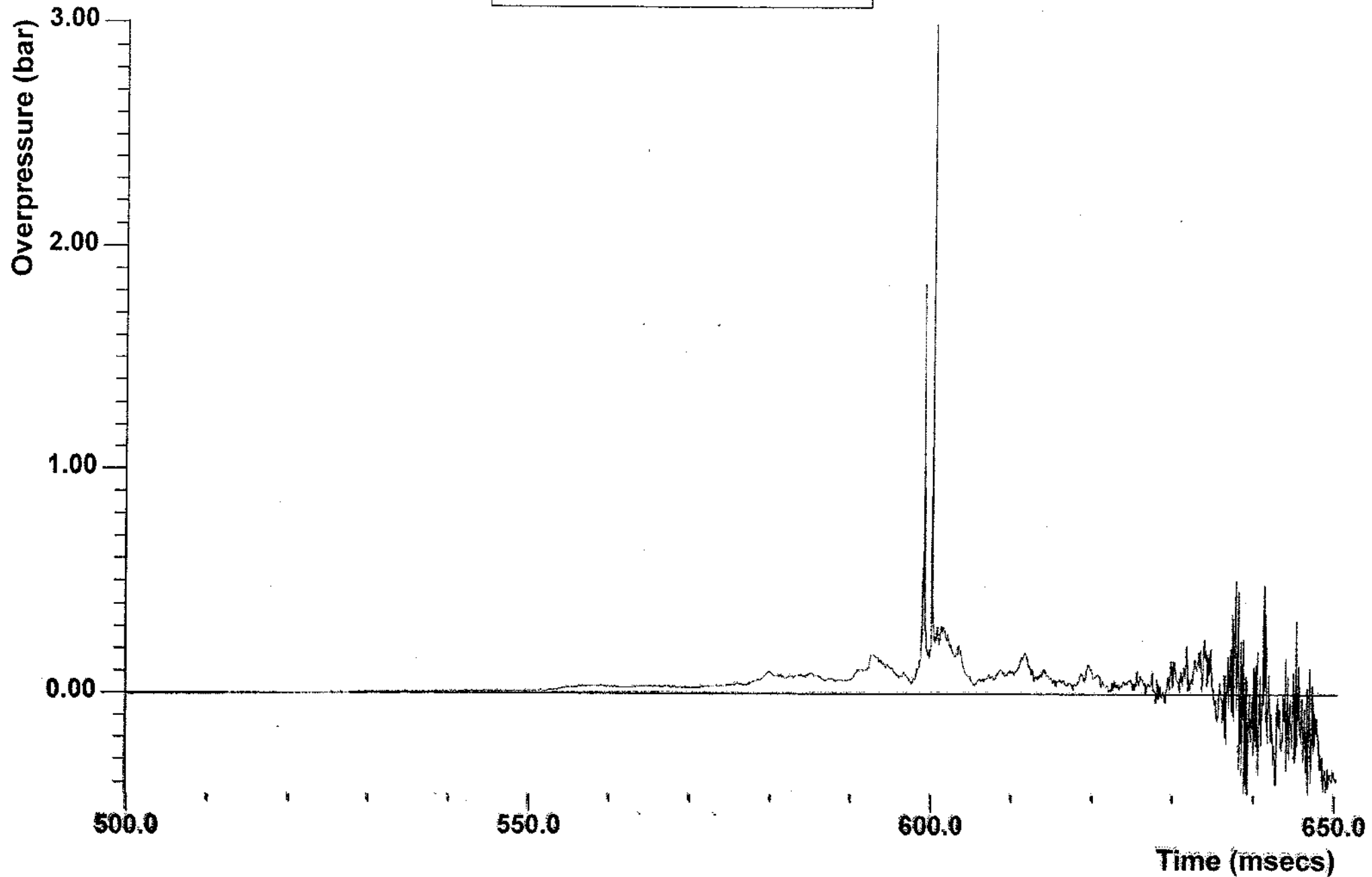
Test: HSE4 (O1, C1, I3)
Transducer no: PE-4



