



**Health & Safety  
Executive**

**OFFSHORE TECHNOLOGY  
REPORT - OTO 98 098**

**A Study of the Repeatability of  
Explosion Tests  
Preliminary Data Report for Test 2**

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# Explosions in Full Scale Offshore Module Geometries

Health & Safety Executive Contract MaTSU 8847/3522

## Preliminary Data Report for Test 2

| <b>Summary of Experimental Conditions</b> |                       |
|---|-----------------------|
| <b>Date</b>                               | 24th June 1997        |
| <b>Time</b>                               | 15:39                 |
| <b>Test Series</b>                        | A                     |
| <b>Confinement Configuration</b>          | C1                    |
| <b>Obstacle Configuration</b>             | O1                    |
| <b>Ignition Position</b>                  | (X:13.5, Y:5, Z:4.25) |
| <b>Mean Equivalence Ratio</b>             | 1.09                  |
| <b>Water Sprays</b>                       | None                  |

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

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**Table 1: Flame Arrival Times**

| <b>Ionisation Probe</b> | <b>X Co-ord (m)</b> | <b>Y Co-ord (m)</b> | <b>Z Co-ord (m)</b> | <b>Flame Arrival Time (msec)</b> |
|-------------------------|---------------------|---------------------|---------------------|----------------------------------|
| IP-1                    | 0.5                 | 0.5                 | 2.0                 | 606.1                            |
| IP-2                    | 6.0                 | 0.5                 | 2.0                 | 577.3                            |
| IP-3                    | 10.0                | 0.5                 | 2.0                 | 525.7                            |
| IP-4                    | 14.0                | 0.5                 | 2.0                 | 490.0                            |
| IP-5                    | 18.0                | 0.5                 | 2.0                 | 535.6                            |
| IP-6                    | 22.0                | 0.5                 | 2.0                 | 571.6                            |
| IP-7                    | 27.5                | 0.5                 | 2.0                 | 607.0                            |
| IP-8                    | 0.5                 | 4.0                 | 2.0                 | 604.3                            |
| IP-9                    | 6.0                 | 4.0                 | 2.0                 | 587.4                            |
| IP-10                   | 14.0                | 4.0                 | 2.0                 | 442.0                            |
| IP-11                   | 22.0                | 4.0                 | 2.0                 | 591.9                            |
| IP-12                   | 27.5                | 4.0                 | 2.0                 | 608.6                            |
| IP-13                   | 0.5                 | 8.0                 | 2.0                 | 604.7                            |
| IP-14                   | 6.0                 | 8.0                 | 2.0                 | 578.4                            |
| IP-15                   | 10.0                | 8.0                 | 2.0                 | 546.3                            |
| IP-16                   | 14.0                | 8.0                 | 2.0                 | 503.1                            |
| IP-17                   | 18.0                | 8.0                 | 2.0                 | 562.0                            |
| IP-18                   | 22.0                | 8.0                 | 2.0                 | 584.7                            |
| IP-19                   | 27.5                | 8.0                 | 2.0                 | 610.0                            |
| IP-20                   | 0.5                 | 11.5                | 2.0                 | 606.8                            |
| IP-21                   | 2.0                 | 11.5                | 2.0                 | 600.5                            |
| IP-22                   | 6.0                 | 11.5                | 2.0                 | 579.8                            |
| IP-23                   | 10.0                | 11.5                | 2.0                 | 559.6                            |
| IP-24                   | 14.0                | 11.5                | 2.0                 | 555.6                            |
| IP-25                   | 18.0                | 11.5                | 2.0                 | 569.9                            |
| IP-26                   | 22.0                | 11.5                | 2.0                 | 584.5                            |
| IP-27                   | 26.0                | 11.5                | 2.0                 | 602.2                            |
| IP-28                   | 27.5                | 11.5                | 2.0                 | 610.4                            |
| IP-29                   | 0.5                 | 0.5                 | 4.0                 | 607.0                            |
| IP-30                   | 6.0                 | 0.5                 | 4.0                 | 571.6                            |
| IP-31                   | 10.0                | 0.5                 | 4.0                 | 549.4                            |
| IP-32                   | 14.0                | 0.5                 | 4.0                 | 478.3                            |
| IP-33                   | 18.0                | 0.5                 | 4.0                 | 529.8                            |

| <b>Ionisation Probe</b> | <b>X Co-ord (m)</b> | <b>Y Co-ord (m)</b> | <b>Z Co-ord (m)</b> | <b>Flame Arrival Time (msec)</b> |
|-------------------------|---------------------|---------------------|---------------------|----------------------------------|
| IP-34                   | 22.0                | 0.5                 | 4.0                 | 570.7                            |
| IP-35                   | 26.0                | 0.5                 | 4.0                 | 595.6                            |
| IP-36                   | 27.5                | 0.5                 | 4.0                 | 607.1                            |
| IP-37                   | 0.5                 | 4.0                 | 4.0                 | 603.2                            |
| IP-38                   | 6.0                 | 4.0                 | 4.0                 | 562.8                            |
| IP-39                   | 14.0                | 4.0                 | 4.0                 | 253.7                            |
| IP-40                   | 22.0                | 4.0                 | 4.0                 | 570.3                            |
| IP-41                   | 26.0                | 4.0                 | 4.0                 | 598.3                            |
| IP-42                   | 27.5                | 4.0                 | 4.0                 | 607.6                            |
| IP-43                   | 0.5                 | 8.0                 | 4.0                 | 602.7                            |
| IP-44                   | 2.0                 | 8.0                 | 4.0                 | 600.0                            |
| IP-45                   | 6.0                 | 8.0                 | 4.0                 | 578.9                            |
| IP-46                   | 10.0                | 8.0                 | 4.0                 | 512.6                            |
| IP-47                   | 14.0                | 8.0                 | 4.0                 | 462.6                            |
| IP-48                   | 18.0                | 8.0                 | 4.0                 | 535.4                            |
| IP-49                   | 22.0                | 8.0                 | 4.0                 | 578.7                            |
| IP-50                   | 26.0                | 8.0                 | 4.0                 | 593.8                            |
| IP-51                   | 27.5                | 8.0                 | 4.0                 | 601.4                            |
| IP-52                   | 26.0                | 10.0                | 4.0                 | 603.1                            |
| IP-53                   | 27.5                | 10.0                | 4.0                 | 605.3                            |
| IP-54                   | 0.5                 | 11.5                | 4.0                 | 604.5                            |
| IP-55                   | 2.0                 | 11.5                | 4.0                 | 597.9                            |
| IP-56                   | 6.0                 | 11.5                | 4.0                 | 580.0                            |
| IP-57                   | 10.0                | 11.5                | 4.0                 | 564.1                            |
| IP-58                   | 14.0                | 11.5                | 4.0                 | 556.8                            |
| IP-59                   | 18.0                | 11.5                | 4.0                 | 576.3                            |
| IP-60                   | 22.0                | 11.5                | 4.0                 | 586.1                            |
| IP-61                   | 26.0                | 11.5                | 4.0                 | 601.5                            |
| IP-62                   | 27.5                | 11.5                | 4.0                 | 608.7                            |
| IP-63                   | 0.5                 | 0.5                 | 6.0                 | 606.6                            |
| IP-64                   | 6.0                 | 0.5                 | 6.0                 | 578.9                            |
| IP-65                   | 10.0                | 0.5                 | 6.0                 | 564.4                            |
| IP-66                   | 14.0                | 0.5                 | 6.0                 | 534.9                            |
| IP-67                   | 18.0                | 0.5                 | 6.0                 | 568.9                            |

| <b>Ionisation Probe</b> | <b>X Co-ord (m)</b> | <b>Y Co-ord (m)</b> | <b>Z Co-ord (m)</b> | <b>Flame Arrival Time (msec)</b> |
|-------------------------|---------------------|---------------------|---------------------|----------------------------------|
| IP-68                   | 22.0                | 0.5                 | 6.0                 | 584.9                            |
| IP-69                   | 27.5                | 0.5                 | 6.0                 | 613.0                            |
| IP-70                   | 0.5                 | 4.0                 | 6.0                 | 604.1                            |
| IP-71                   | 6.0                 | 4.0                 | 6.0                 | 573.3                            |
| IP-72                   | 14.0                | 4.0                 | 6.3                 | 432.7                            |
| IP-73                   | 22.0                | 4.0                 | 6.0                 | 586.4                            |
| IP-74                   | 27.5                | 4.0                 | 6.0                 | 611.2                            |
| IP-75                   | 0.5                 | 8.0                 | 6.0                 | 603.5                            |
| IP-76                   | 6.0                 | 8.0                 | 6.0                 | 584.4                            |
| IP-77                   | 10.0                | 8.0                 | 6.0                 | 537.9                            |
| IP-78                   | 14.0                | 8.0                 | 6.0                 | 487.7                            |
| IP-79                   | 18.0                | 8.0                 | 6.0                 | 541.0                            |
| IP-80                   | 22.0                | 8.0                 | 6.0                 | 586.1                            |
| IP-81                   | 27.5                | 8.0                 | 6.0                 | 605.4                            |
| IP-82                   | 0.5                 | 11.5                | 6.0                 | 613.8                            |
| IP-83                   | 2.0                 | 11.5                | 6.0                 | 601.5                            |
| IP-84                   | 6.0                 | 11.5                | 6.0                 | 587.3                            |
| IP-85                   | 10.0                | 11.5                | 6.0                 | 572.3                            |
| IP-86                   | 14.0                | 11.5                | 6.0                 | 560.0                            |
| IP-87                   | 18.0                | 11.5                | 6.0                 | 574.5                            |
| IP-88                   | 22.0                | 11.5                | 6.0                 | 586.0                            |
| IP-89                   | 26.0                | 11.5                | 6.0                 | 608.5                            |
| IP-90                   | 27.5                | 11.5                | 6.0                 | 613.3                            |

**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          | 961                         | 828                         | 614.7                | 36.4                             | 51.5          |
| PI-2                | 6.0          | 0.5          | 0.0          | 488                         | 461                         | 616.6                | 71.1                             | 102.3         |
| PI-3                | 12.5         | 0.5          | 0.0          | 514                         | 489                         | 623.5                | 95.0                             | 122.0         |
| PI-4                | 22.0         | 0.5          | 0.0          | 423                         | 401                         | 609.8                | 68.8                             | 101.6         |
| PI-5                | 27.5         | 0.5          | 0.0          | 1282                        | 868                         | 619.6                | 40.6                             | 54.2          |
| PI-6                | 0.5          | 6.0          | 0.0          | 1835                        | 1604                        | 614.8                | 28.7                             | 34.4          |
| PI-7                | 9.0          | 6.0          | 0.0          | 1009                        | 818                         | 621.7                | 75.0                             | 83.7          |
| PI-8                | 14.0         | 6.0          | 0.0          | 708                         | 652                         | 618.5                | 80.3                             | 101.8         |
| PI-9                | 21.0         | 6.0          | 0.0          | 1047                        | 929                         | 617.3                | 59.4                             | 77.8          |
| PI-10               | 27.5         | 6.0          | 0.0          | 814                         | 755                         | 612.8                | 37.9                             | 64.6          |
| PI-11               | 0.5          | 11.5         | 0.0          | 1346                        | 1105                        | 608.2                | 25.8                             | 51.1          |
| PI-12               | 12.3         | 11.5         | 0.0          | 627                         | 547                         | 613.8                | 86.6                             | 109.5         |
| PI-13               | 27.5         | 11.5         | 0.0          | 1231                        | 1077                        | 609.8                | 26.2                             | 53.1          |
| PI-14               | 0.5          | 0.5          | 4.0          | 817                         | 700                         | 606.2                | 29.0                             | 56.5          |
| PI-15               | 4.5          | 0.6          | 4.0          | 562                         | 460                         | 614.6                | 69.7                             | 98.3          |
| PI-16               | 11.2         | 0.0          | 5.5          | 531                         | 483                         | 622.6                | 98.8                             | 123.7         |
| PI-17               | 12.0         | 0.5          | 4.0          | 427                         | 388                         | 625.0                | 103.8                            | 125.9         |
| PI-18               | 22.0         | 0.5          | 4.0          | 470                         | 422                         | 624.8                | 86.8                             | 106.3         |
| PI-19               | 27.5         | 0.5          | 4.0          | 741                         | 561                         | 615.9                | 39.6                             | 67.7          |
| PI-20               | 10.2         | 4.0          | 4.0          | 504                         | 447                         | 619.2                | 97.8                             | 125.7         |
| PI-21               | 0.5          | 7.0          | 4.0          | 853                         | 813                         | 602.9                | 27.4                             | 62.3          |
| PI-22               | 18.0         | 8.0          | 4.0          | 535                         | 469                         | 622.6                | 108.1                            | 131.1         |
| PI-23               | 27.5         | 6.0          | 4.0          | 751                         | 652                         | 611.3                | 39.4                             | 468.9         |
| PI-24               | 0.5          | 11.5         | 4.0          | 1059                        | 958                         | 605.7                | 22.4                             | 50.3          |
| PI-25               | 10.0         | 11.5         | 4.0          | 413                         | 398                         | 611.6                | 85.5                             | 120.1         |
| PI-26               | 18.0         | 11.5         | 4.0          | 417                         | 376                         | 617.6                | 88.3                             | 113.1         |
| PI-27               | 27.5         | 11.5         | 4.0          | 1479                        | 1164                        | 606.2                | 21.3                             | 49.1          |
| PI-28               | 0.8          | 0.8          | 8.0          | 2005                        | 1177                        | 617.9                | 33.7                             | 35.5          |
| PI-29               | 13.9         | 1.7          | 8.0          | 559                         | 480                         | 625.1                | 95.7                             | 114.2         |
| PI-30               | 26.1         | 1.7          | 8.0          | 1951                        | 1340                        | 620.1                | 40.8                             | 43.7          |
| PI-31               | 5.9          | 5.0          | 8.0          | 709                         | 645                         | 598.7                | 48.8                             | 287.6         |
| PI-32               | 18.9         | 5.0          | 8.0          | 504                         | 486                         | 620.3                | 88.5                             | 113.3         |
| PI-33               | 1.1          | 11.1         | 8.0          | 3031                        | 863                         | 615.2                | 2.1                              | 5.0           |
| PI-34               | 12.8         | 11.2         | 8.0          | 437                         | 407                         | 616.4                | 84.9                             | 119.1         |
| PI-35               | 26.1         | 11.3         | 8.0          | 1863                        | 1051                        | 614.3                | 32.7                             | 46.8          |



**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          | 2172                        | 1914  |
| PE-2                | 40.0         | 6.0          | 1.0          | 483                         | 426   |
| PE-3                | 52.0         | 6.0          | 1.0          | 646                         | 583   |
| PE-4                | 76.0         | 6.0          | 1.0          | 277                         | 196   |
| PE-5                | 47.2         | 25.2         | 1.0          | 1399                        | 642   |
| PE-6                | 61.3         | 39.3         | 1.0          | 195                         | 175   |
| PE-7                | 14.0         | 18.0         | 1.0          | 399                         | 384   |
| PE-8                | 14.0         | 24.0         | 1.0          | 107                         | 63  |
| PE-9                | 14.0         | 36.0         | 1.0          | 365                         | 339   |
| PE-10               | 14.0         | 60.0         | 1.0          | 215                         | 198   |
| PE-11               | -21.2        | 25.2         | 1.0          | 349                         | 300   |

**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          | 9.7                           |
| 2                  | 12.0         | 8.0          | 0.8          | 9.7                           |
| 3                  | 1.2          | 3.1          | 1.5          | 9.5                           |
| 4                  | 7.7          | 10.9         | 3.8          | 9.8                           |
| 5                  | 13.5         | 5.5          | 4.5          | 9.8                           |
| 6                  | 25.9         | 6.0          | 5.2          | 9.8                           |
| 7                  | 4.0          | 8.5          | 4.9          | 9.7                           |
| 8                  | 19.8         | 8.0          | 7.6          | 9.6                           |

**Table 5: Weather Conditions**

| <b>Air Temperature (°C)</b> | <b>Atmospheric Pressure (mbar)</b> | <b>Wind Speed (ms<sup>-1</sup>)</b> | <b>Wind Direction (° from Magnetic North)</b> |
|-----------------------------|------------------------------------|-------------------------------------|---|
| 14.4                        | 976                                | 4.2                                 | 104   |

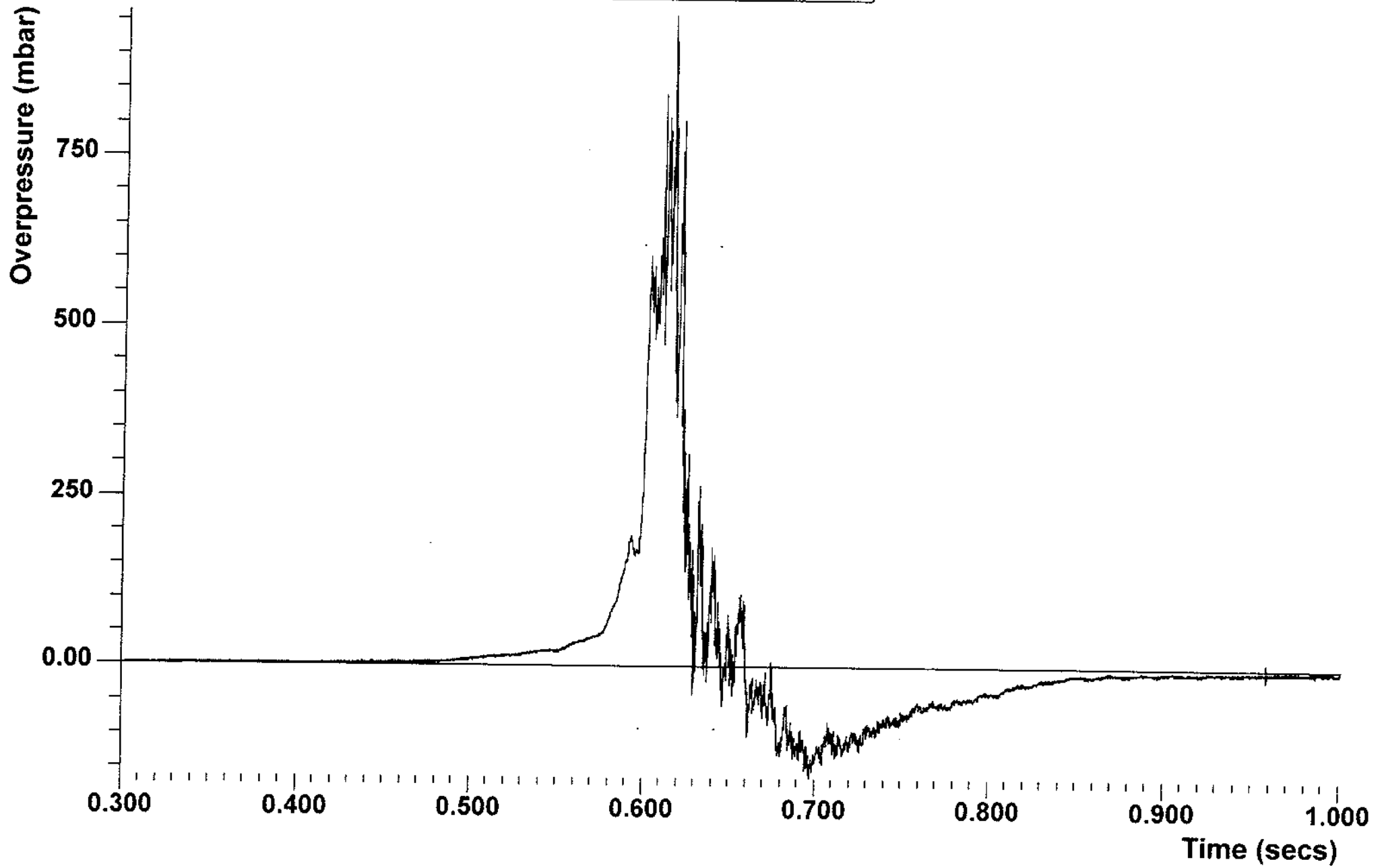
**Table 6: Confinement Configuration**

| <b>Confinement Configuration</b> | <b>Rig Face*</b> | <b>Confinement</b> |
|----------------------------------|------------------|--------------------|
| C1                               | North            | Open               |
|                                  | East             | Open               |
|                                  | South            | Open               |
|                                  | West             | Open               |

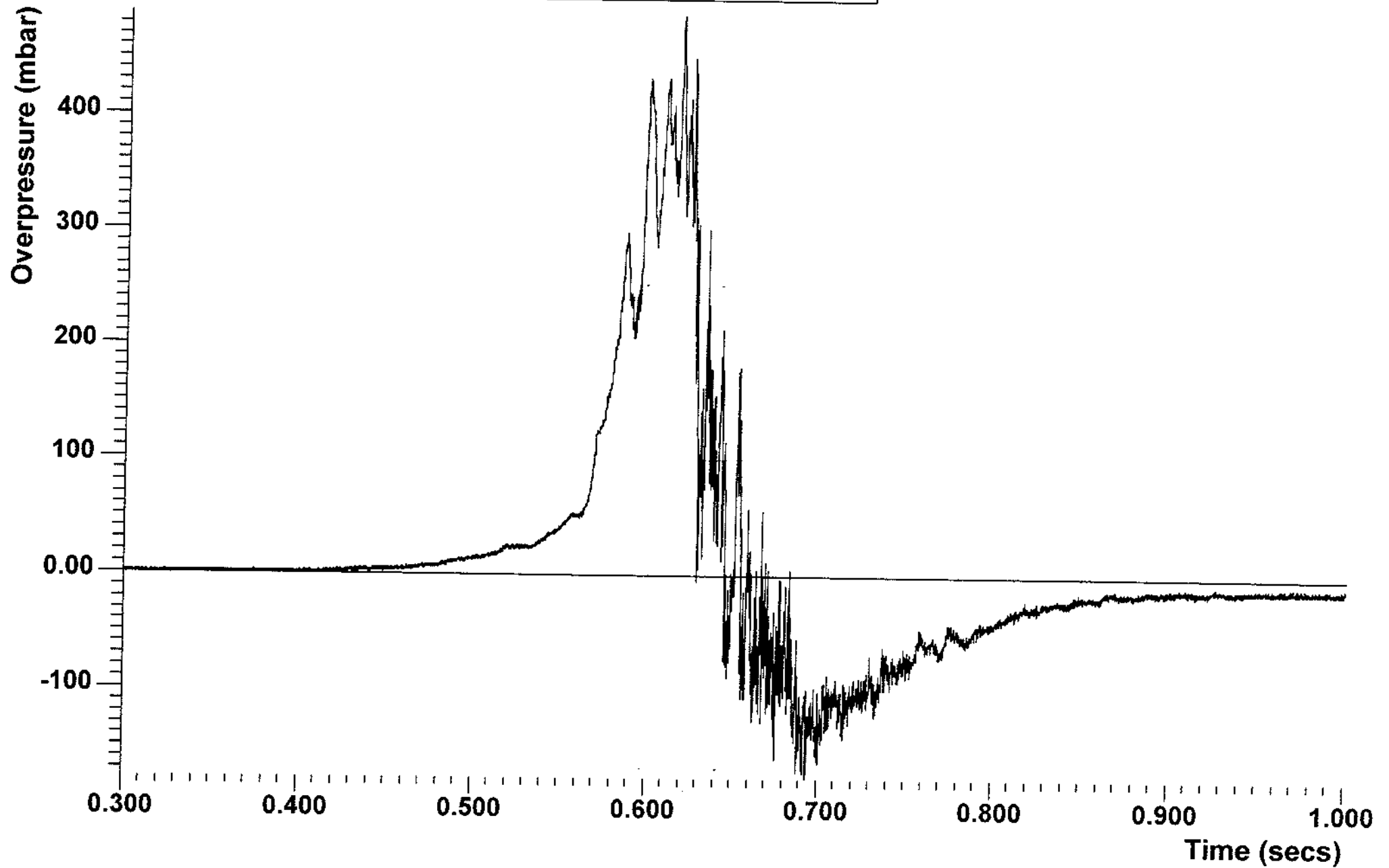
\* - Origin is at the junction of the West and South faces at ground level. Roof and floor also confined.

