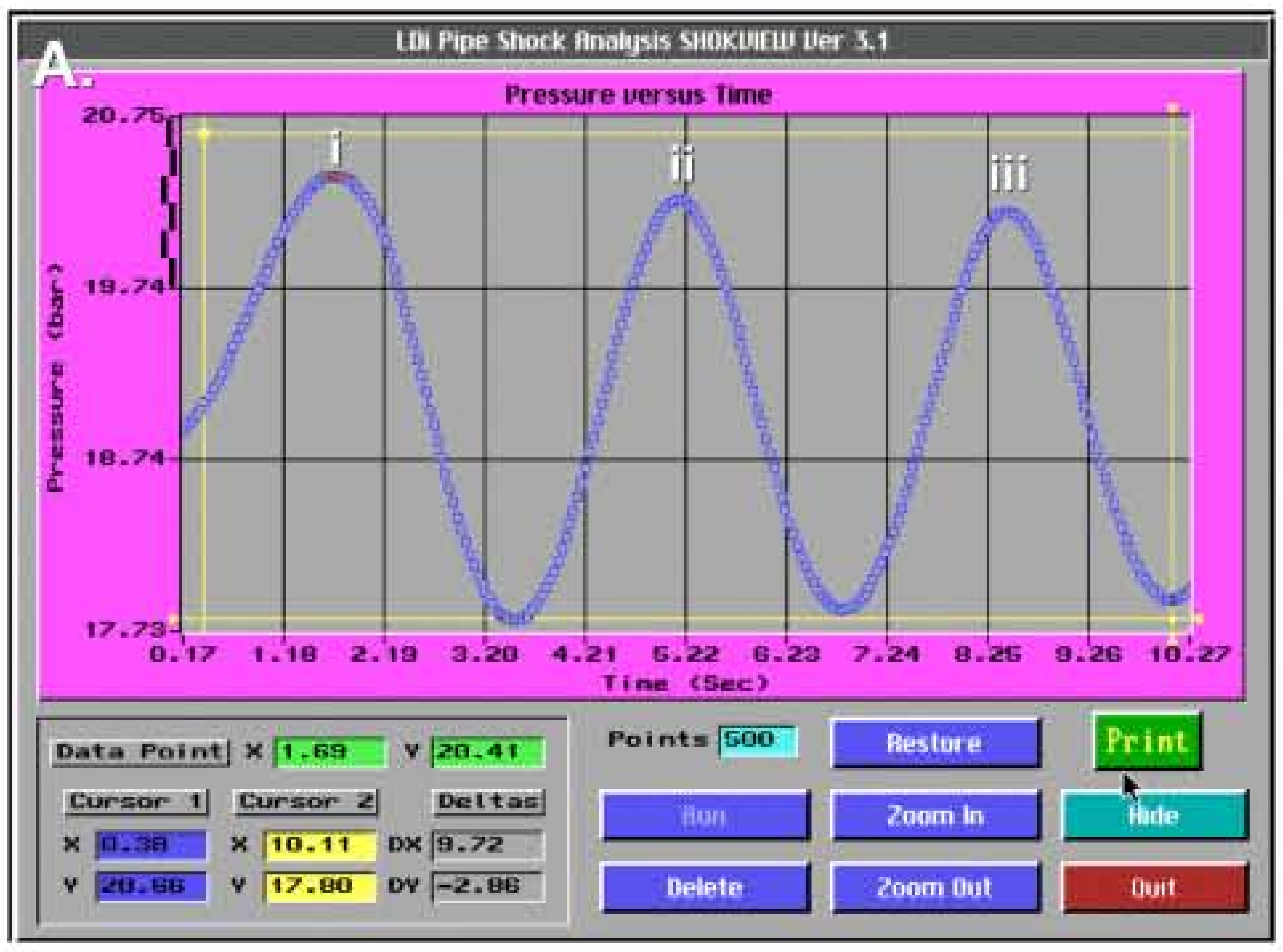
LDi-P27

Generally, it is far less expensive to determine the peak pressure level and the frequency for the system piping, by running the system in a software model compiled in *LDi ShockView* for you, than to drill & tap holes for transducers, add an oscillograph, & or data capture the problem.



NOTE:- **Money is only saved by "modelling" when the input data is correct. Otherwise "garbage in - garbage out".**

Some important facts that may be overlooked are:

The elasticity of the pipe wall and the compressibility of the liquid govern the height of the pressure spike and the time taken for the wave to travel and return. Therefor these two figures --"elastic modulus of the pipe & the bulk modulus of the liquid"--are vital figures.