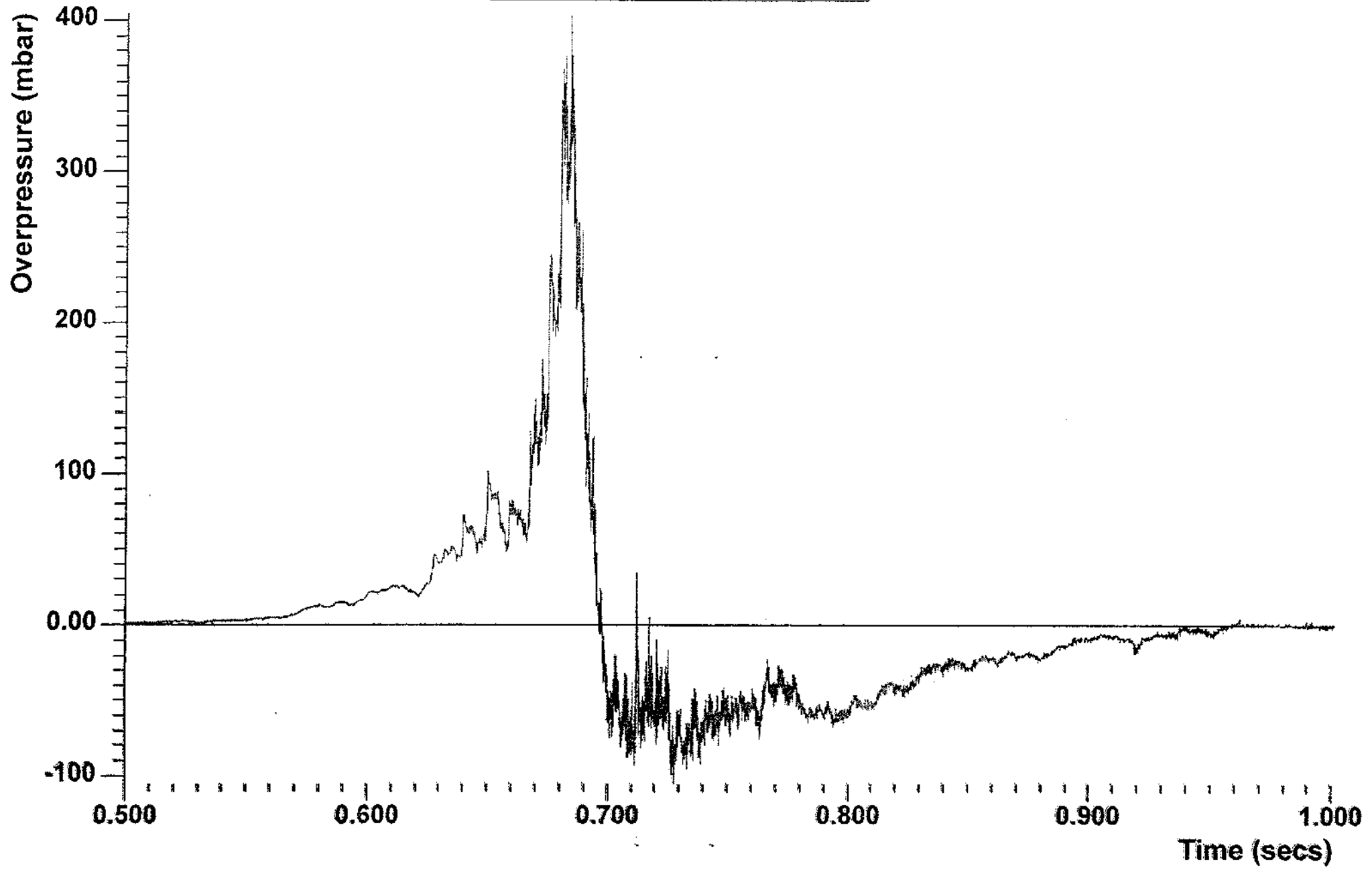
Test: HSE4 (O1, C1, I3)
Transducer no: PE-6