## **Appendix A: Internal Overpressure Profiles**

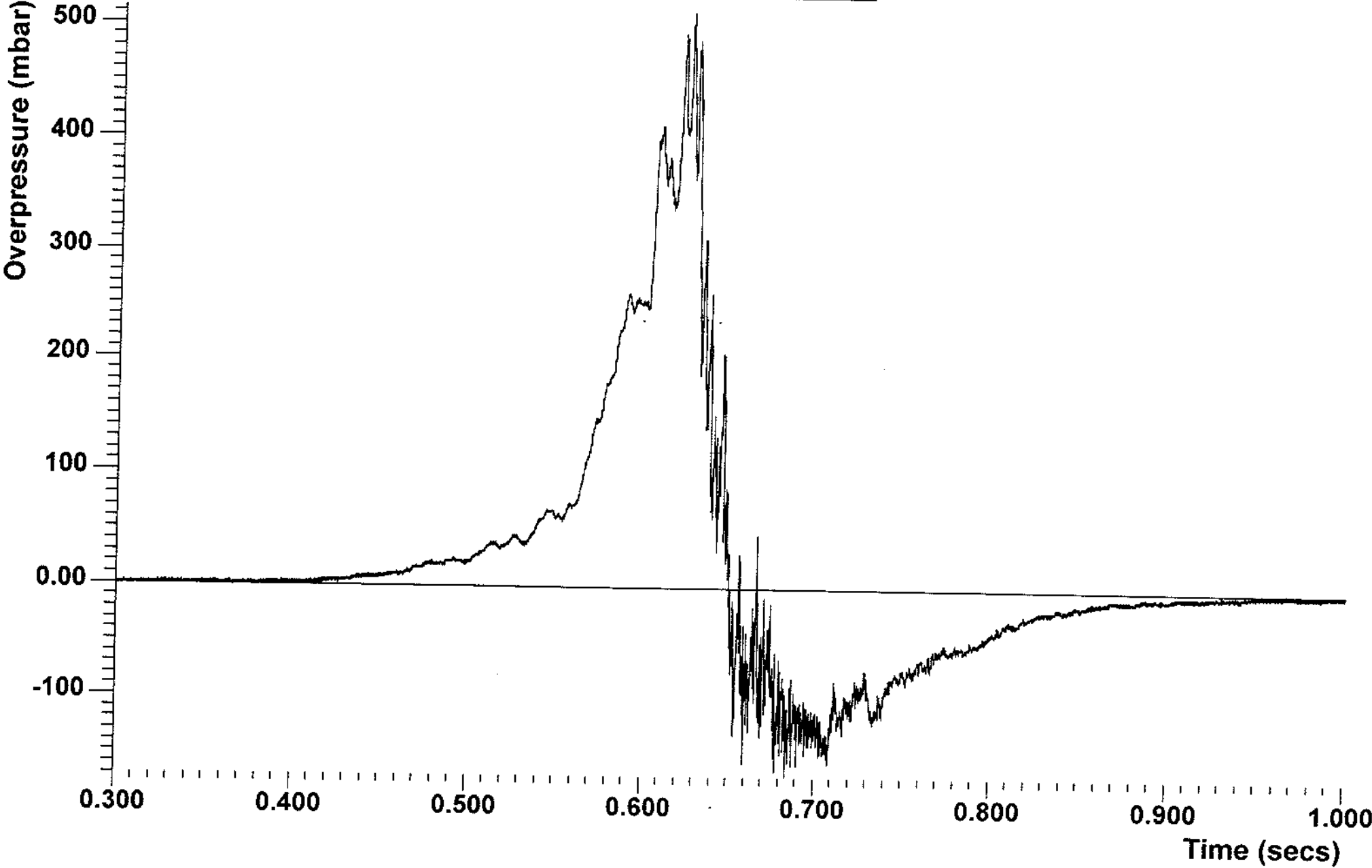
Test: HSE2 (01, C1, I2)  
Transducer no: PI-1



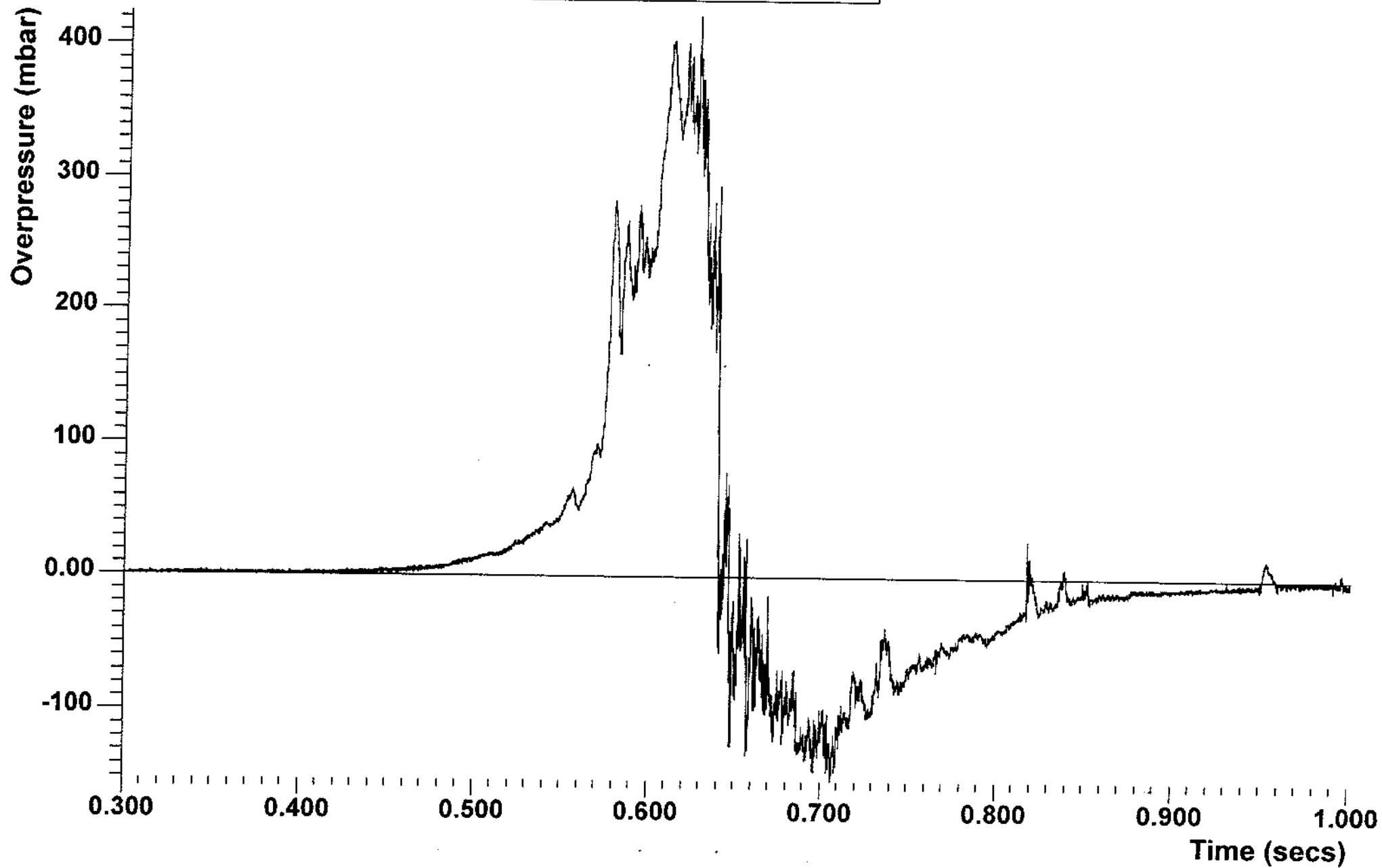
Test: HSE2 (01, C1, I2)  
Transducer no: PI-2



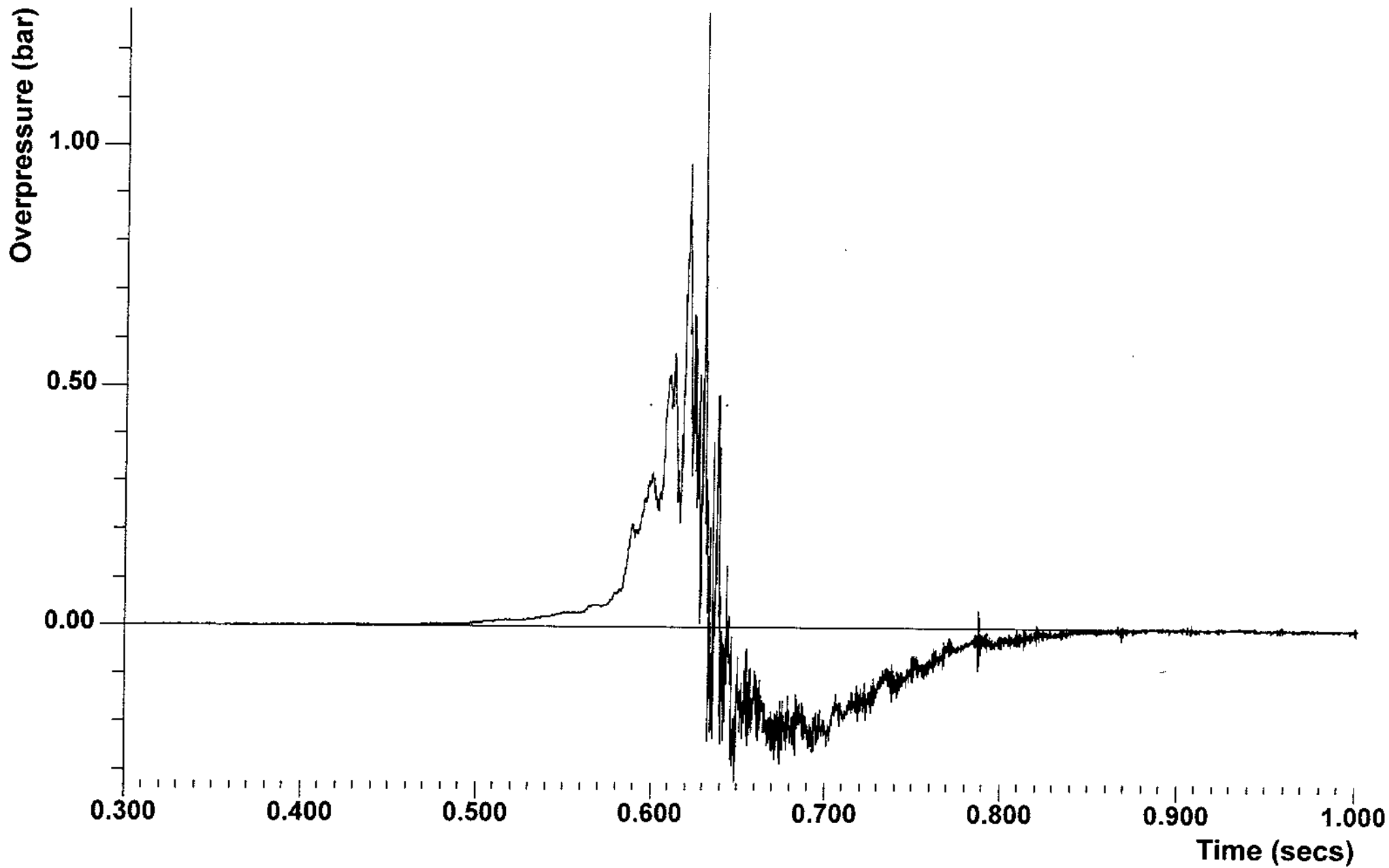
Test: HSE2 (01, C1, I2)  
Transducer no: PI-3



Test: HSE2 (01, C1, I2)  
Transducer no: PI-4

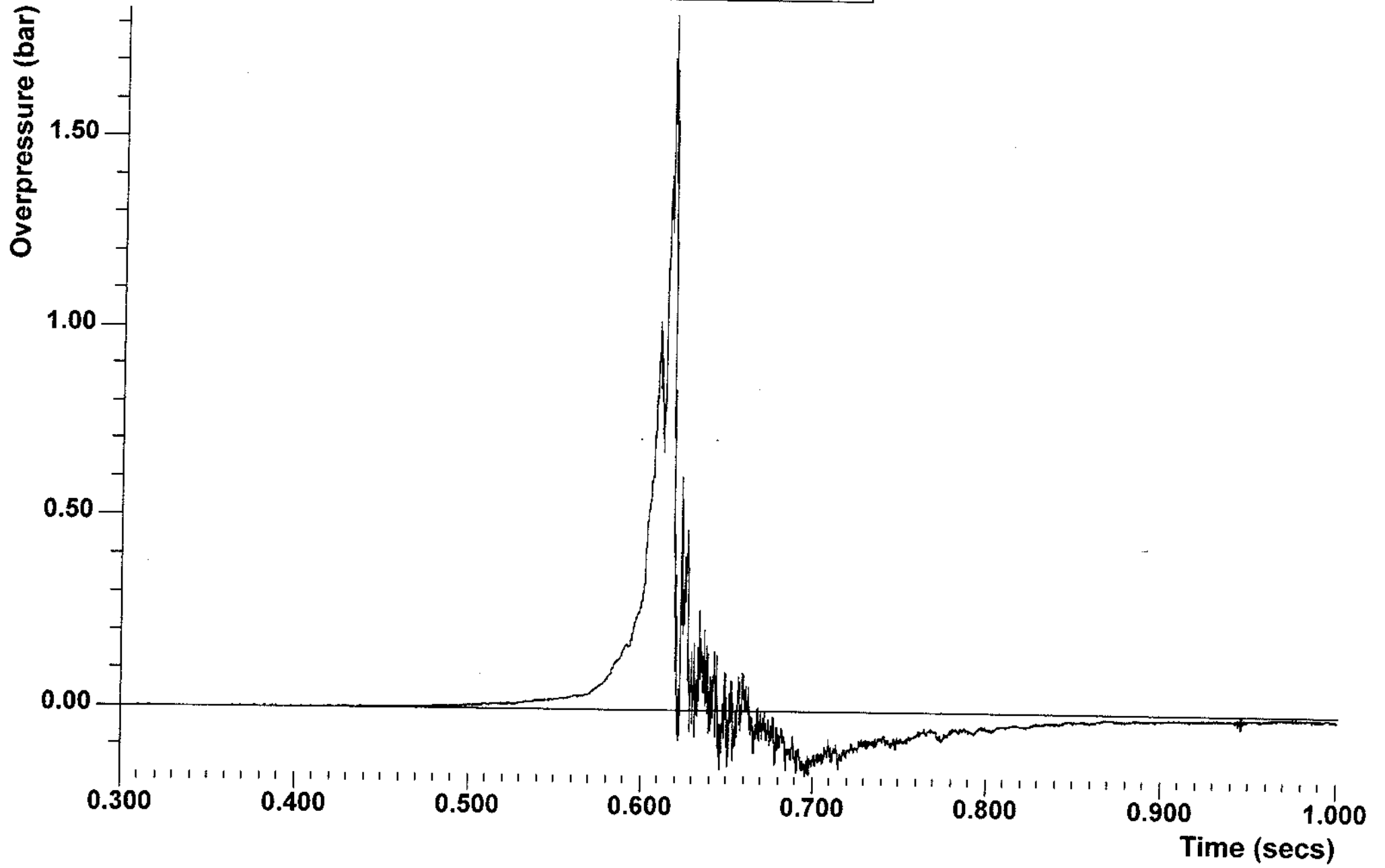


**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-5**

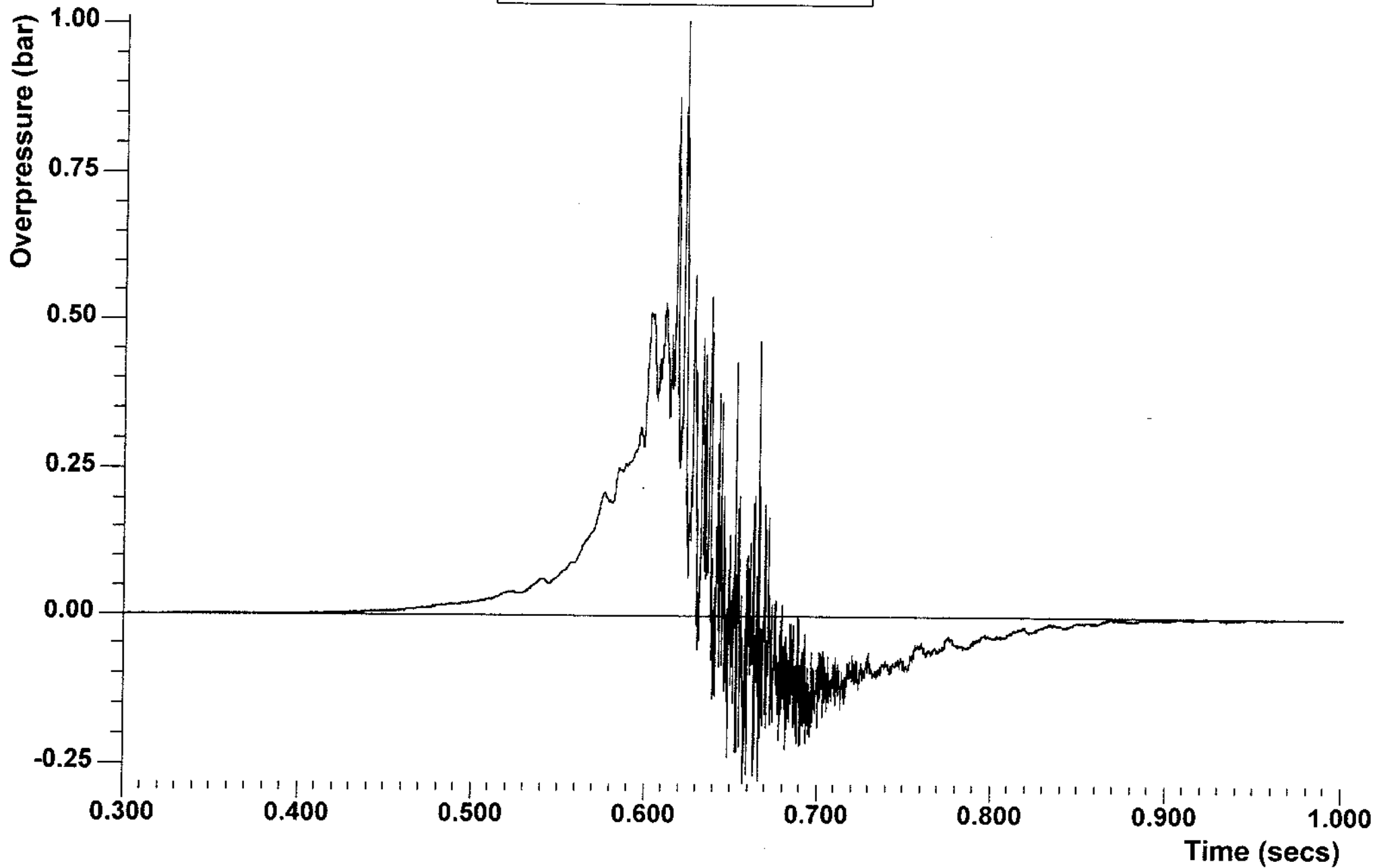




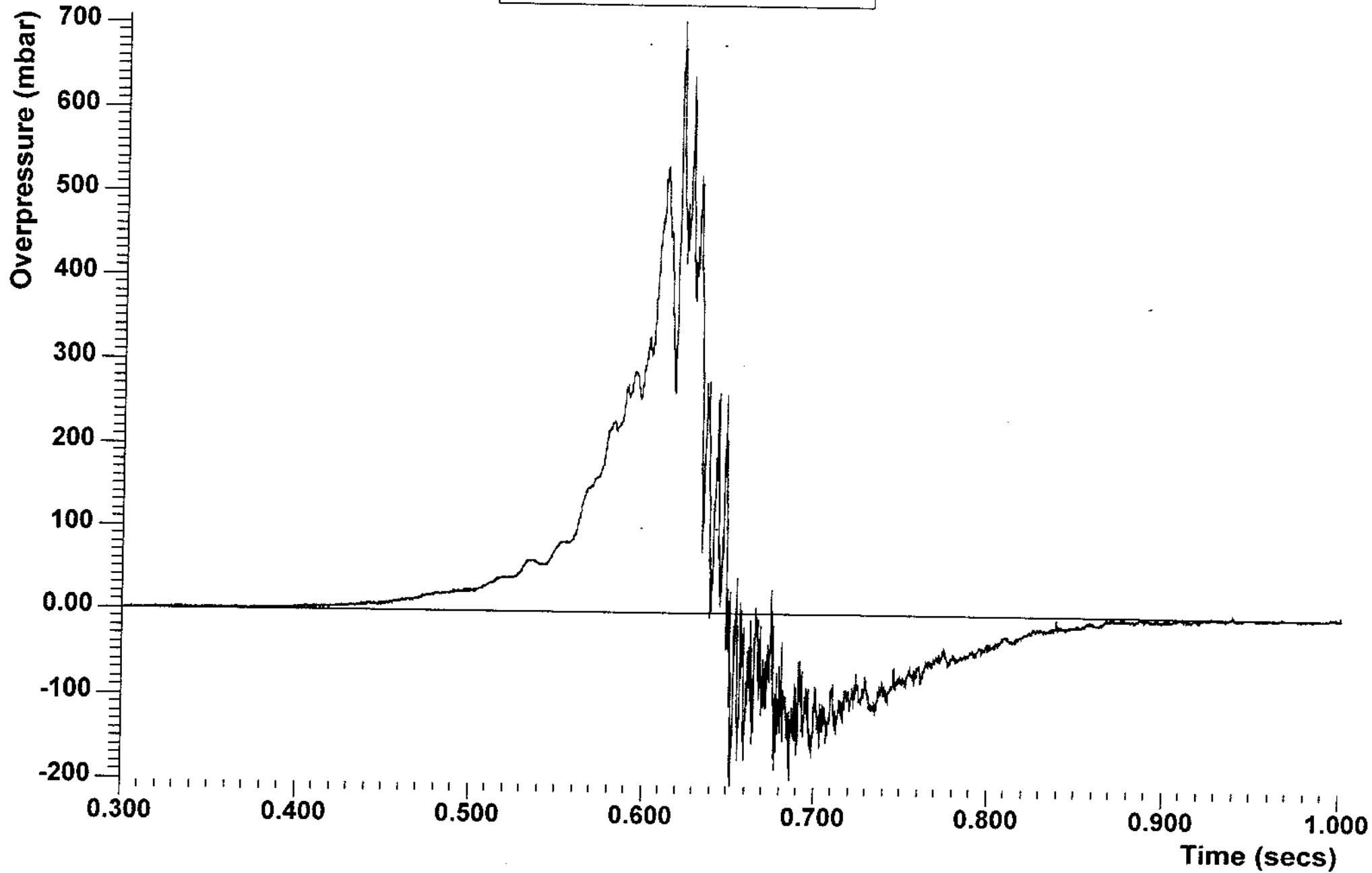
Test: HSE2 (01, C1, I2)  
Transducer no: PI-6