For a soft garden hose the speed of the wave will be down to about Mach1- say 700 m.p.h.-OR-for a very strong heavy wall iron pipe and the most incompressible liquid at low temperature say- 3250 m.p.h.

Hut highly volatile hydro-carbons may have a bulk modulus of 300e-5. Retrigerants and Ammonia can be even more compressible. Generally speaking the chemical engineer will be able to supply the right figure to you because he has it for calculating mass transfer and reactions.

The effective modulus controls the wave speed which controls the frequency of reverberation.

Time: The time taken for a valve to close, or pump to start-up is ultra important; see the "VERIFICATION" plot bottom right.

Smaller pipes-higher flow velocity, gives more dissipation so that the shock is reduced before it rebounds.

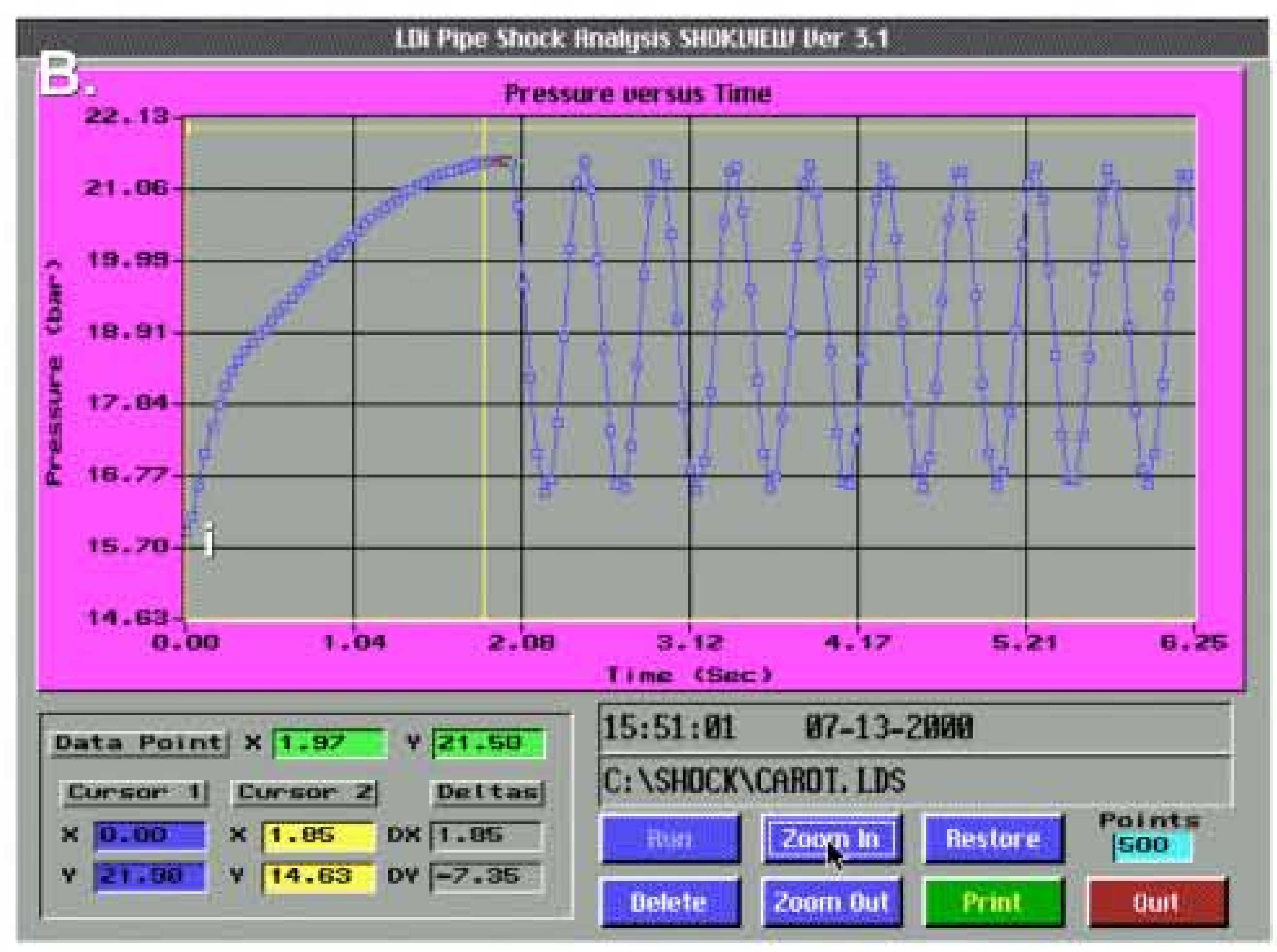
Accuracy of SHOCKVIEW depends on data accuracy - page 28.