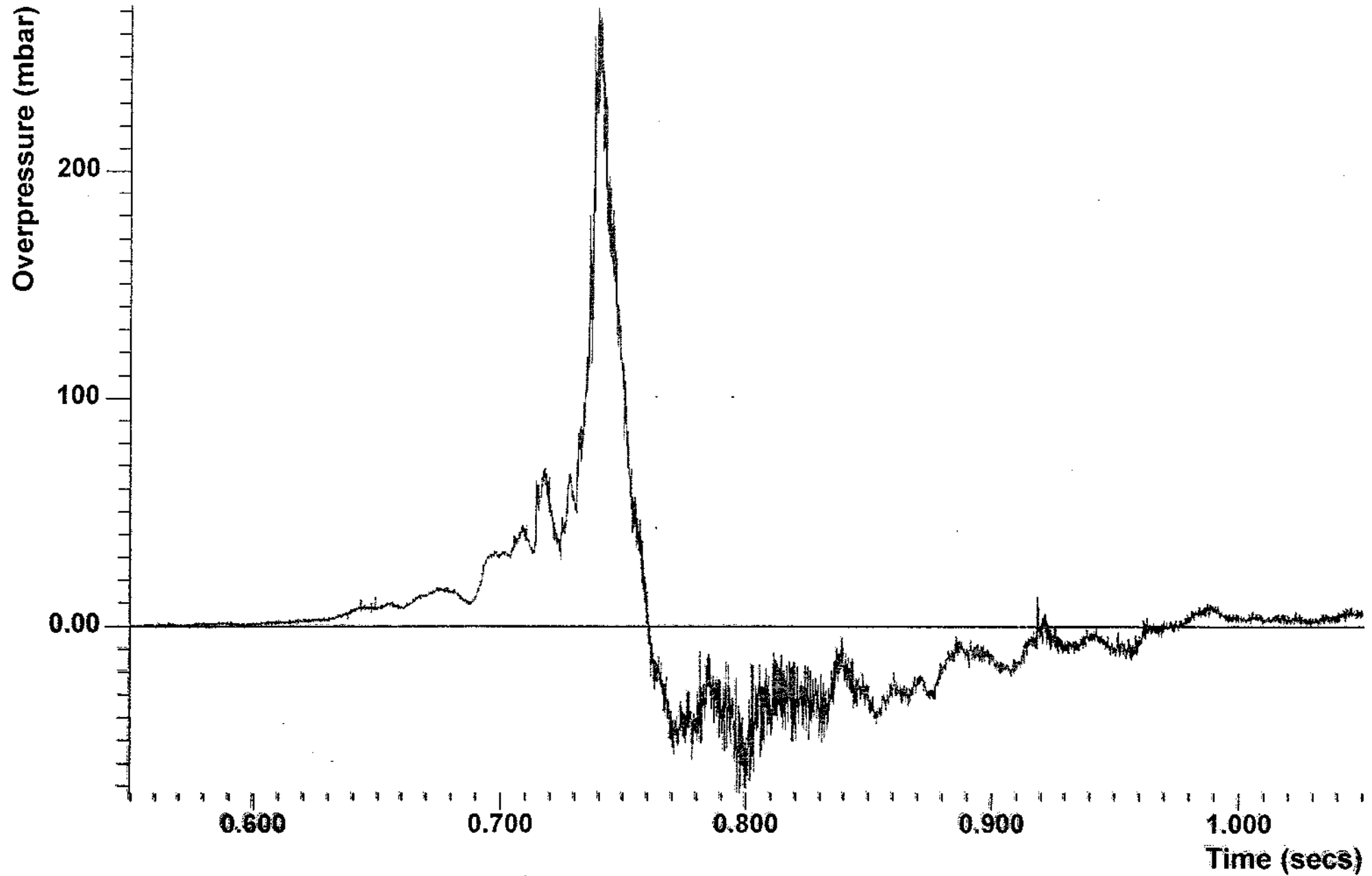
Test: HSE4 (O1, C1, I3)
Transducer no: PE-7



Test: HSE4 (O1, C1, I3)
Transducer no: PE-9



Test: HSE4 (O1, C1, I3)
Transducer no: PE-10



Test: HSE4 (O1, C1, I3)
Transducer no: PE-11