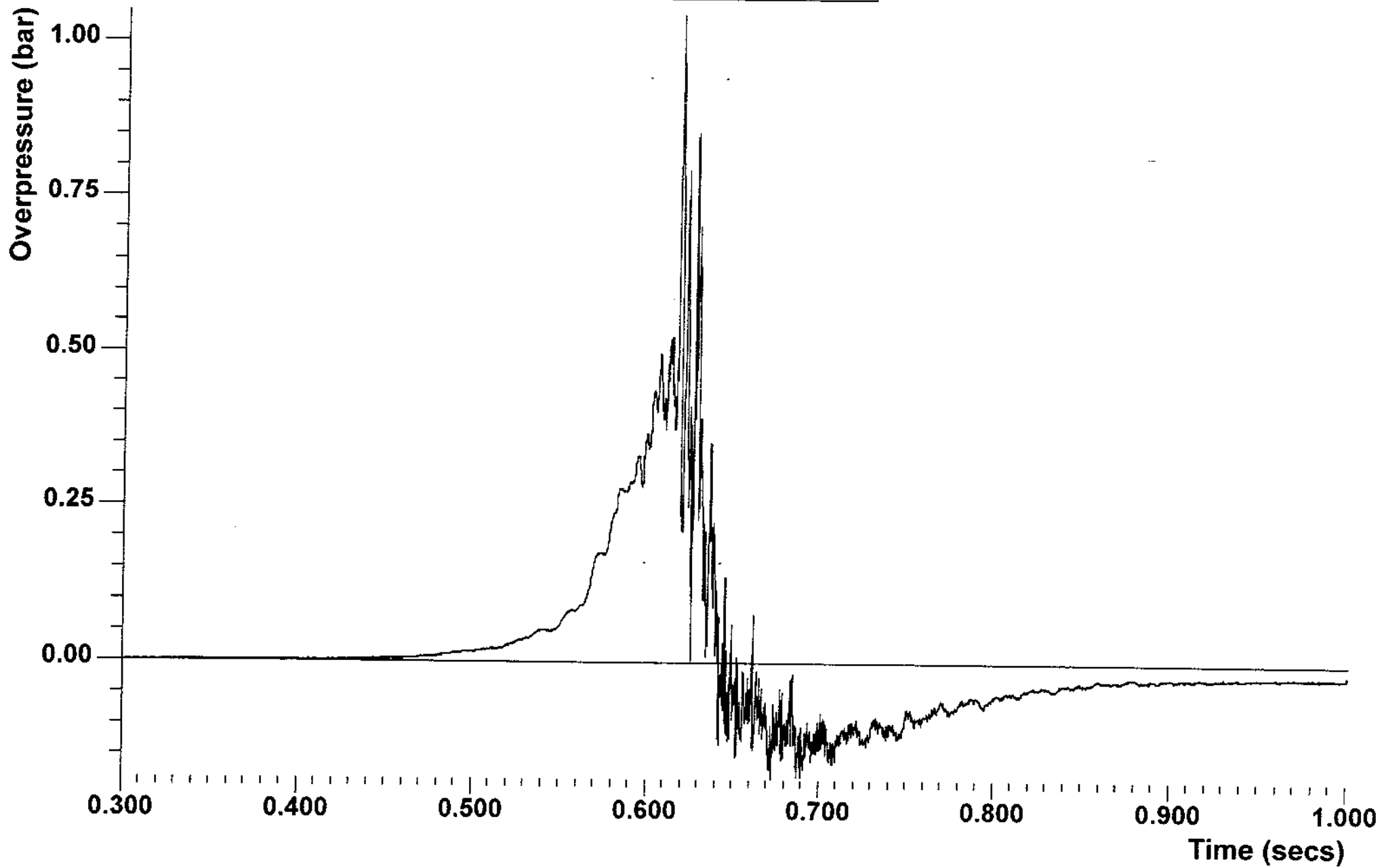
Test: HSE2 (01, C1, I2)  
Transducer no: PI-7



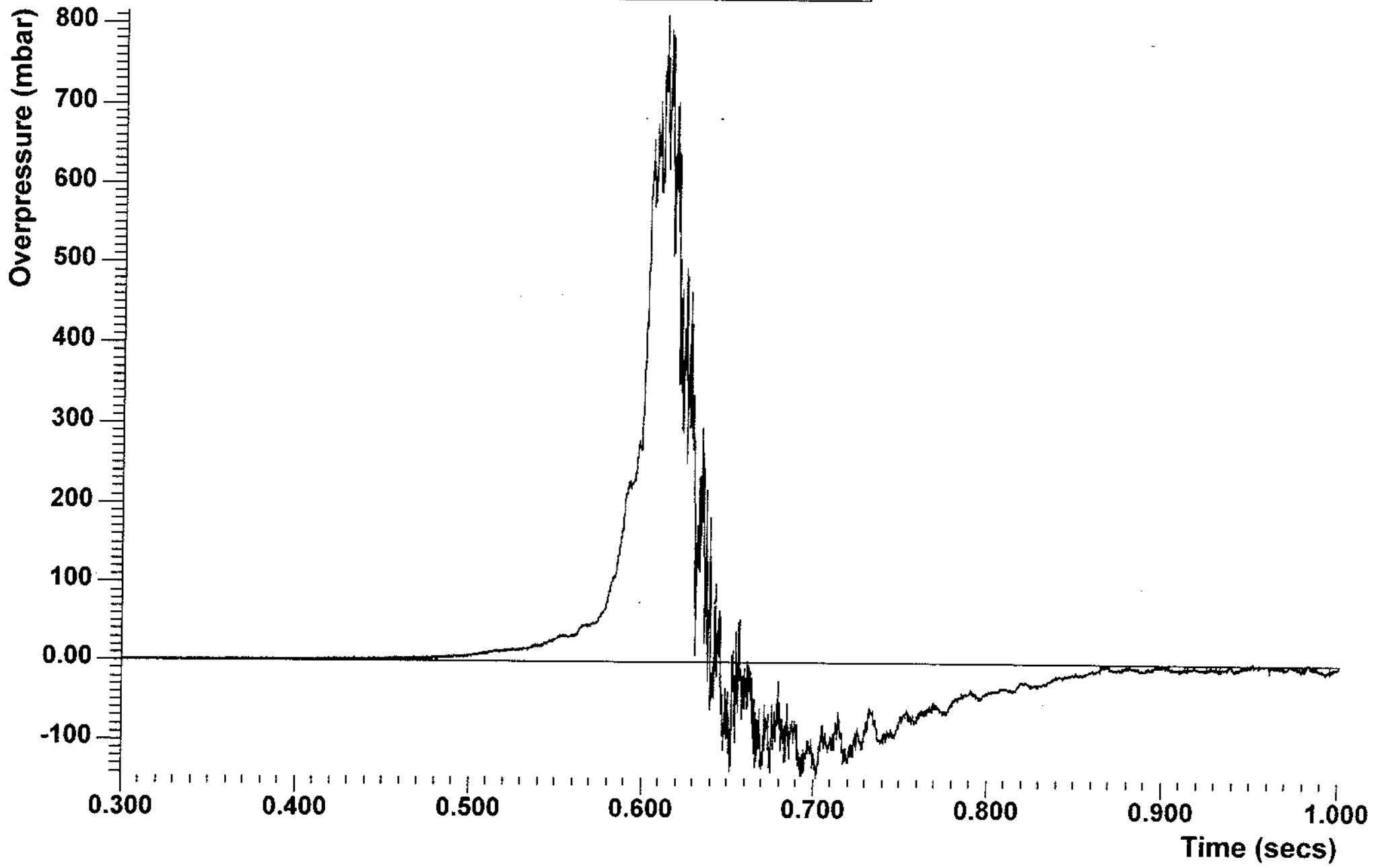
Test: HSE2 (01, C1, I2)  
Transducer no: PI-8



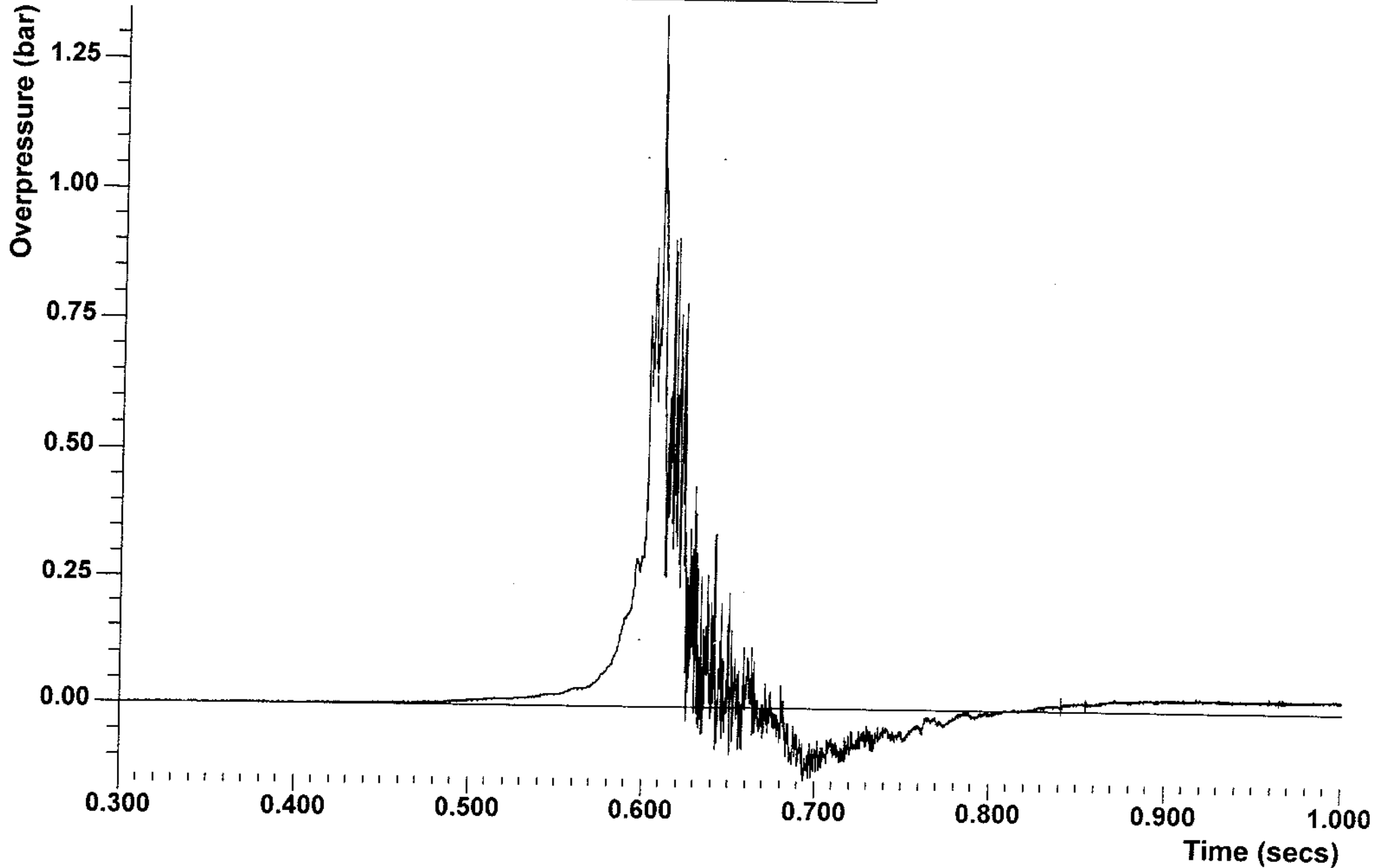
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-9**



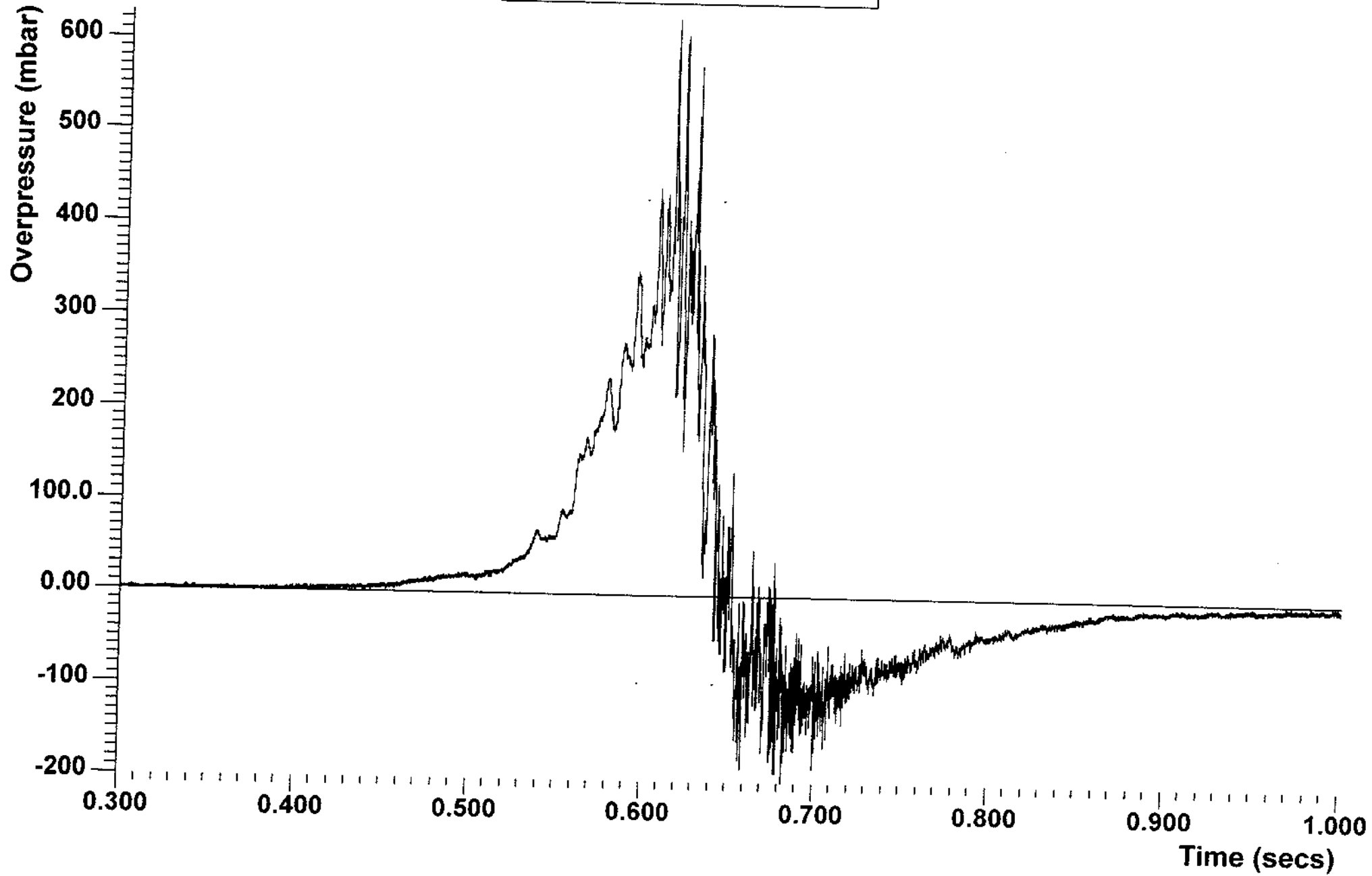
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-10**



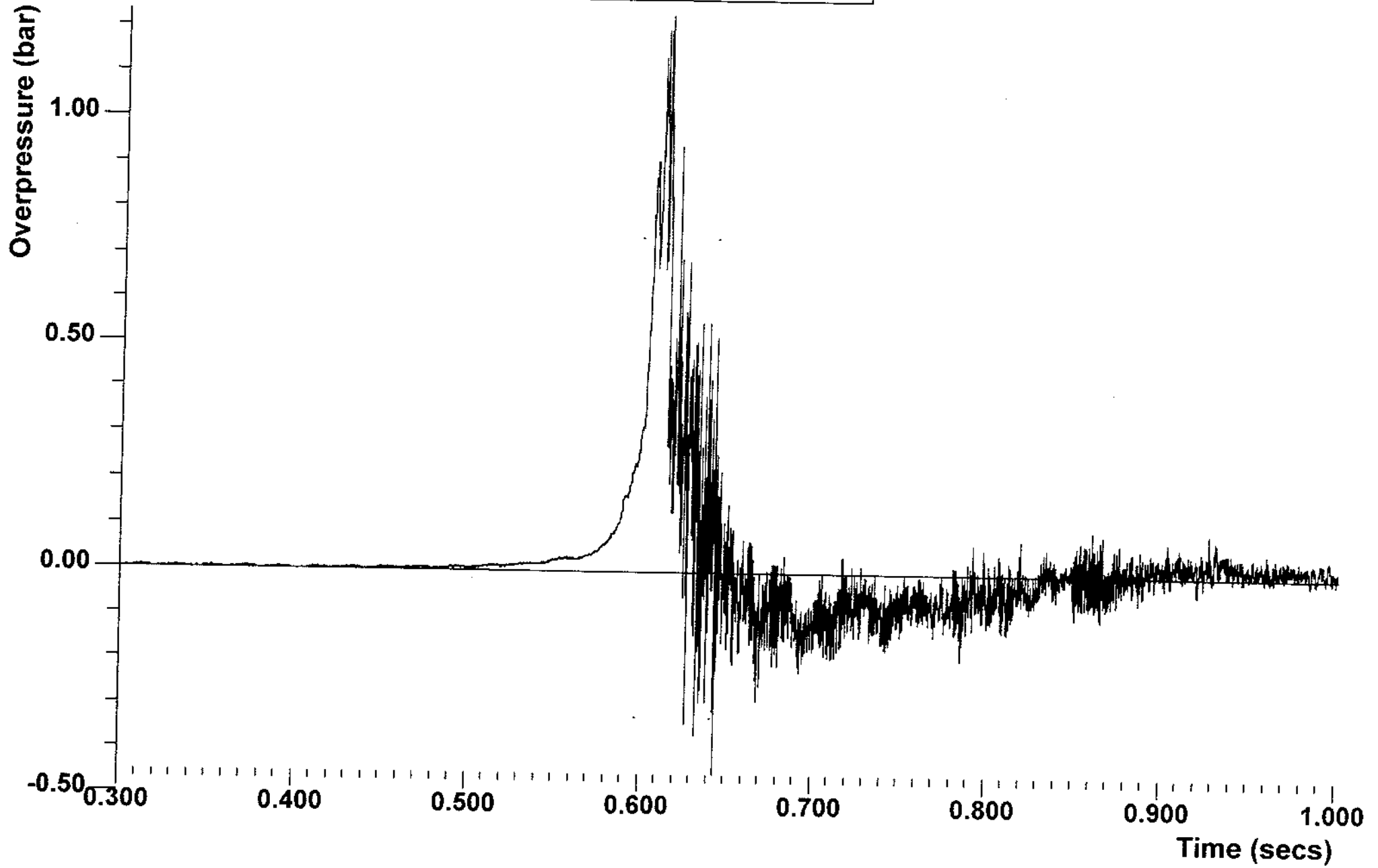
Test: HSE2 (01, C1, I2)  
Transducer no: PI-11



Test: HSE2 (01, C1, I2)  
Transducer no: PI-12

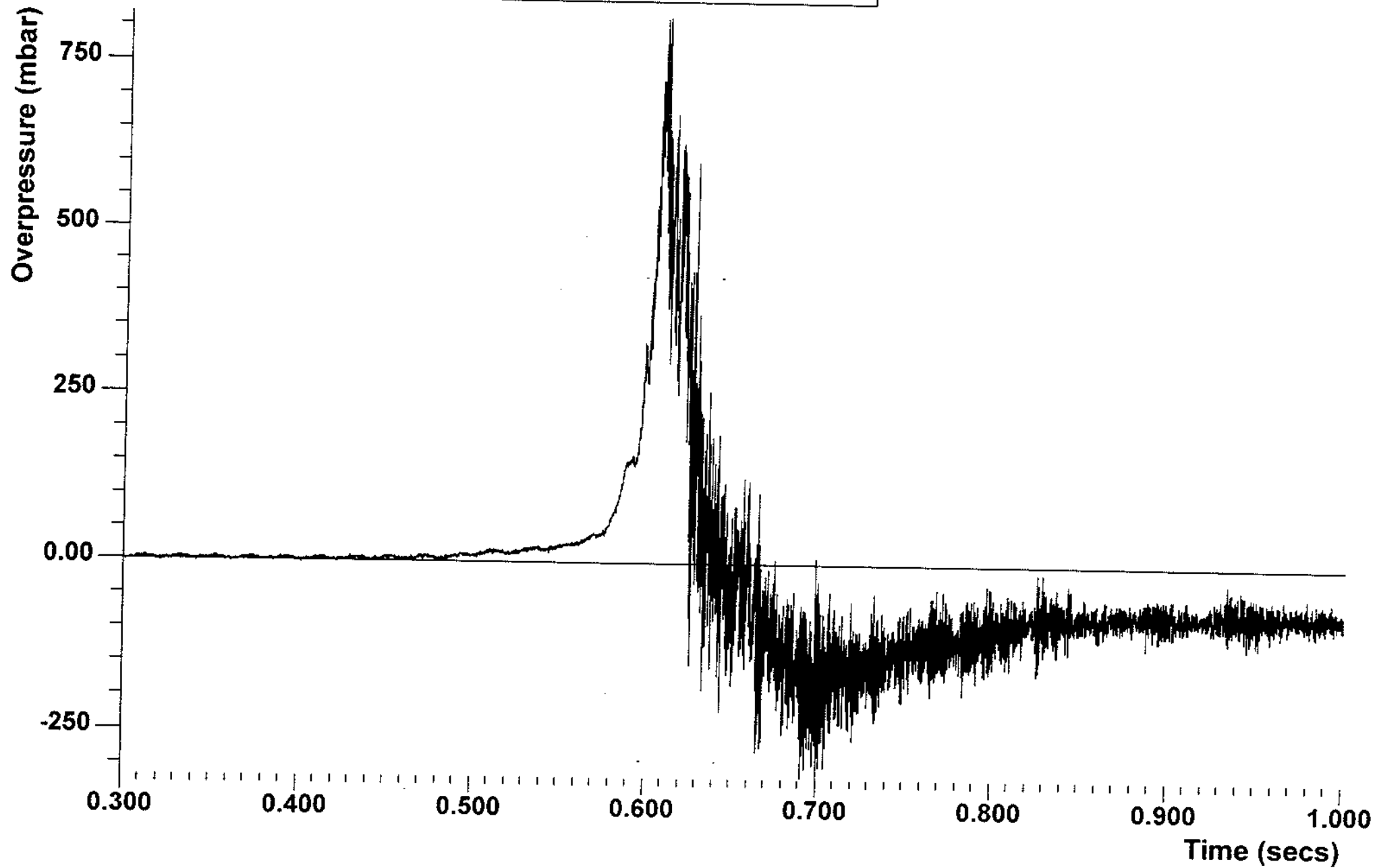


Test: HSE2 (01, C1, I2)  
Transducer no: PI-13

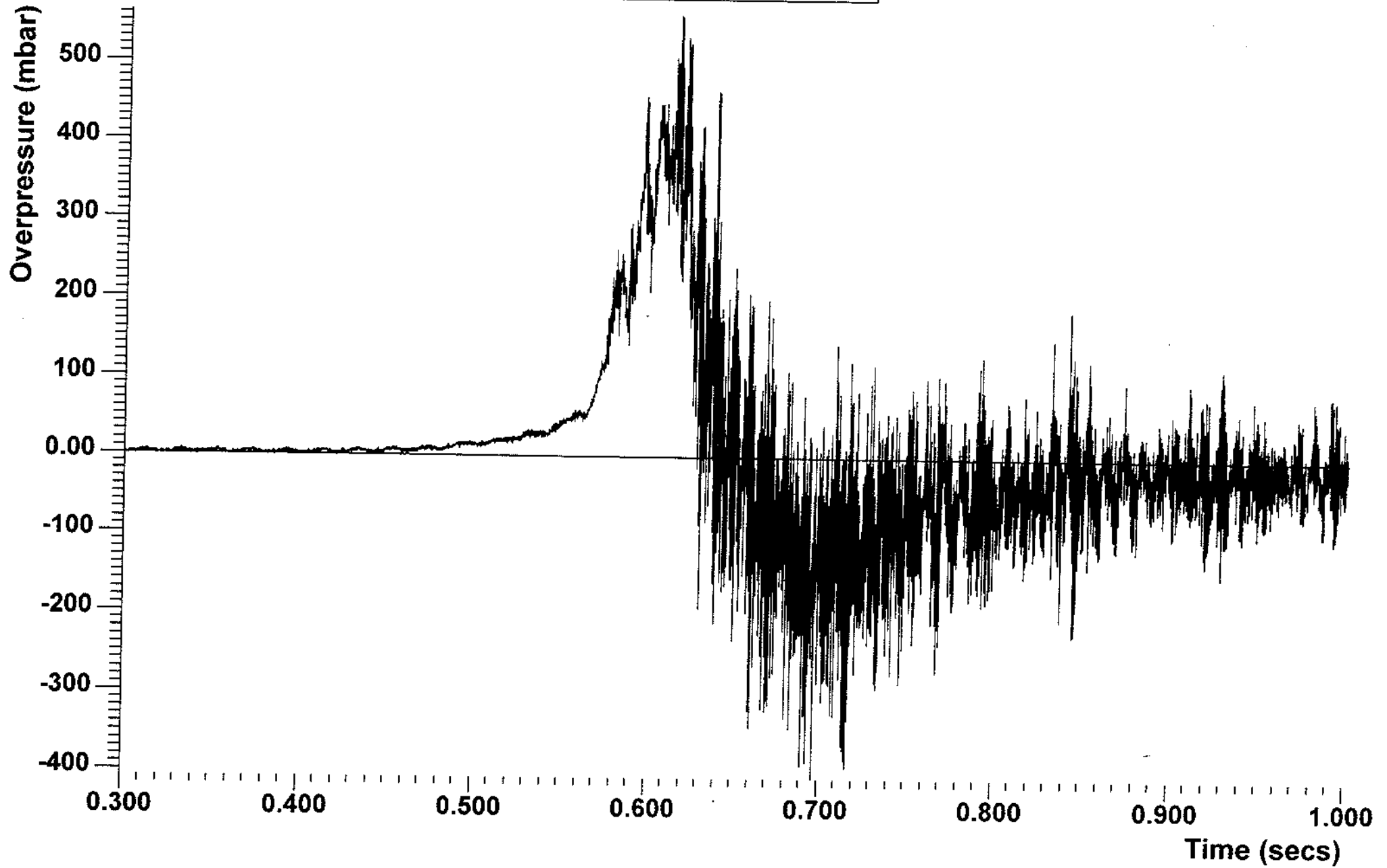




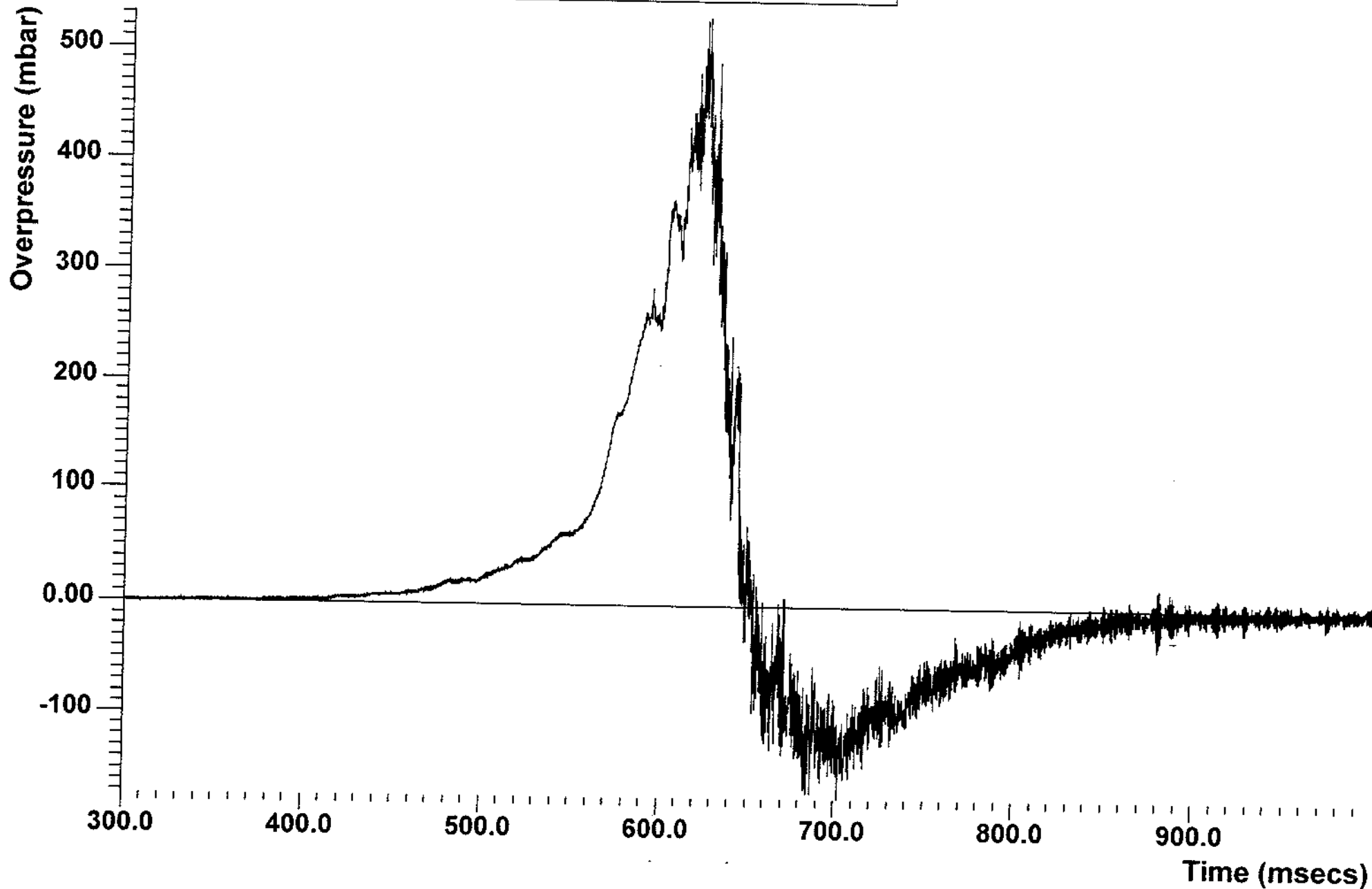
Test: HSE2 (01, C1, I2)  
Transducer no: PI-14



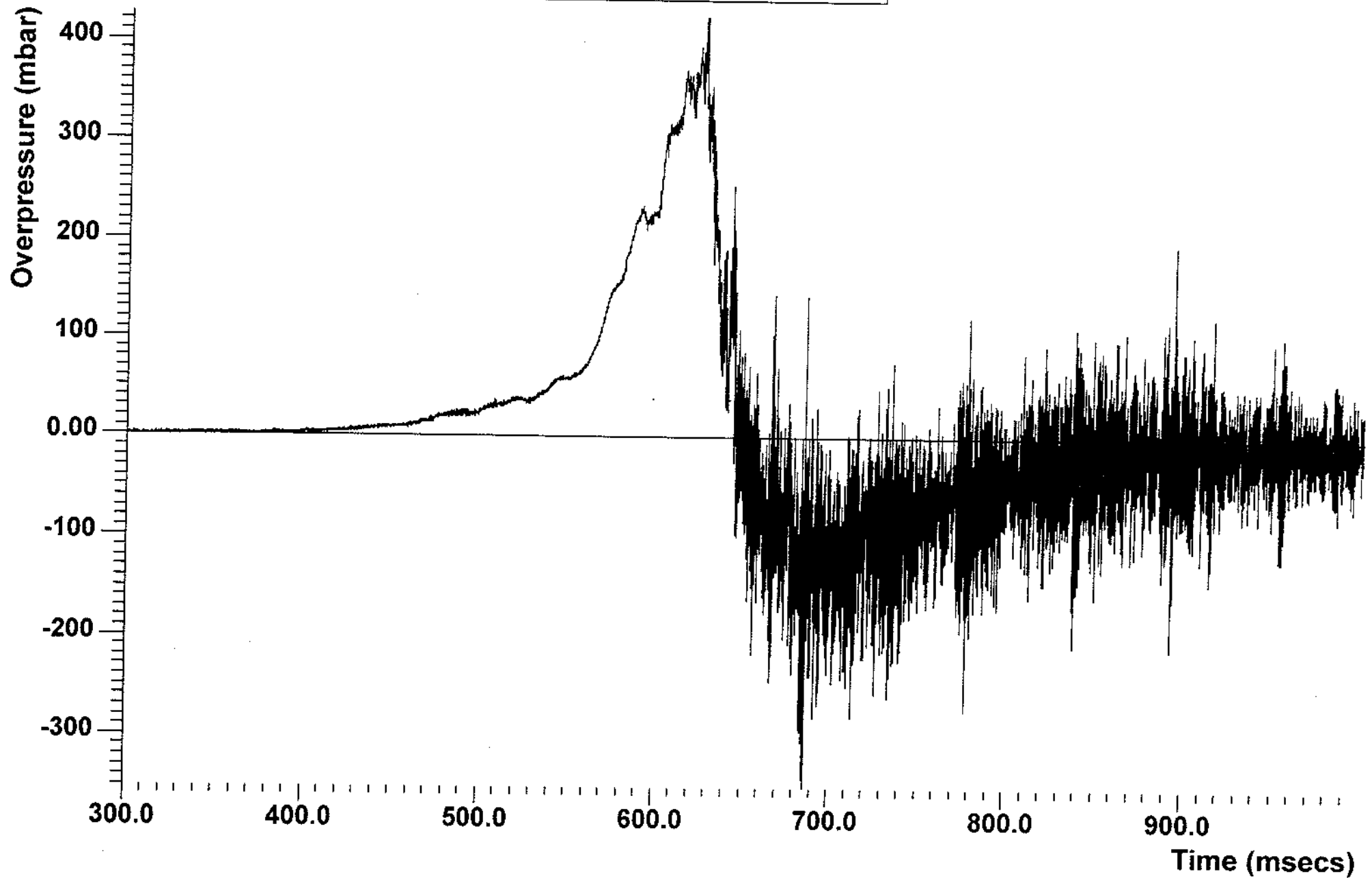
Test: HSE2 (01, C1, I2)  
Transducer no: PI-15



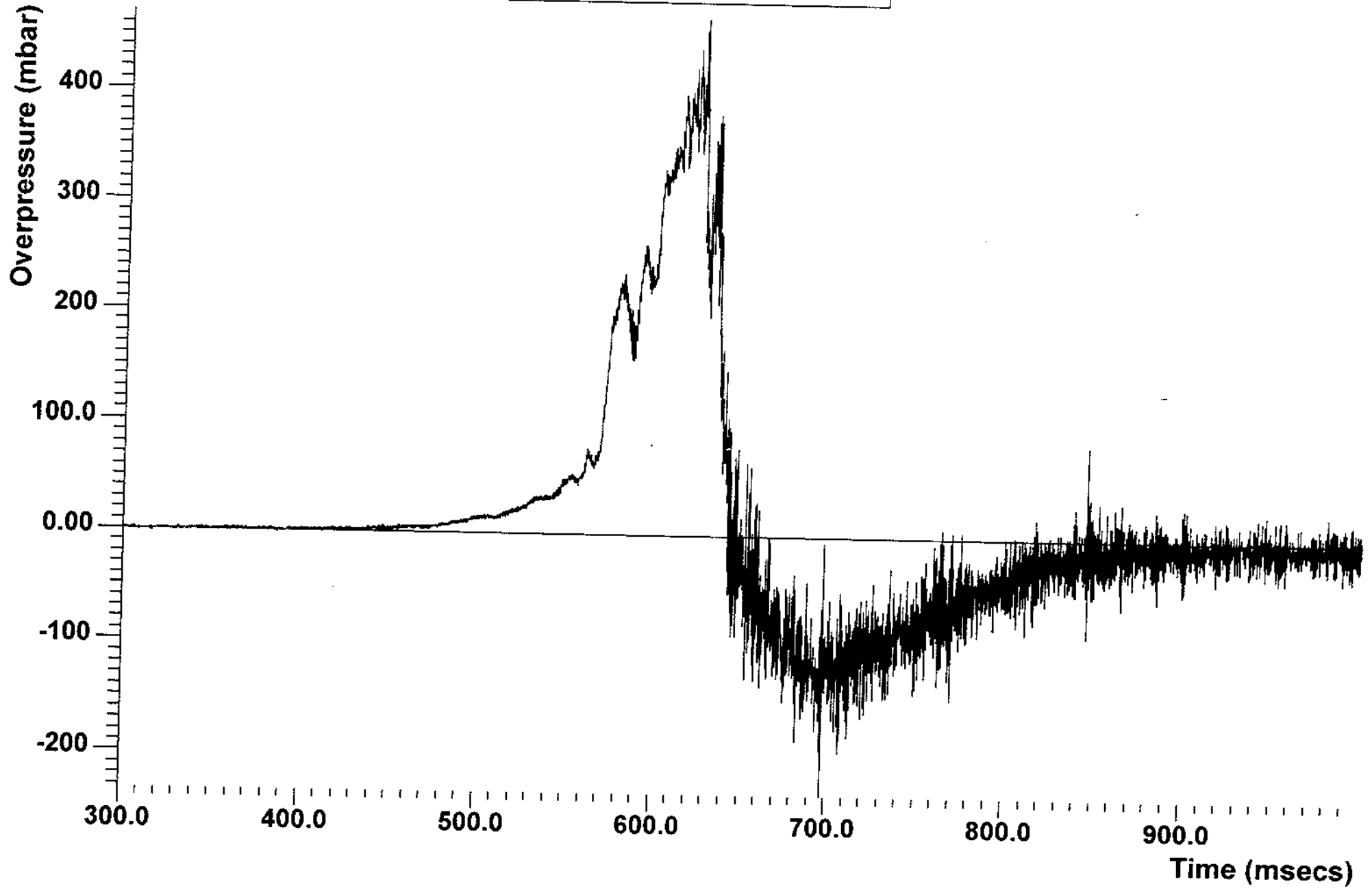
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-16**



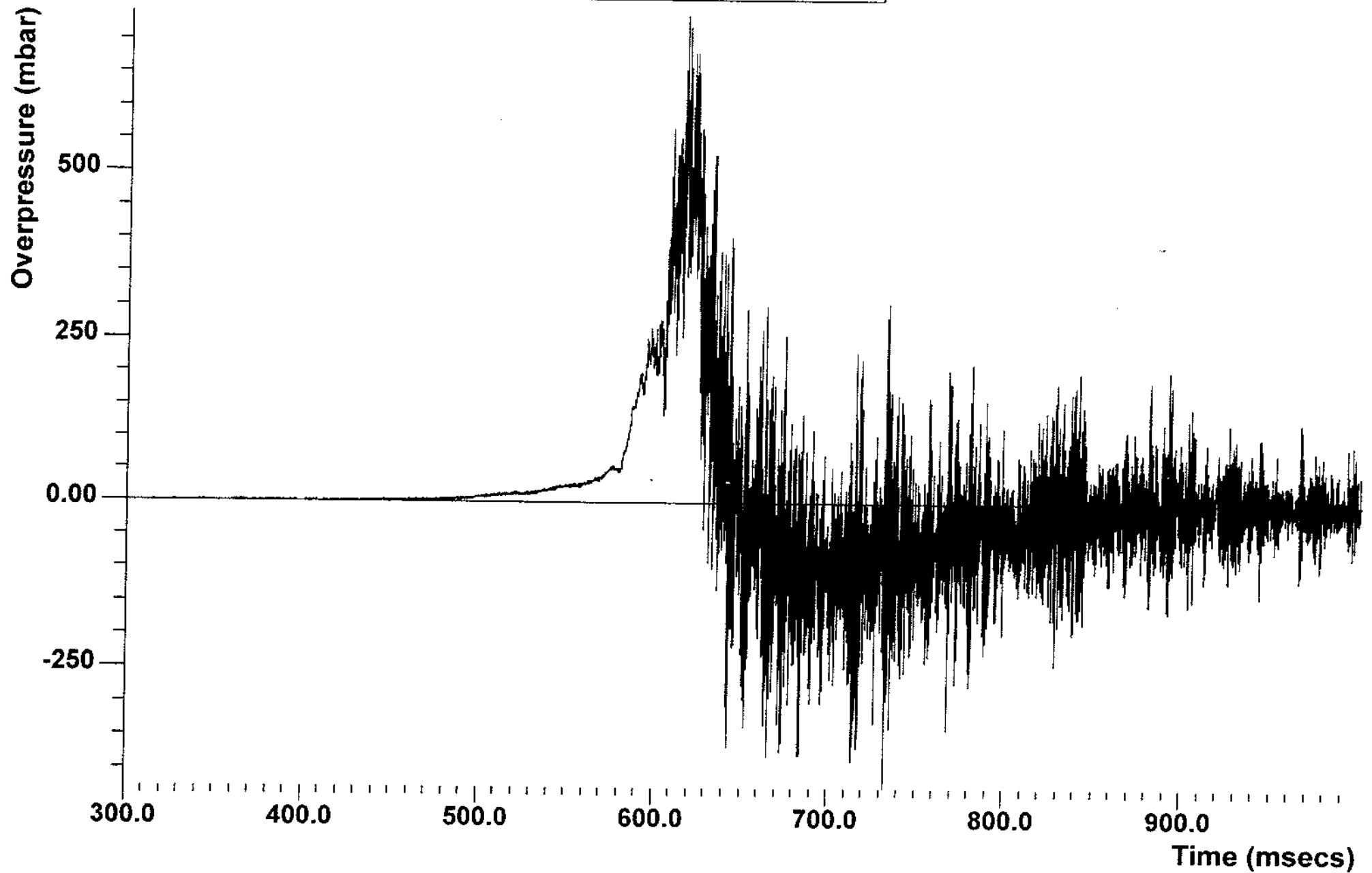
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-17**



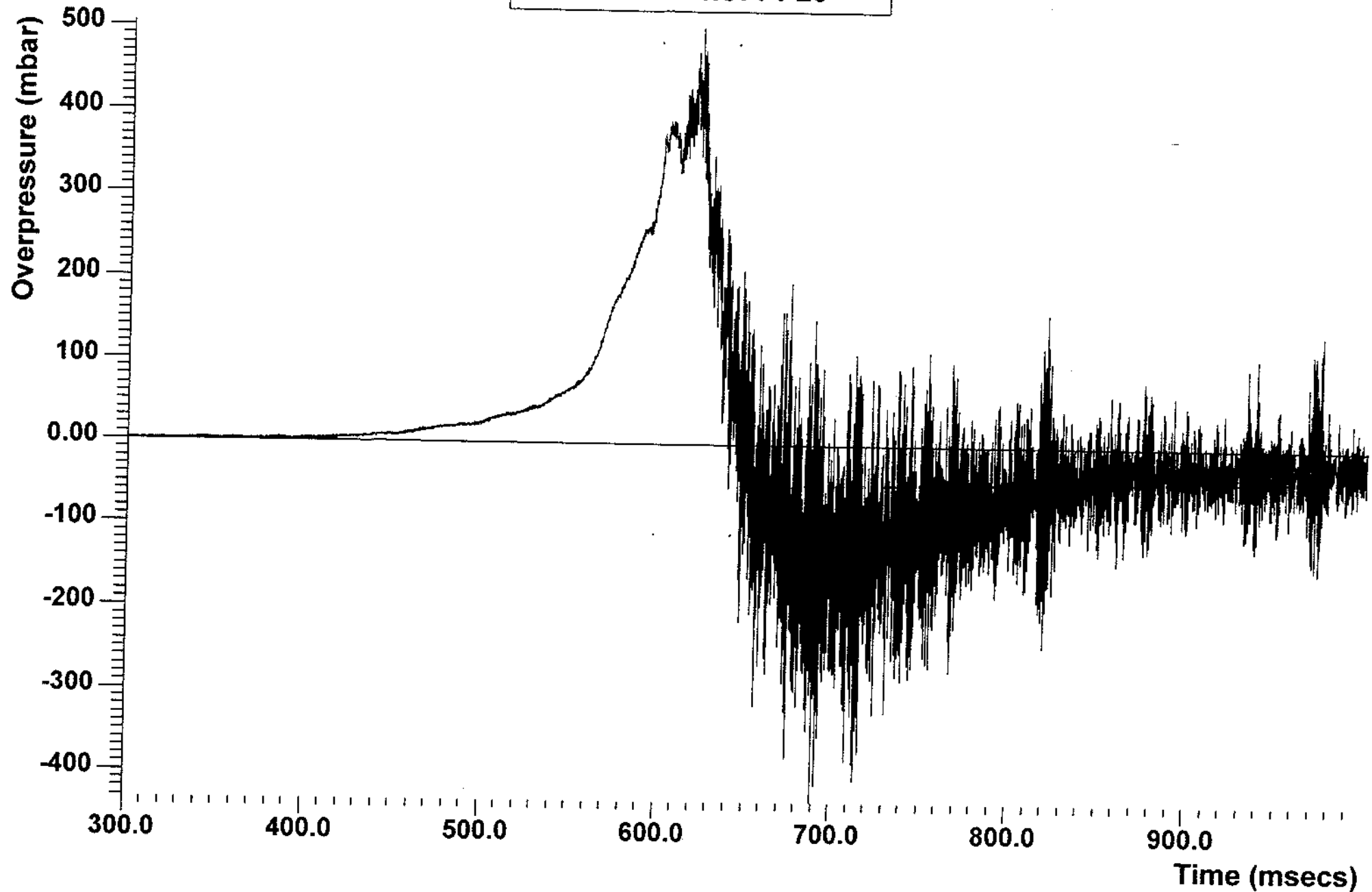
Test: HSE2 (01, C1, I2)  
Transducer no: PI-18



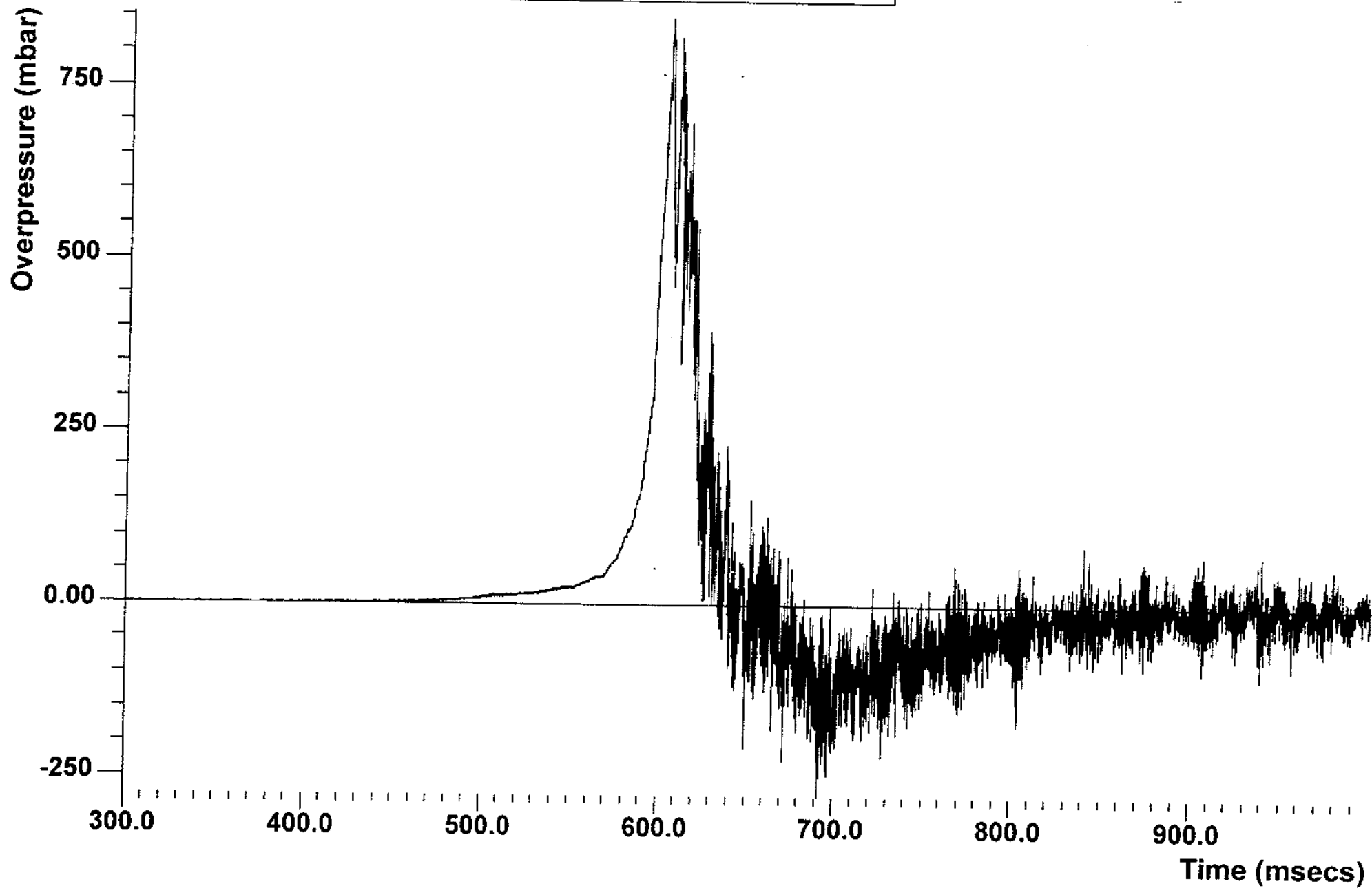
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-19**



Test: HSE2 (01, C1, I2)  
Transducer no: PI-20

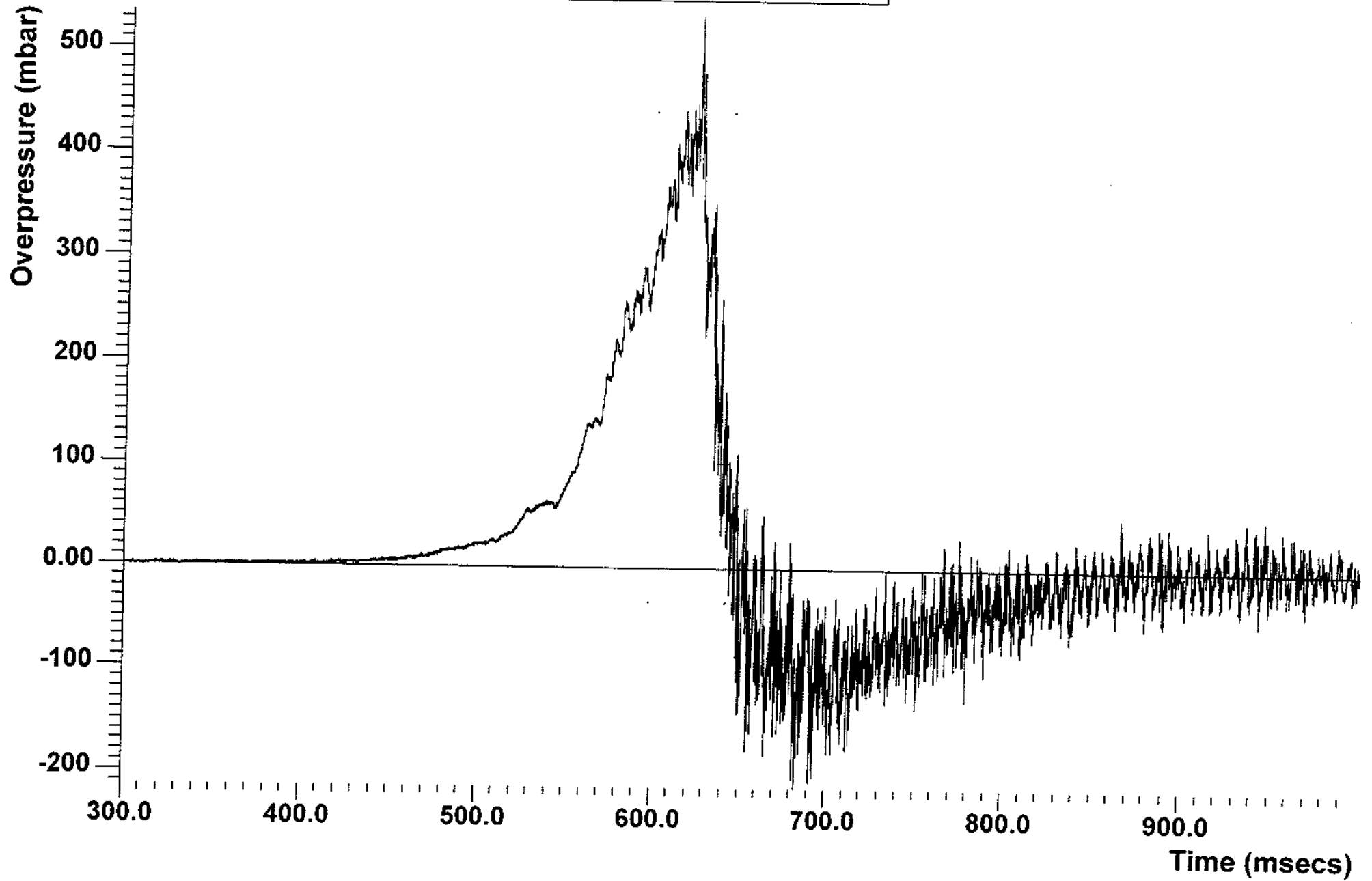


**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-21**

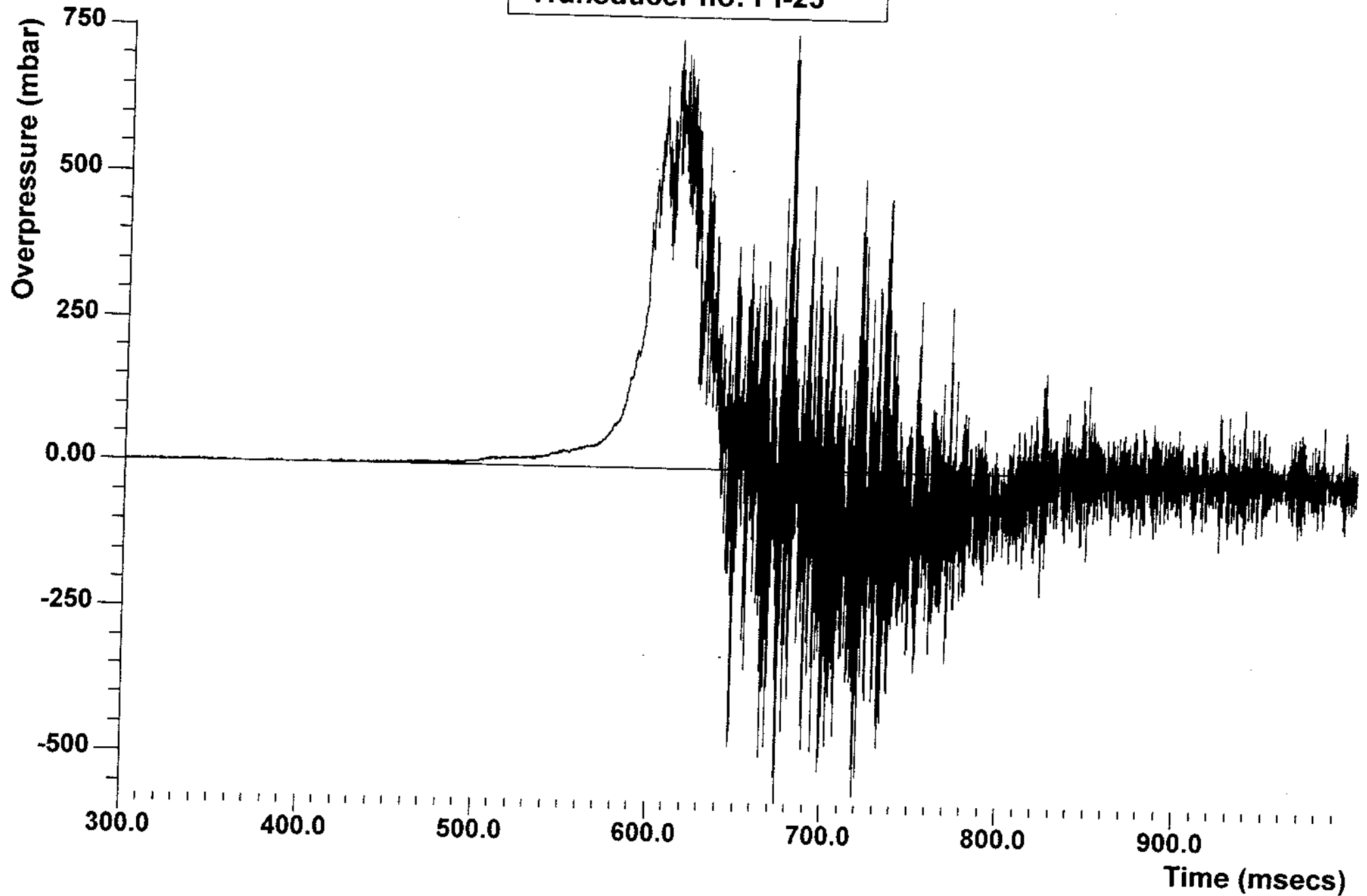




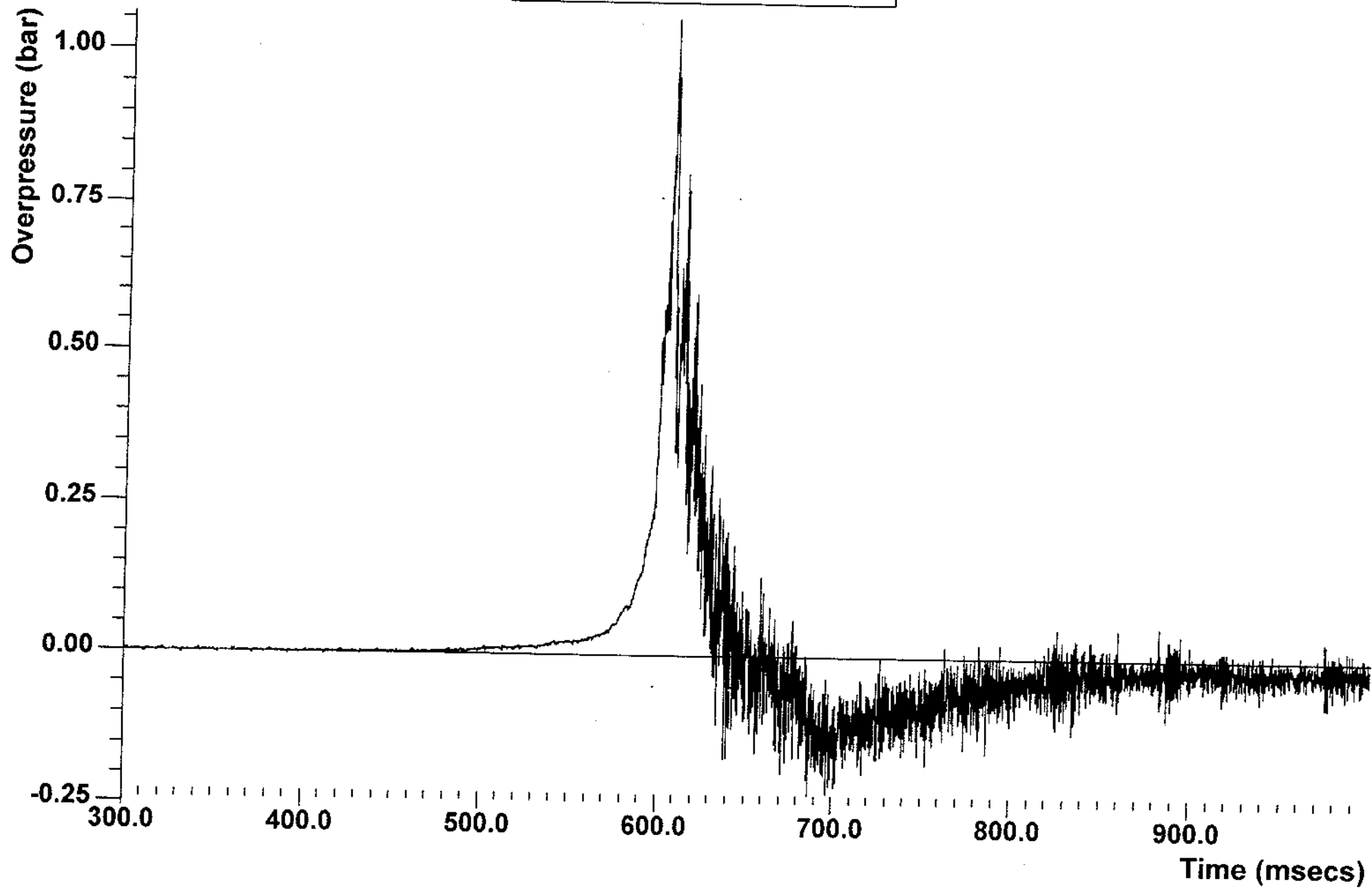
Test: HSE2 (01, C1, I2)  
Transducer no: PI-22



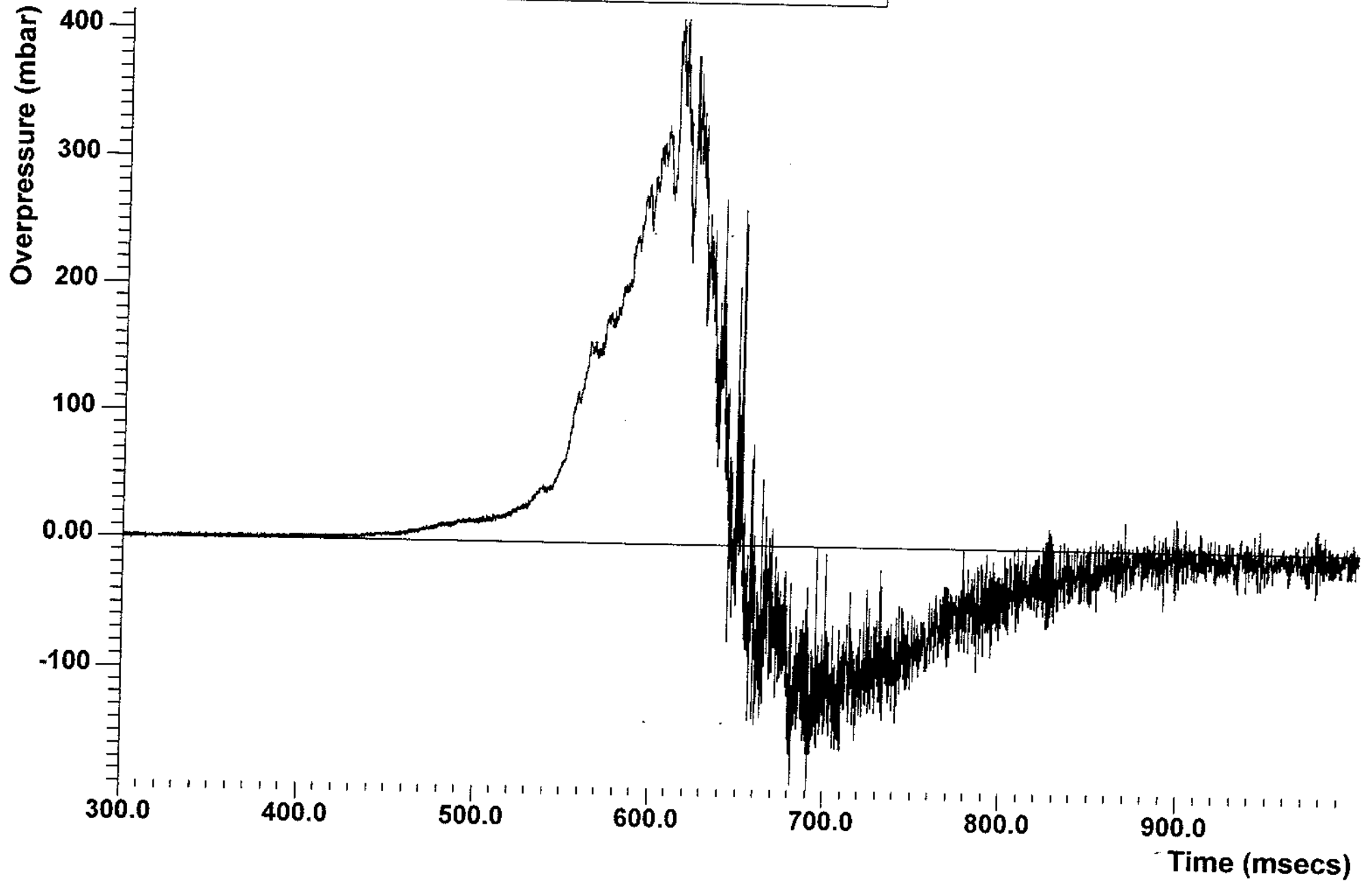
Test: HSE2 (01, C1, I2)  
Transducer no: PI-23



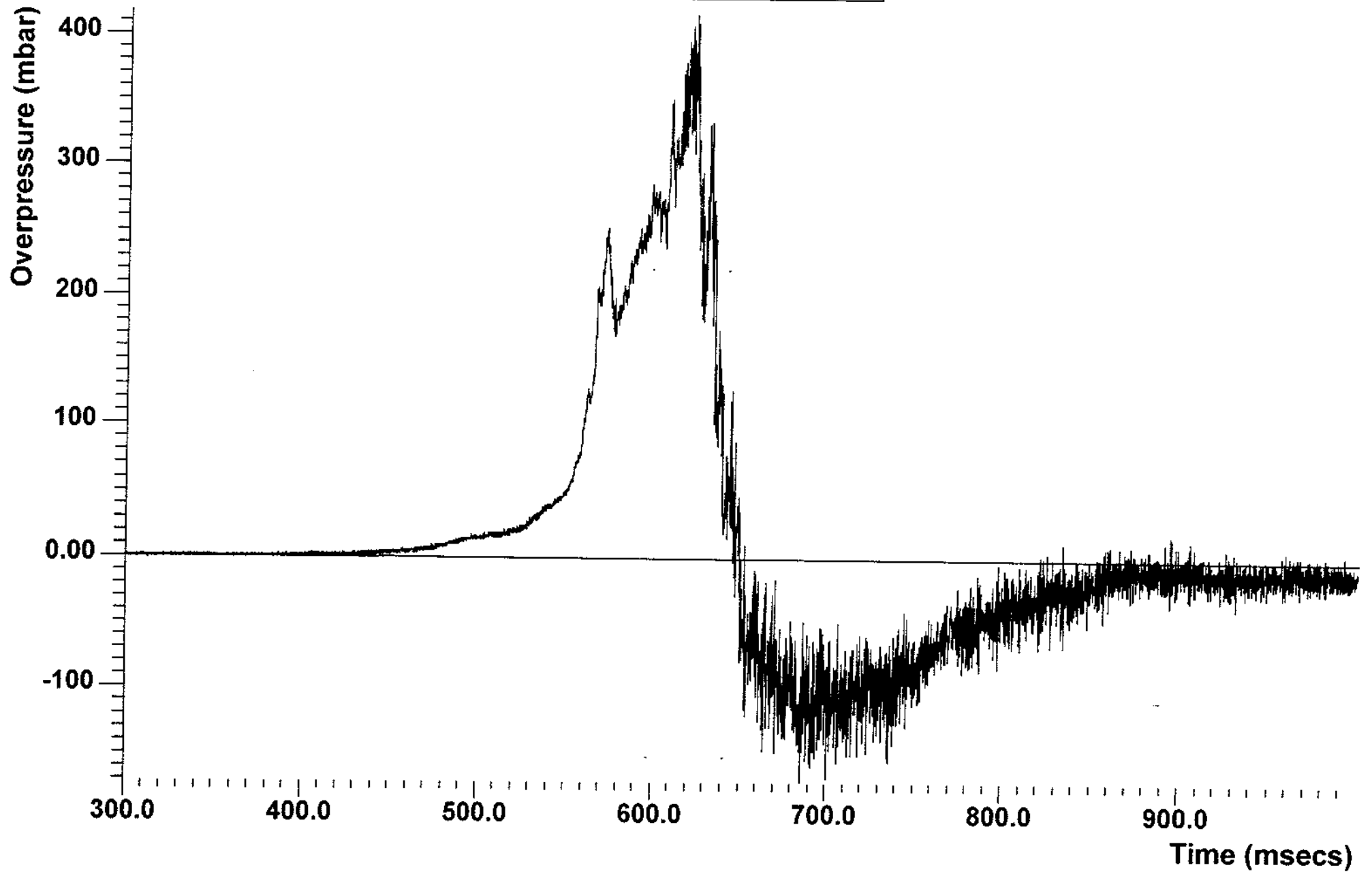
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-24**



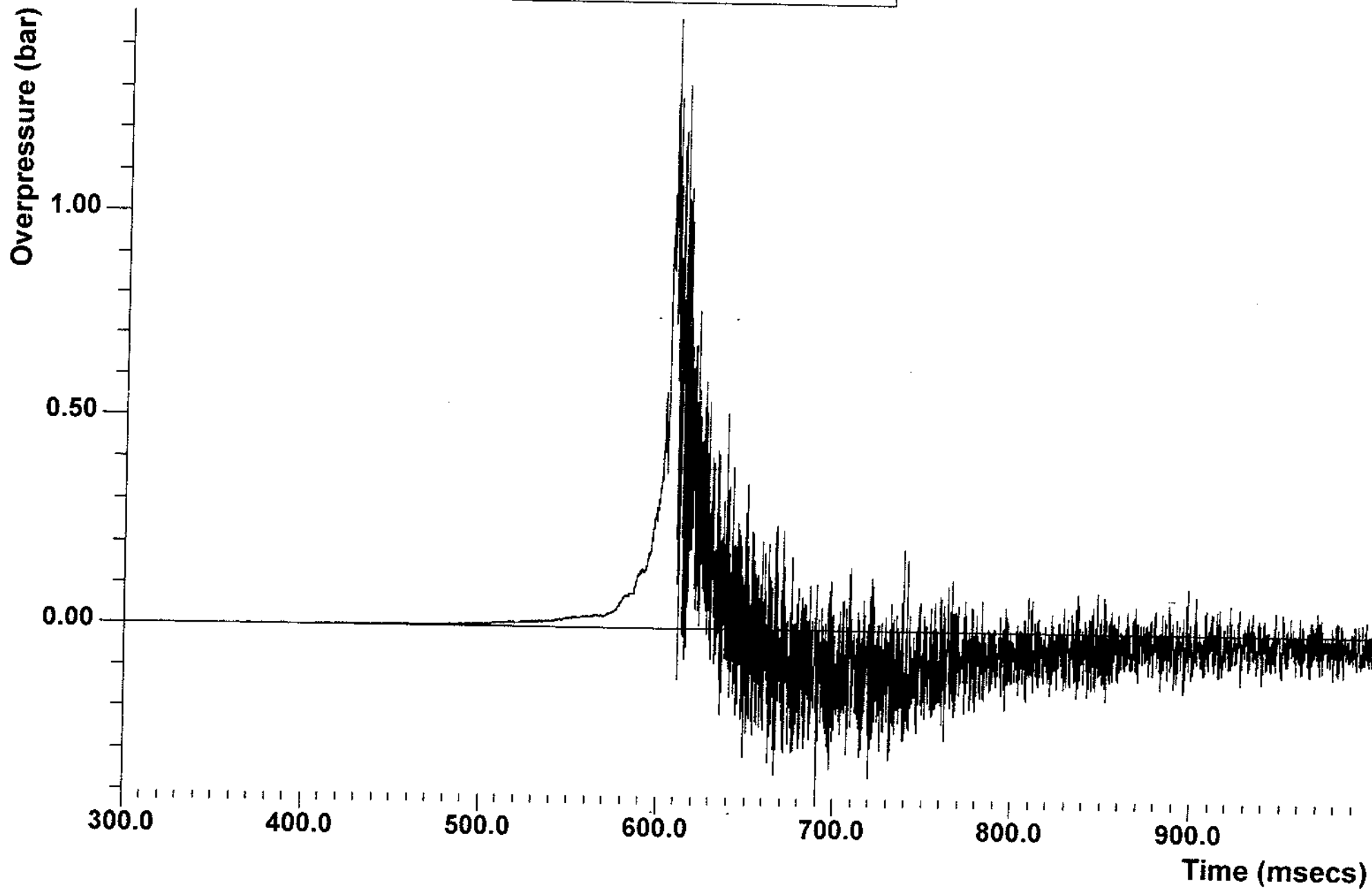
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-25**



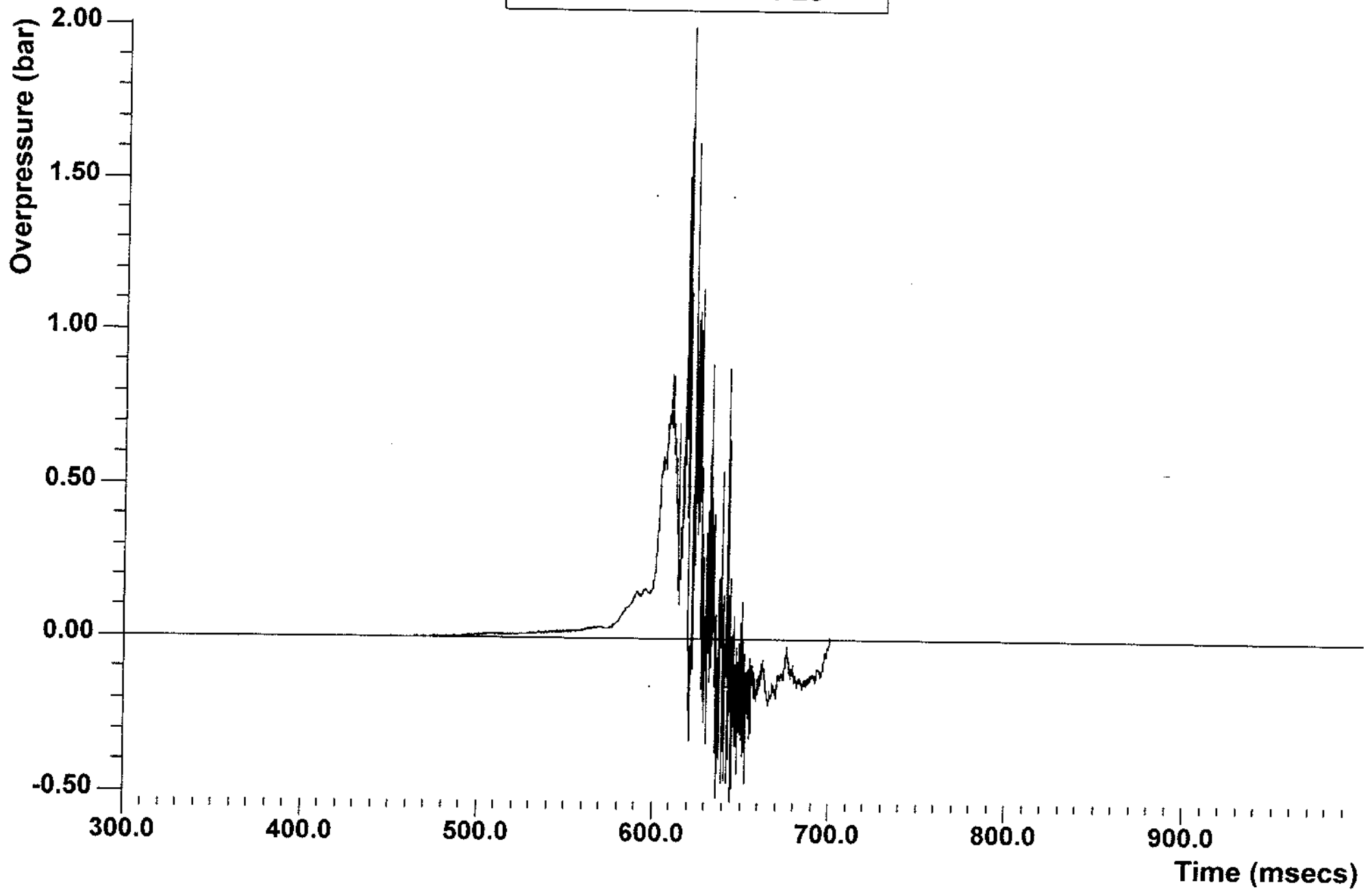
Test: HSE2 (01, C1, I2)  
Transducer no: PI-26



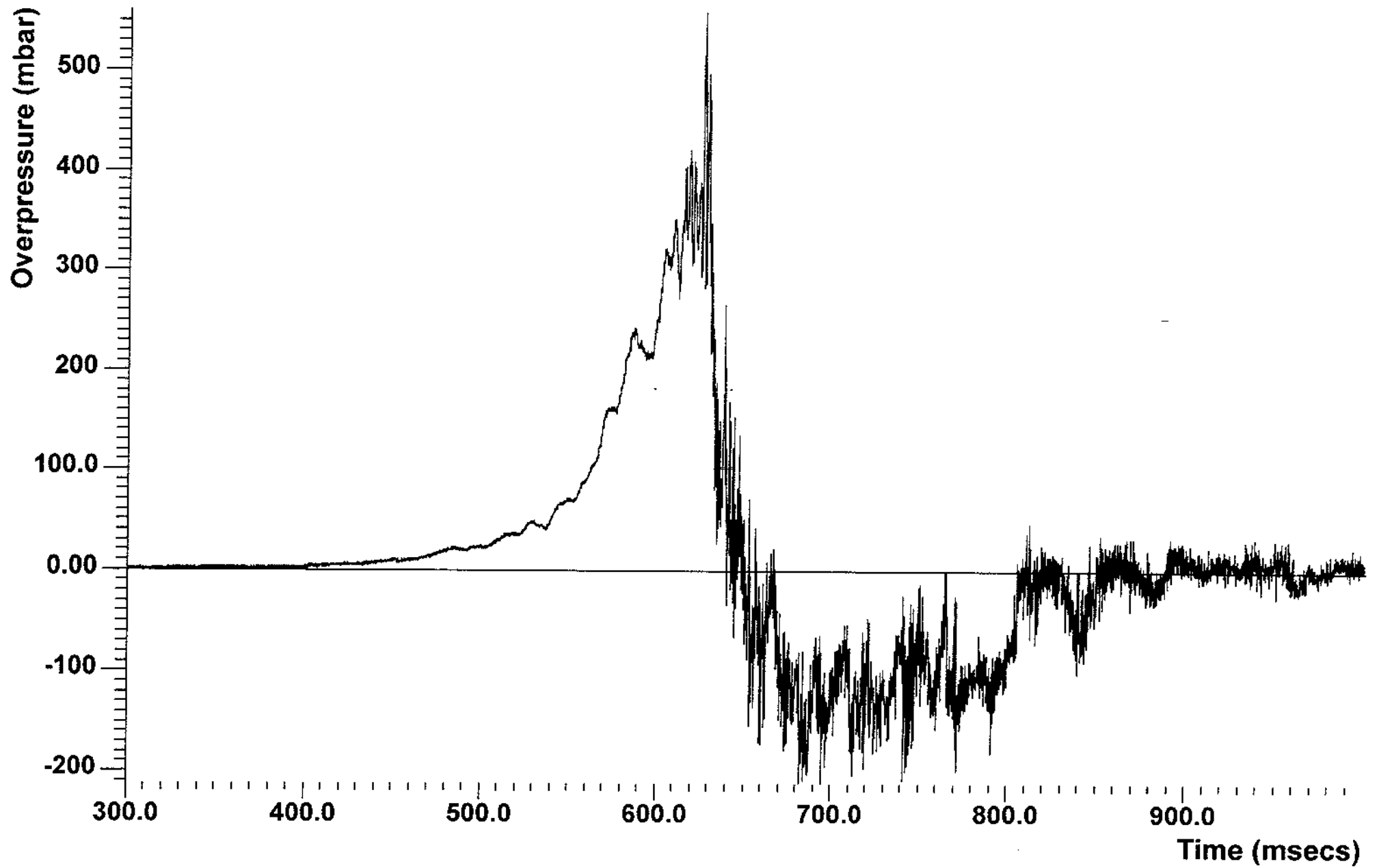
Test: HSE2 (01, C1, I2)  
Transducer no: PI-27



Test: HSE2 (01, C1, I2)  
Transducer no: PI-28

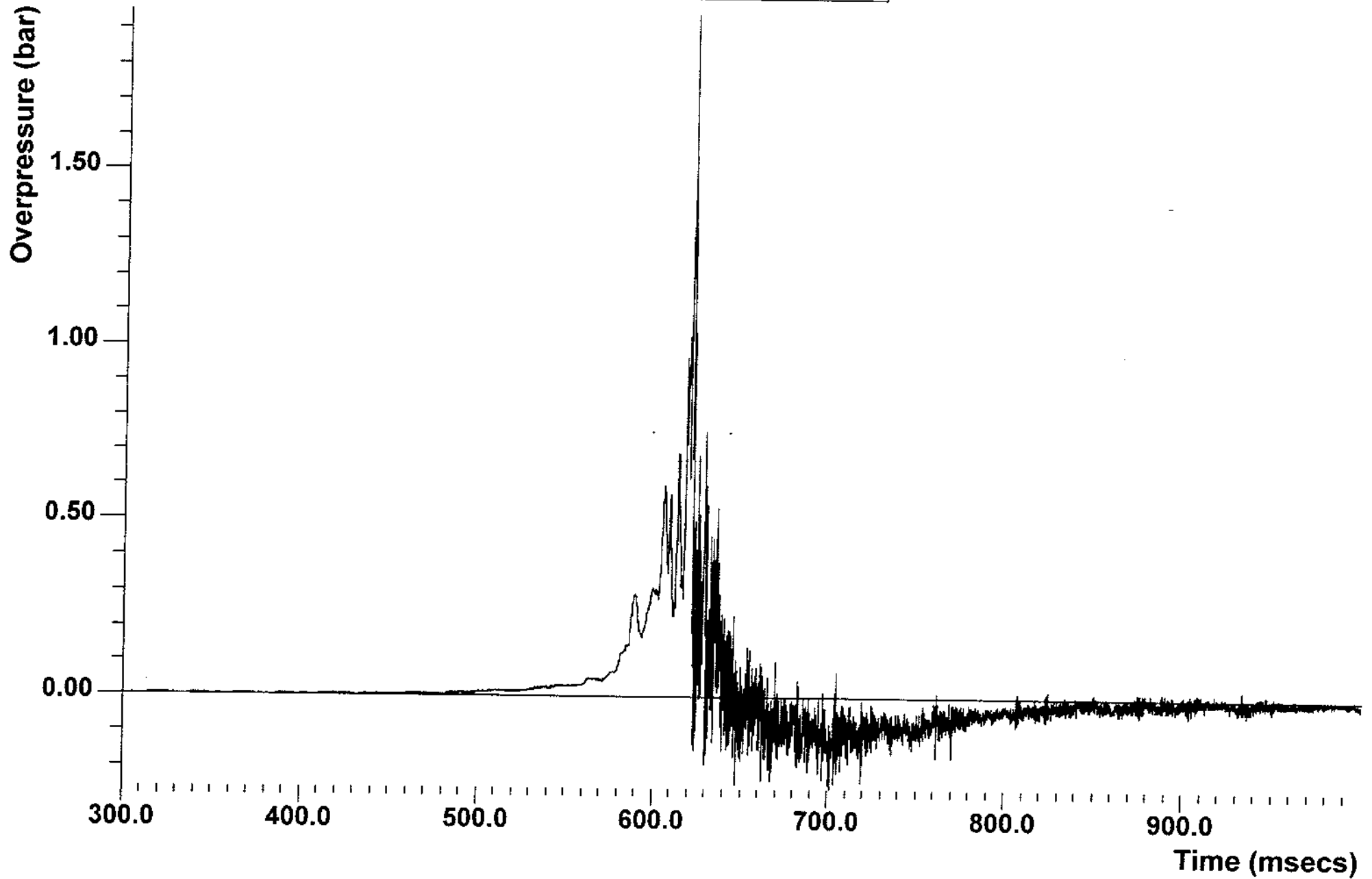


**Test: HSE2 (01, C1, I2)**  
**Transducer no: PI-29**

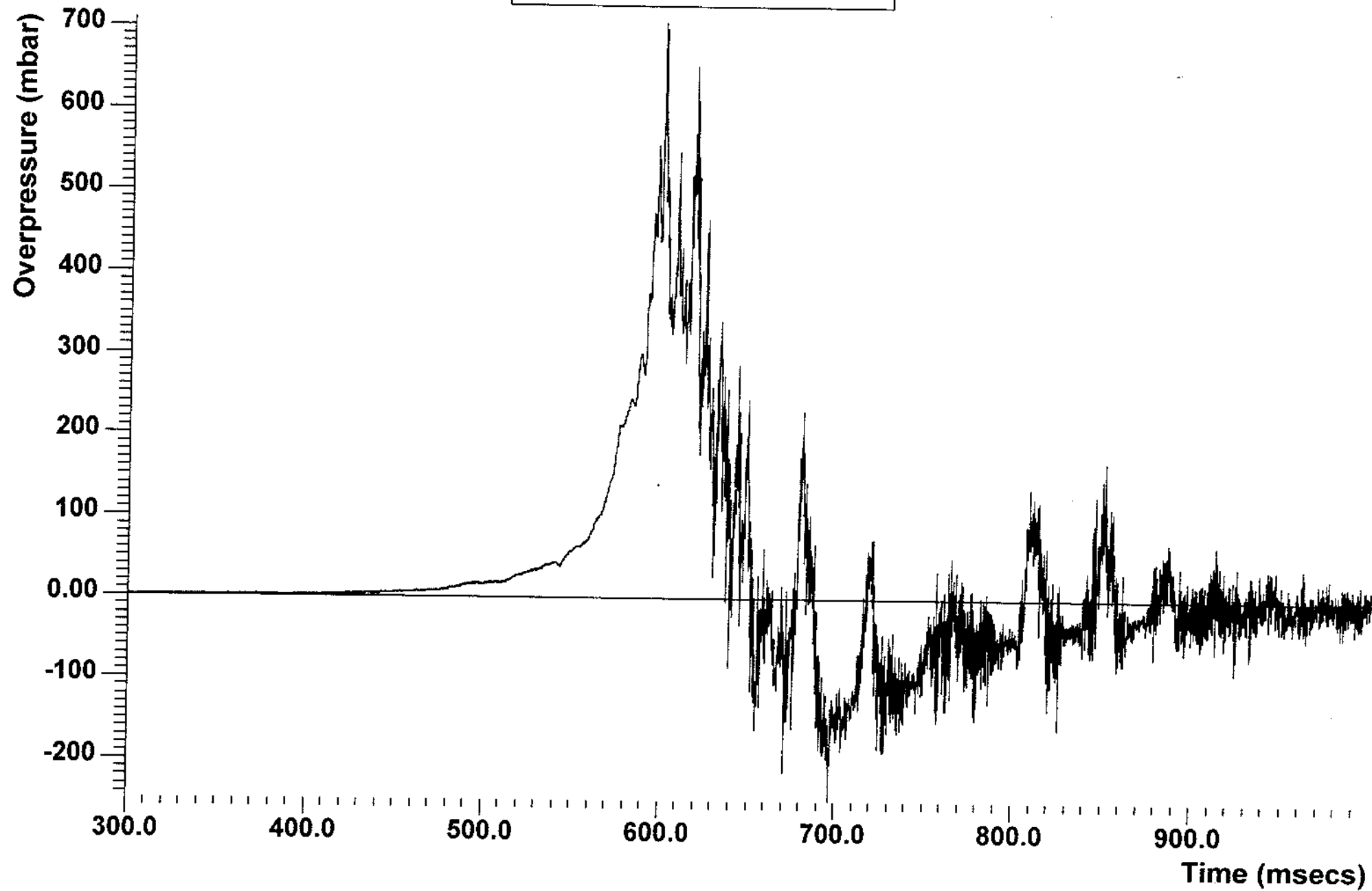




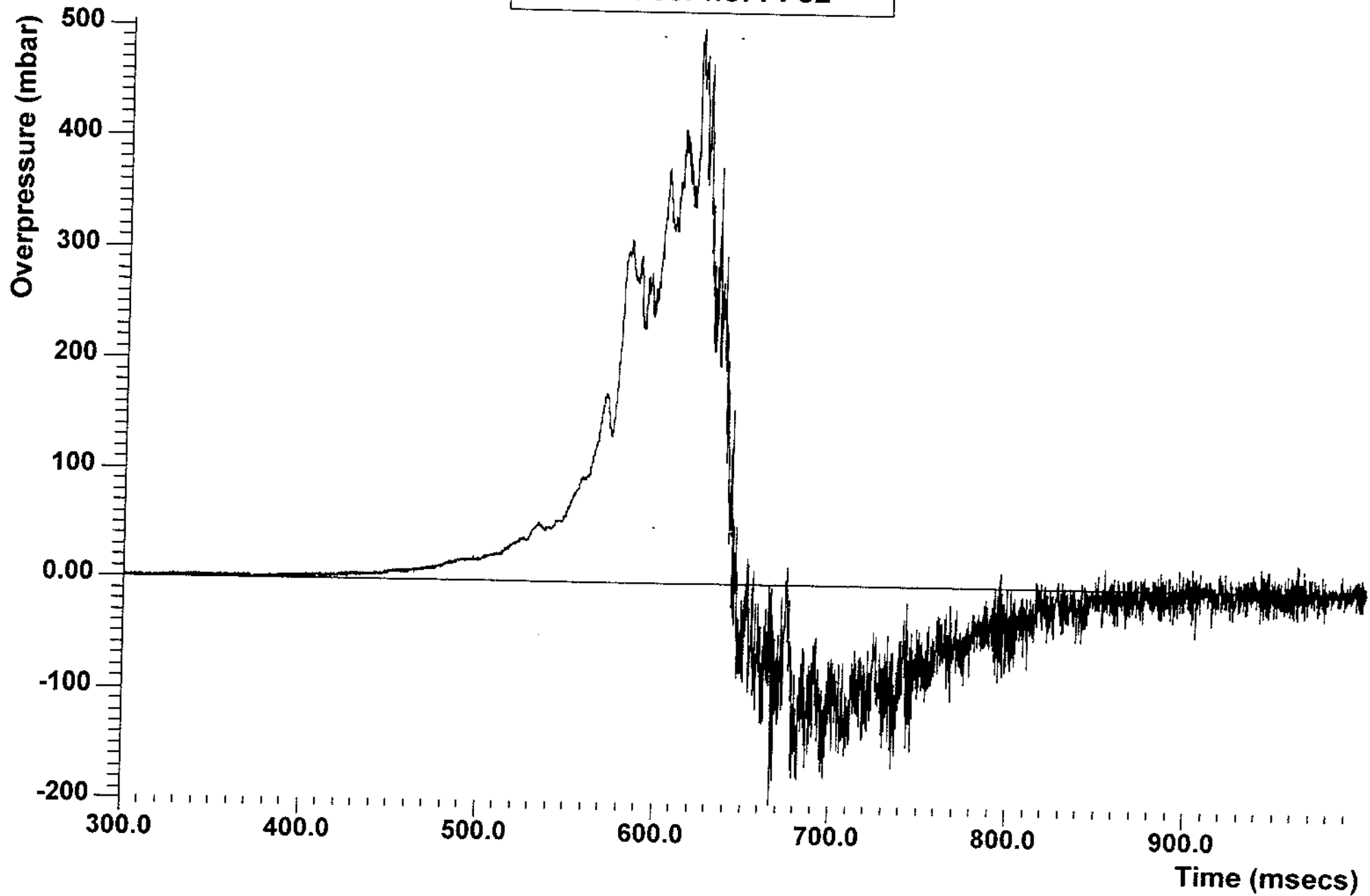
Test: HSE2 (01, C1, I2)  
Transducer no: PI-30



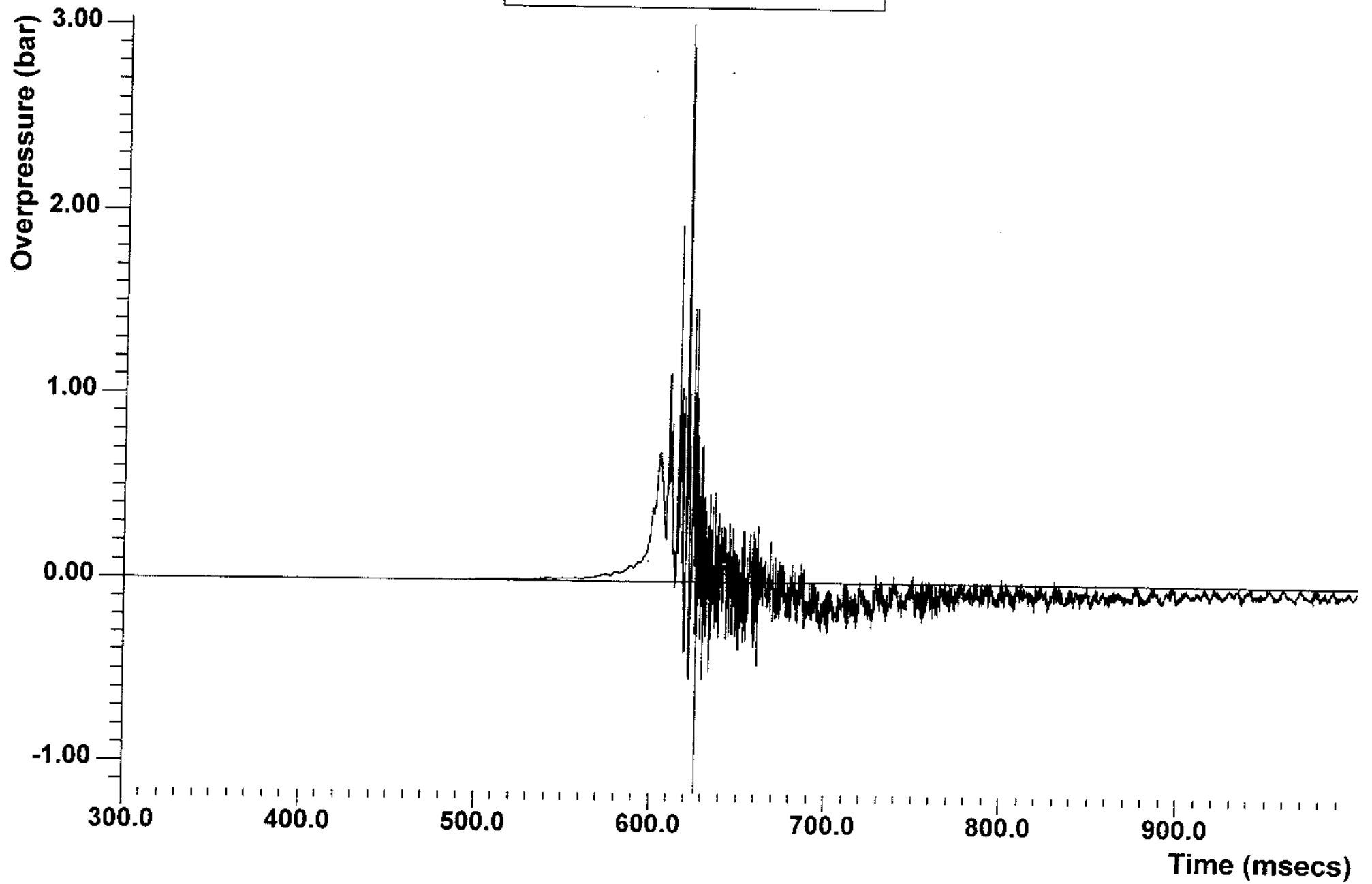
Test: HSE2 (01, C1, I2)  
Transducer no: PI-31



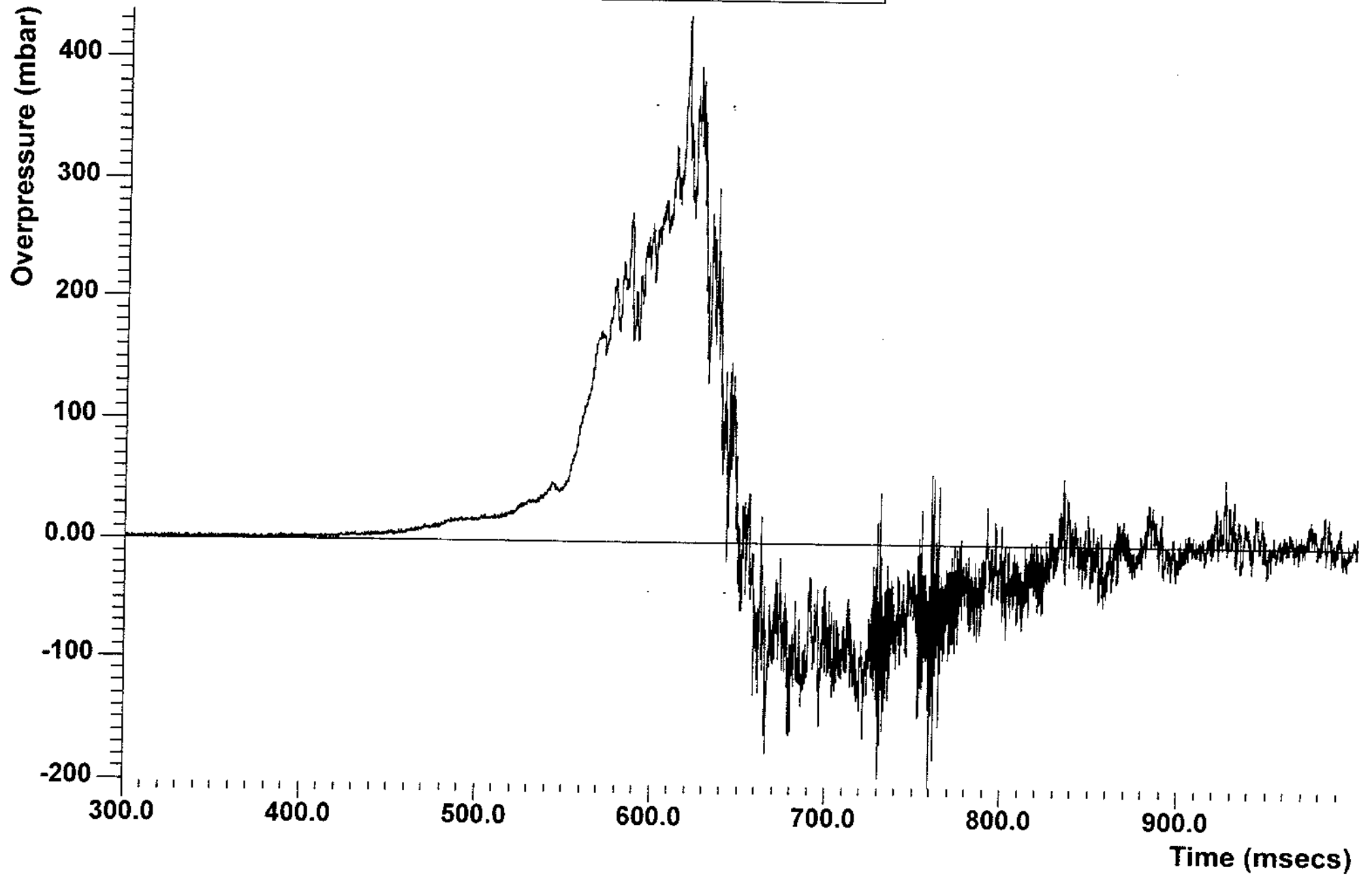
Test: HSE2 (01, C1, I2)  
Transducer no: PI-32



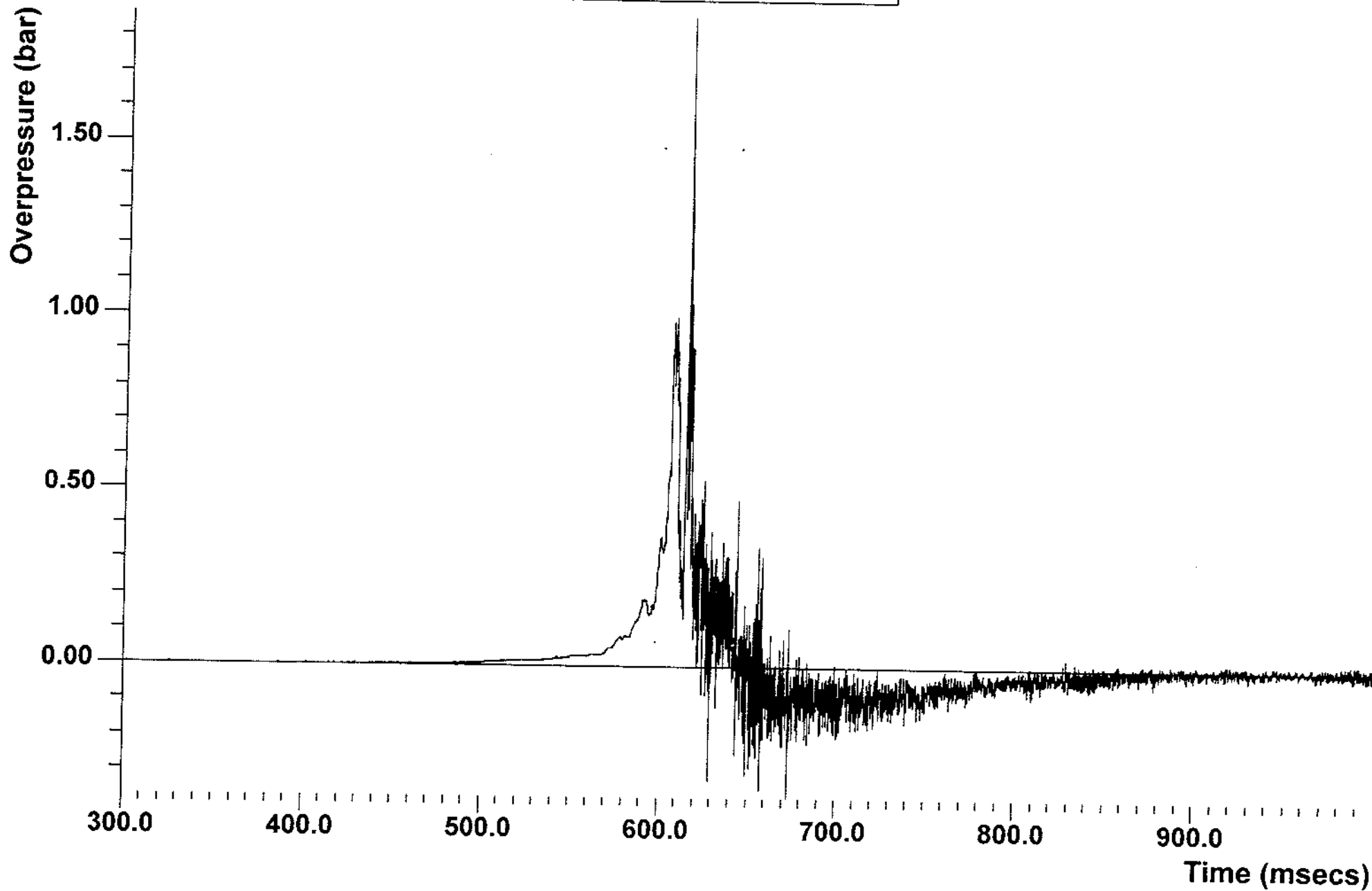
Test: HSE2 (01, C1, I2)  
Transducer no: PI-33



Test: HSE2 (01, C1, I2)  
Transducer no: PI-34

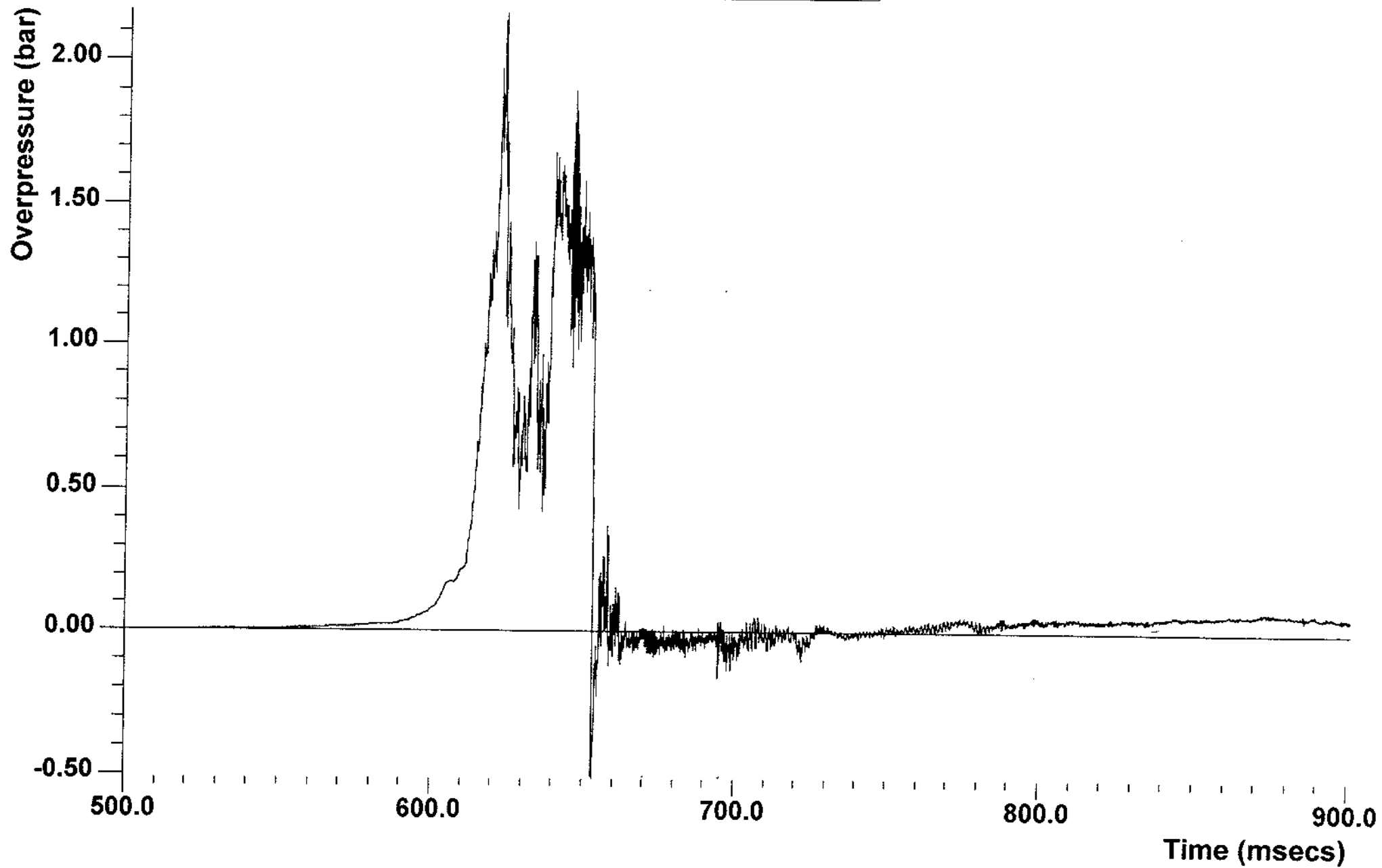


Test: HSE2 (01, C1, I2)  
Transducer no: PI-35



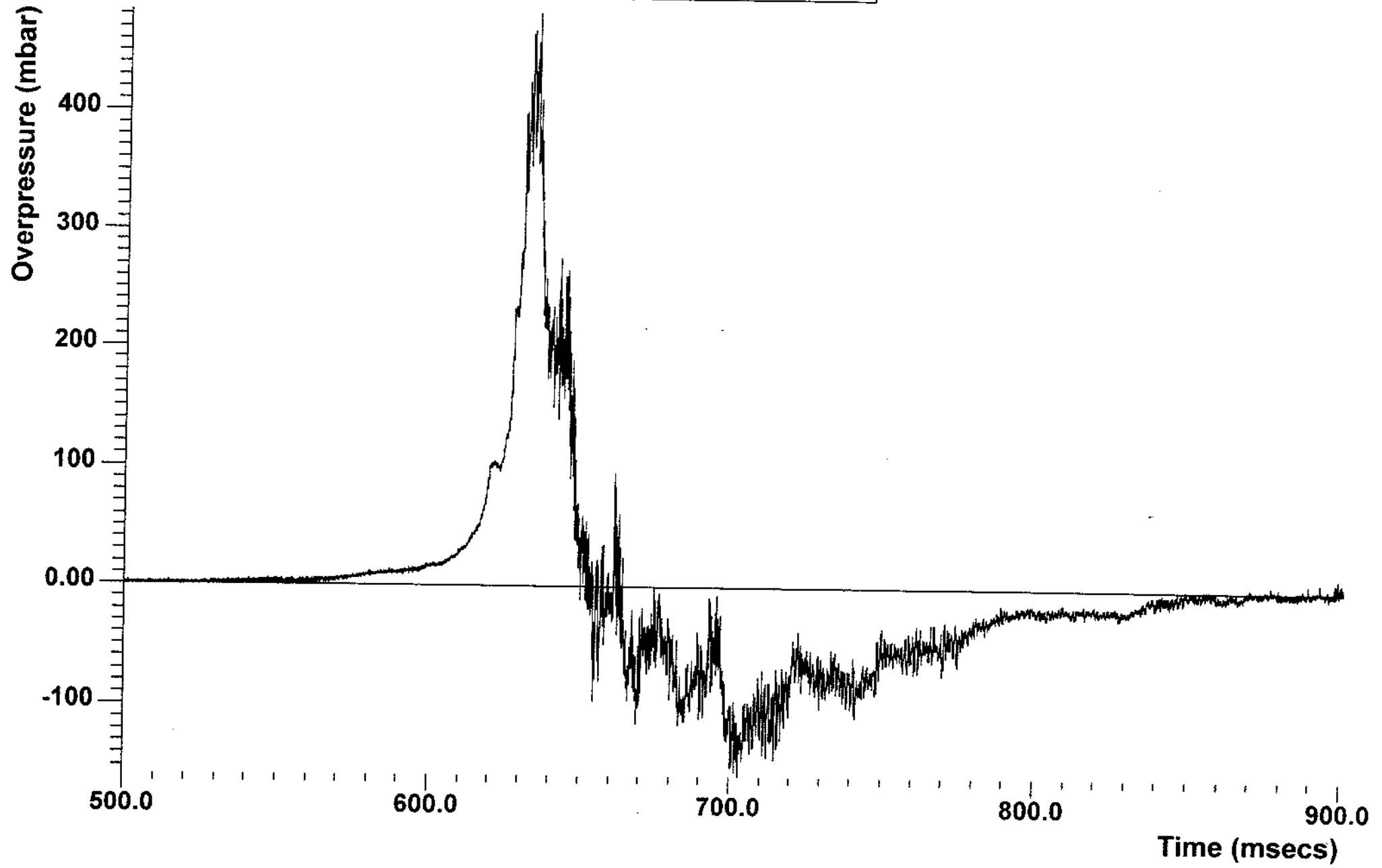
## **Appendix B: External Overpressure Profiles**

Test: HSE2 (01, C1, I2)  
Transducer no: PE-1

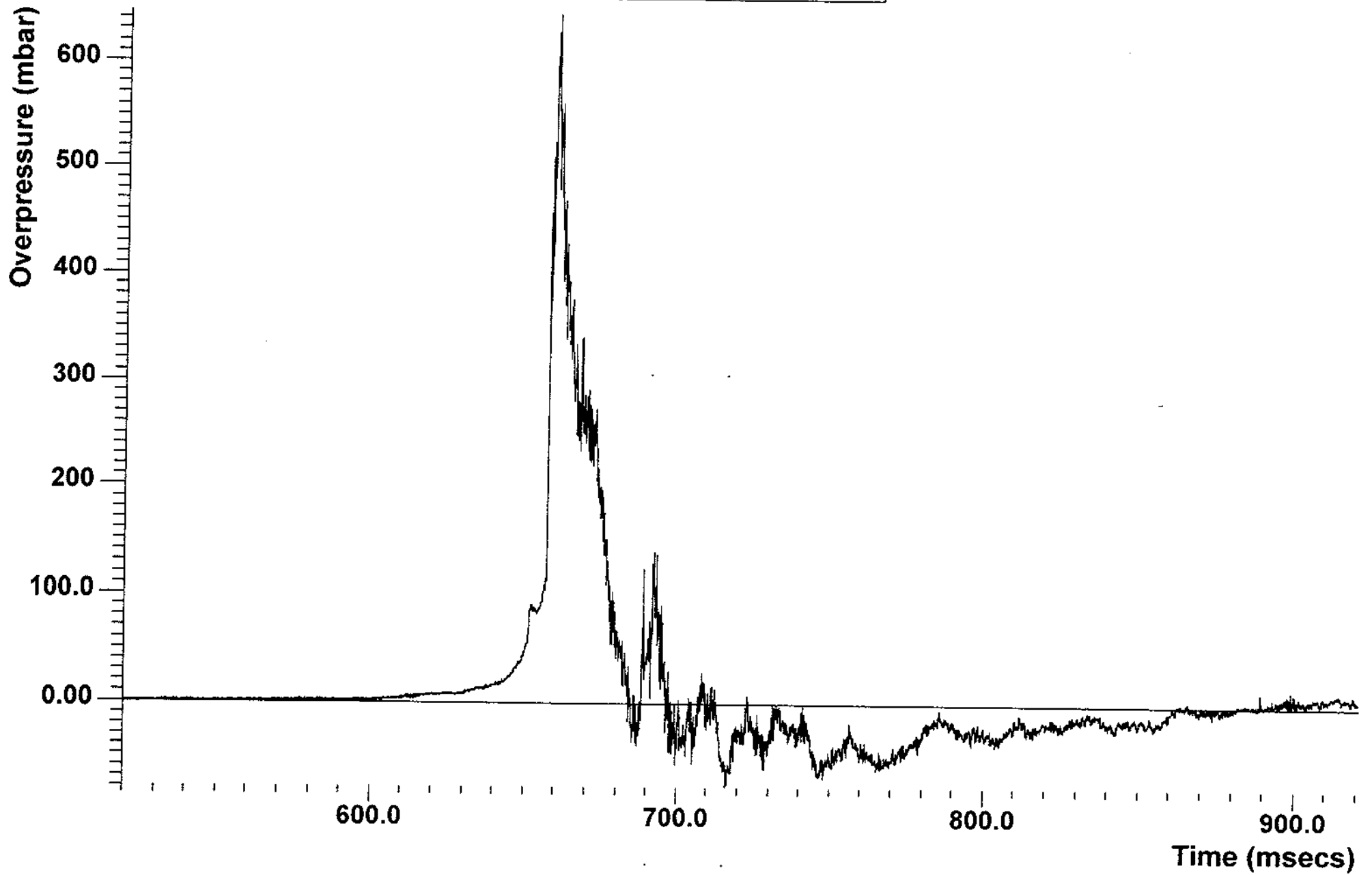




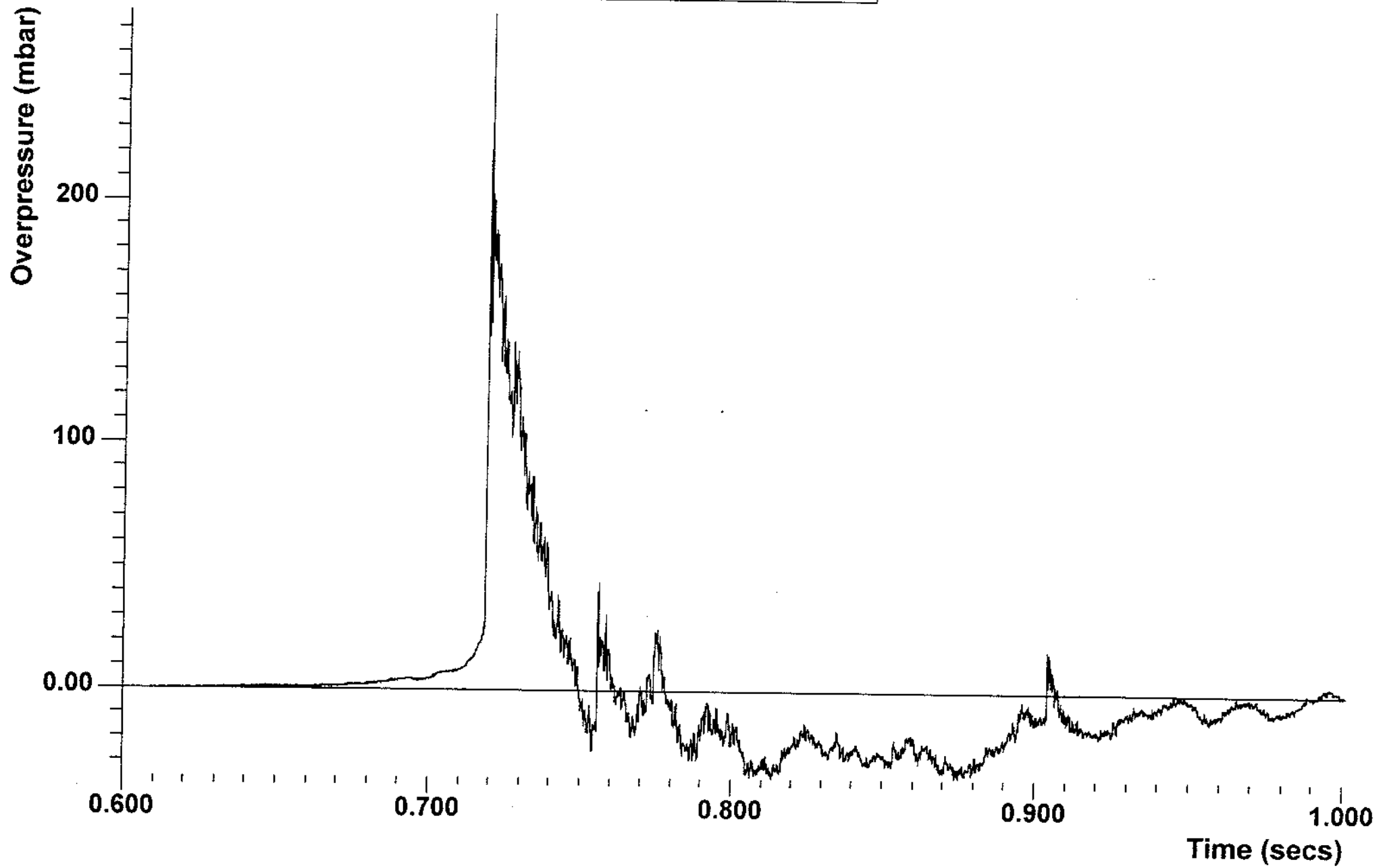
Test: HSE2 (01, C1, I2)  
Transducer no: PE-2



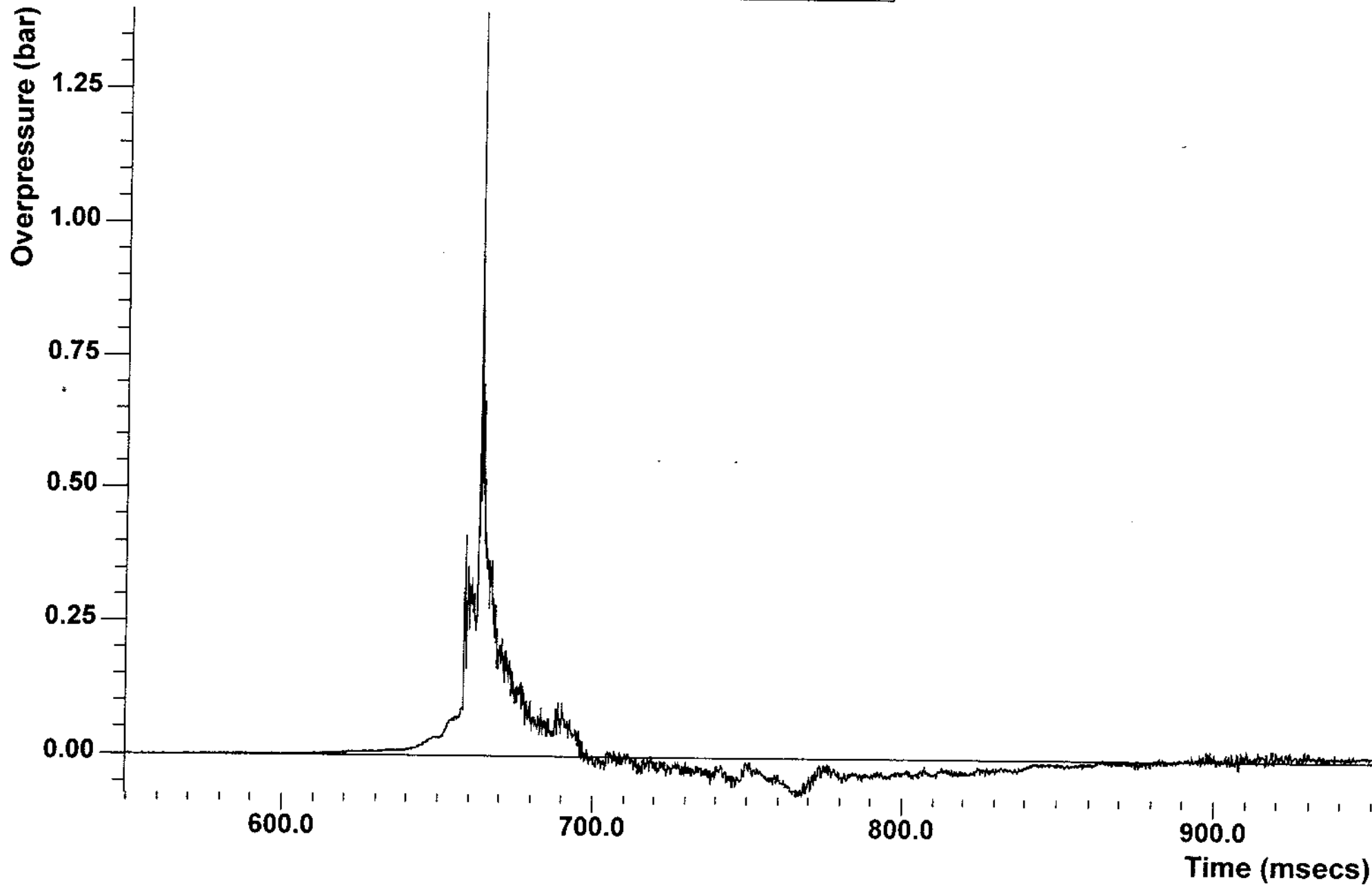
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PE-3**



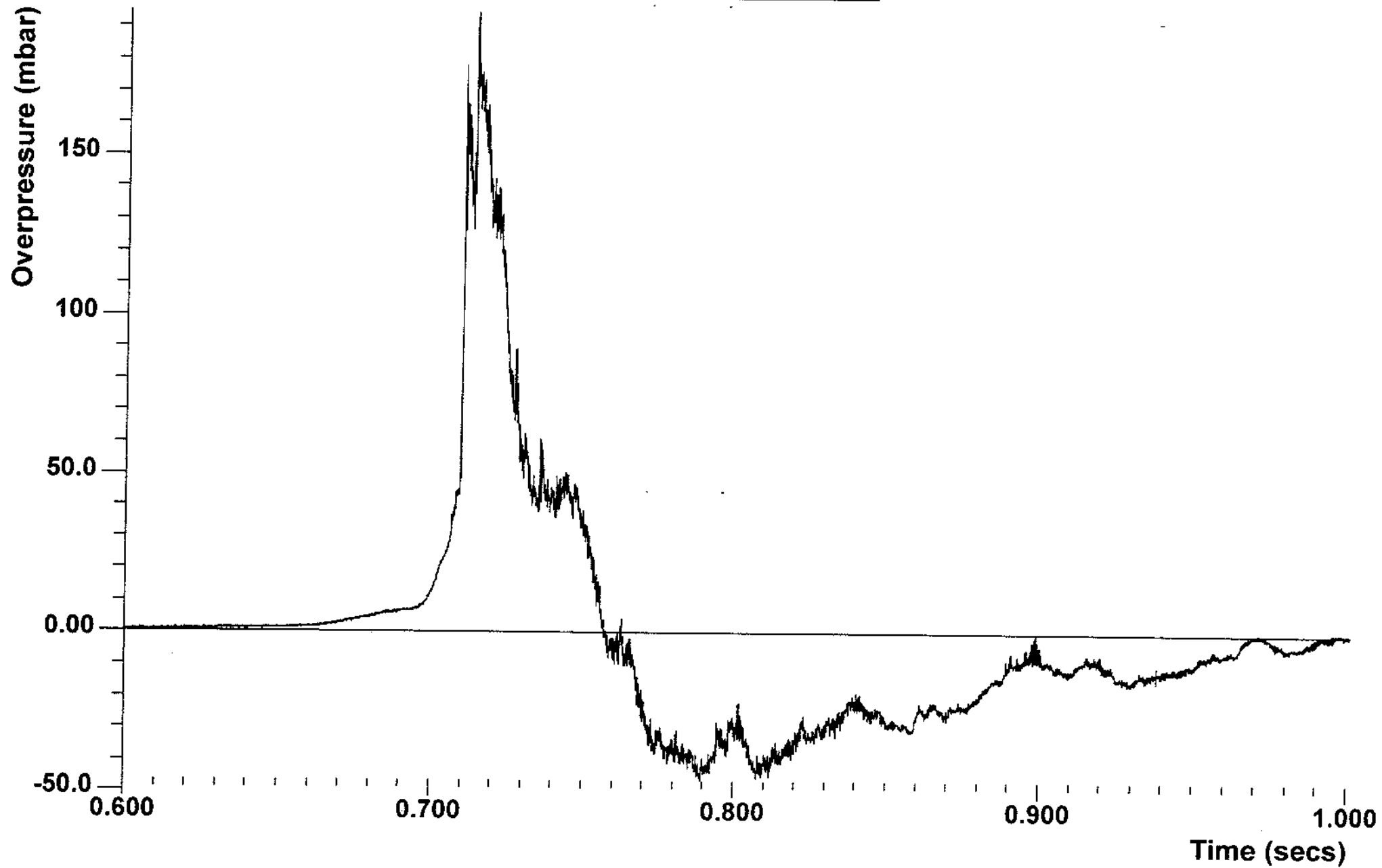
Test: HSE2 (01, C1, I2)  
Transducer no: PE-4



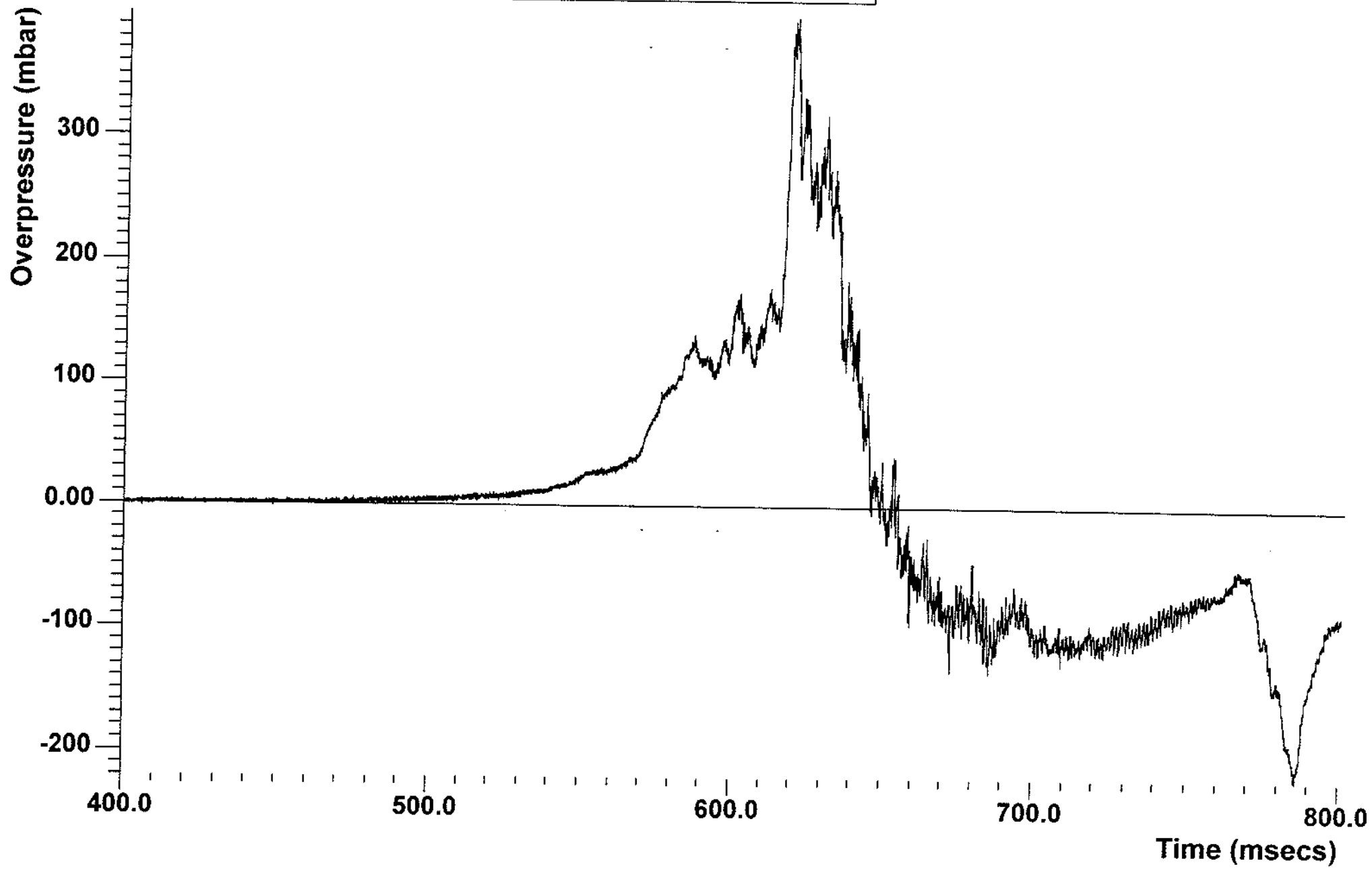
Test: HSE2 (01, C1, I2)  
Transducer no: PE-5



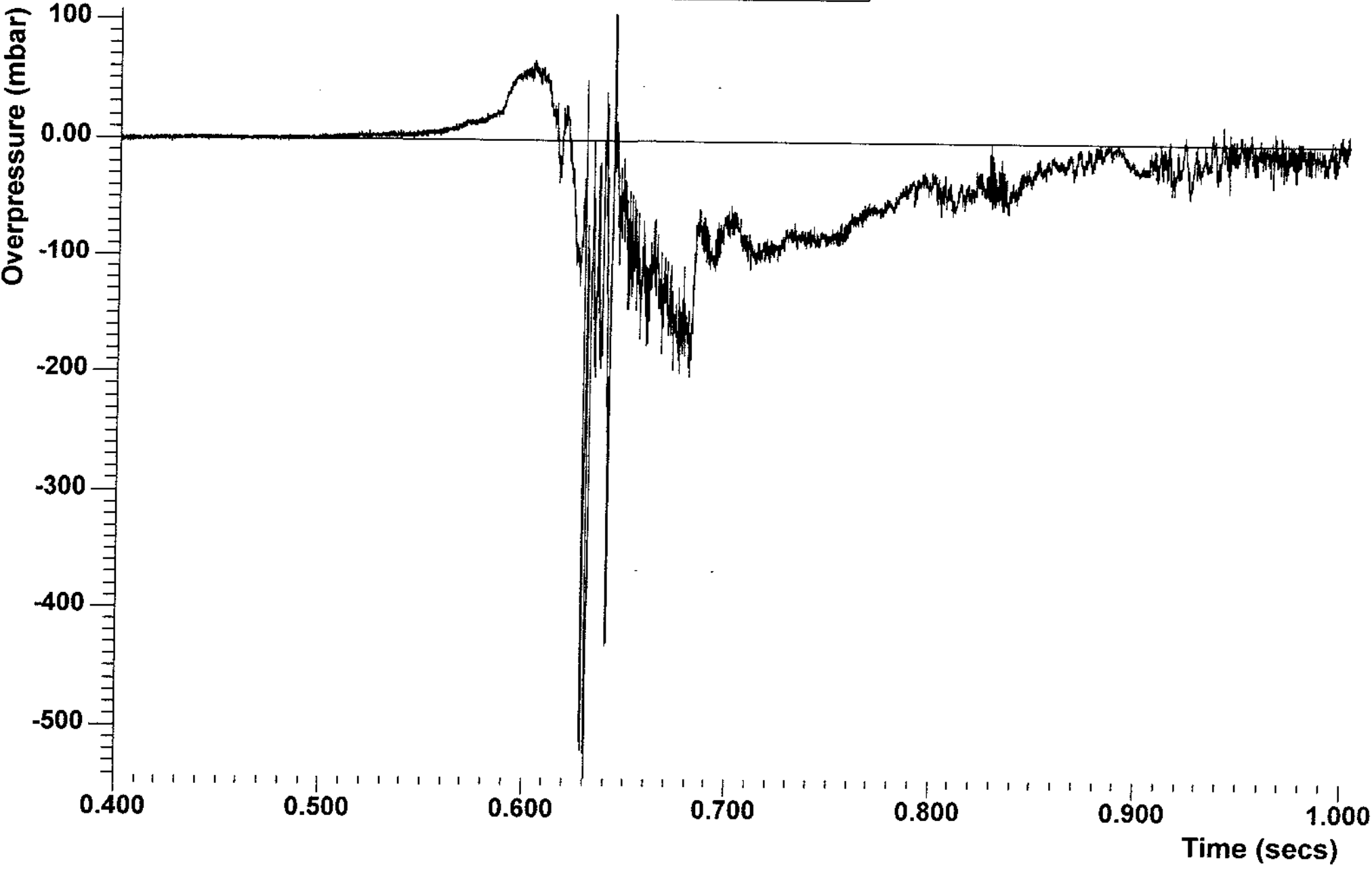
Test: HSE2 (01, C1, I2)  
Transducer no: PE-6



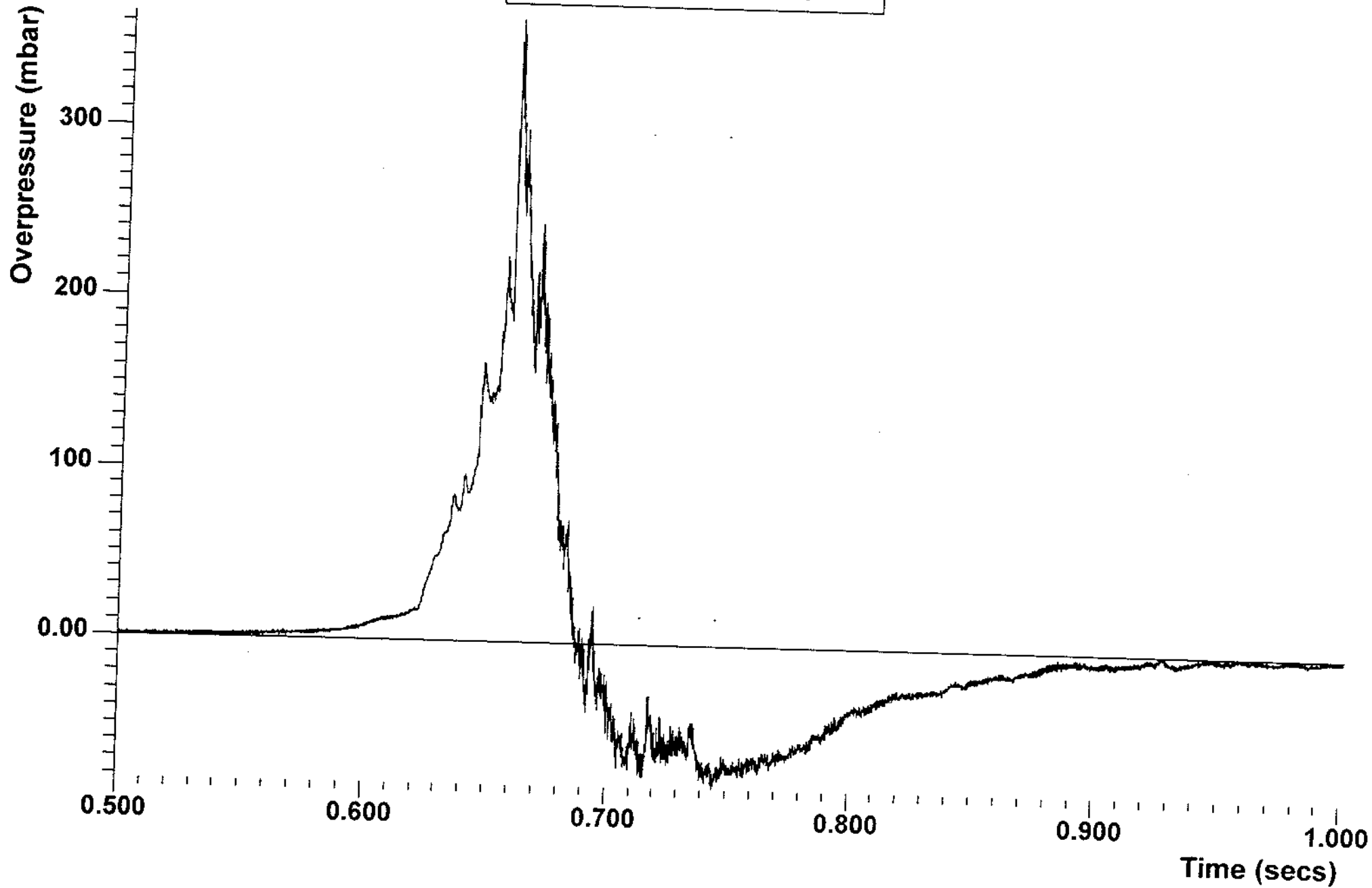
**Test: HSE2 (01, C1, I2)**  
**Transducer no: PE-7**



Test: HSE2 (01, C1, I2)  
Transducer no: PE-8

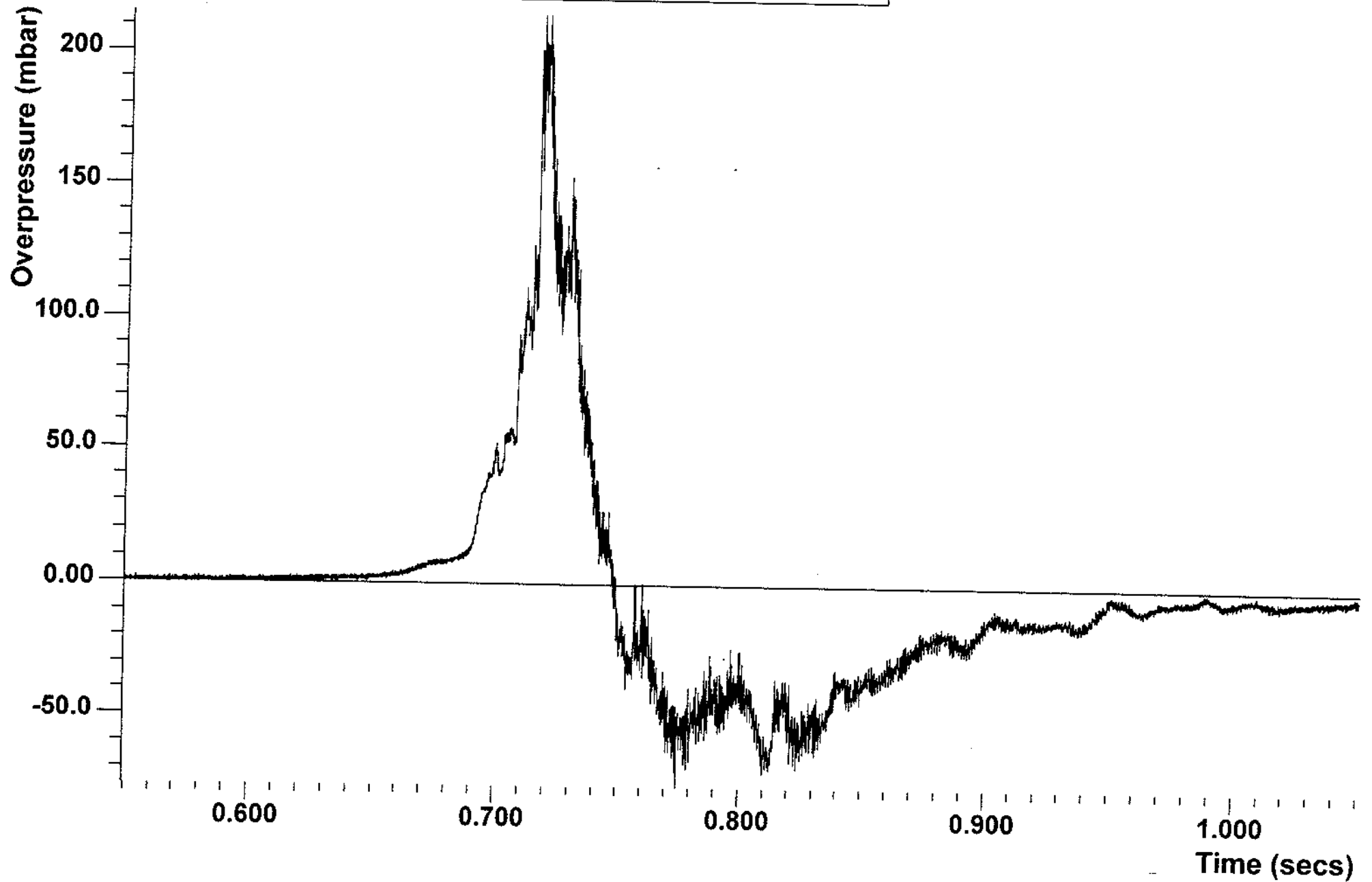


Test: HSE2 (01, C1, I2)  
Transducer no: PE-9





**Test: HSE2 (01, C1, I2)**  
**Transducer no: PE-10**



Test: HSE2 (01, C1, I2)  
Transducer no: PE-11