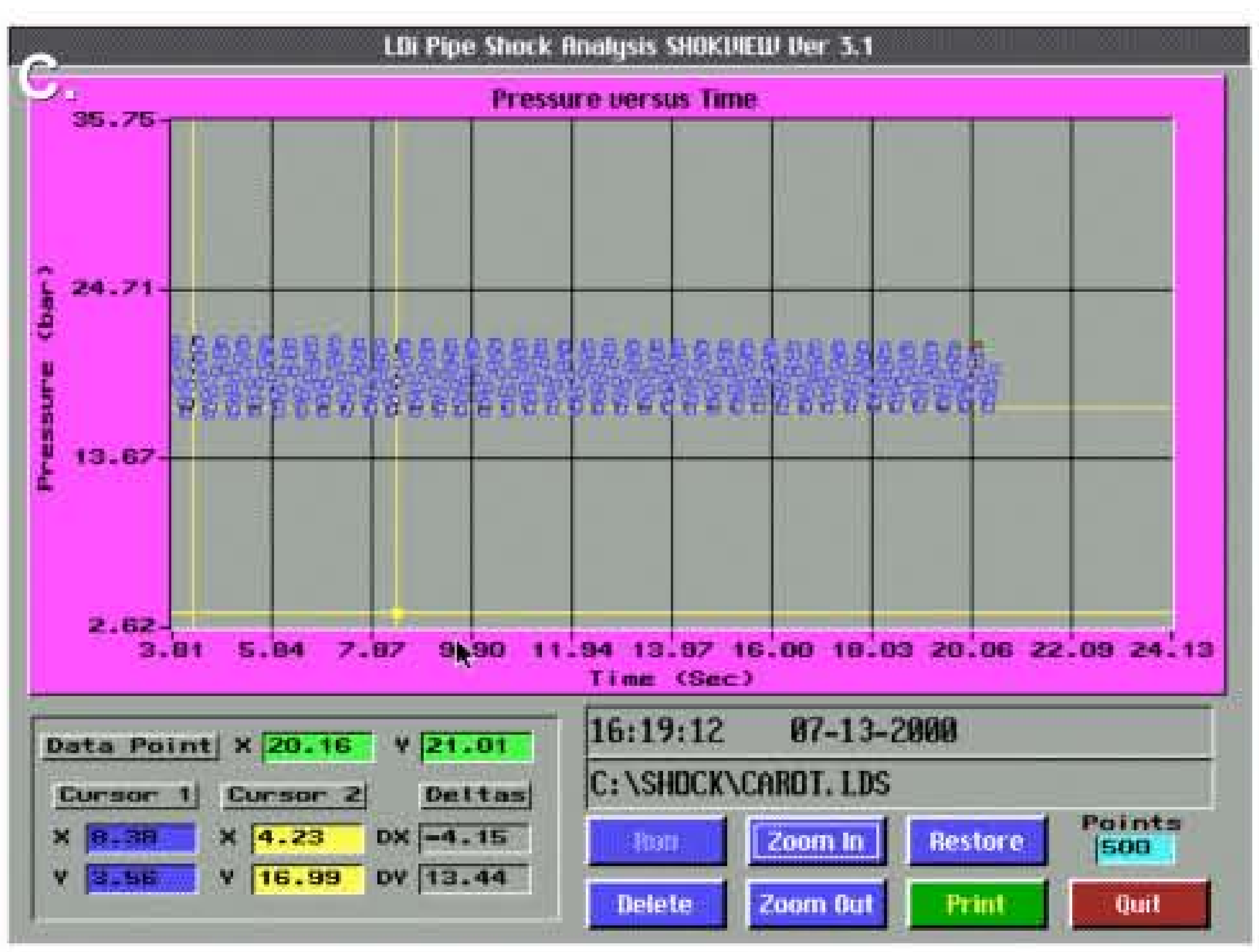
Example *ShockView* output plots A, B, & C show :

A. **In the time between i - ii & ii - iii which is 3.5 seconds for this long pipe, the pressure wave dissipation by rotary flow against the pipe wall, is only 2.5 psi.**
This warns of potential danger, that this system could easily become an amplifier. The pipe is oversized for the flow rate.

B. **A 2 second pump start-up, 19 bar (275psi) 150# system makes ± 39 psi shock at 2.43 Hertz.**
We also see first point "i" at 15.9 bar. This means that the total pressure drop for the system is 3.1 bar, or 45 psi.

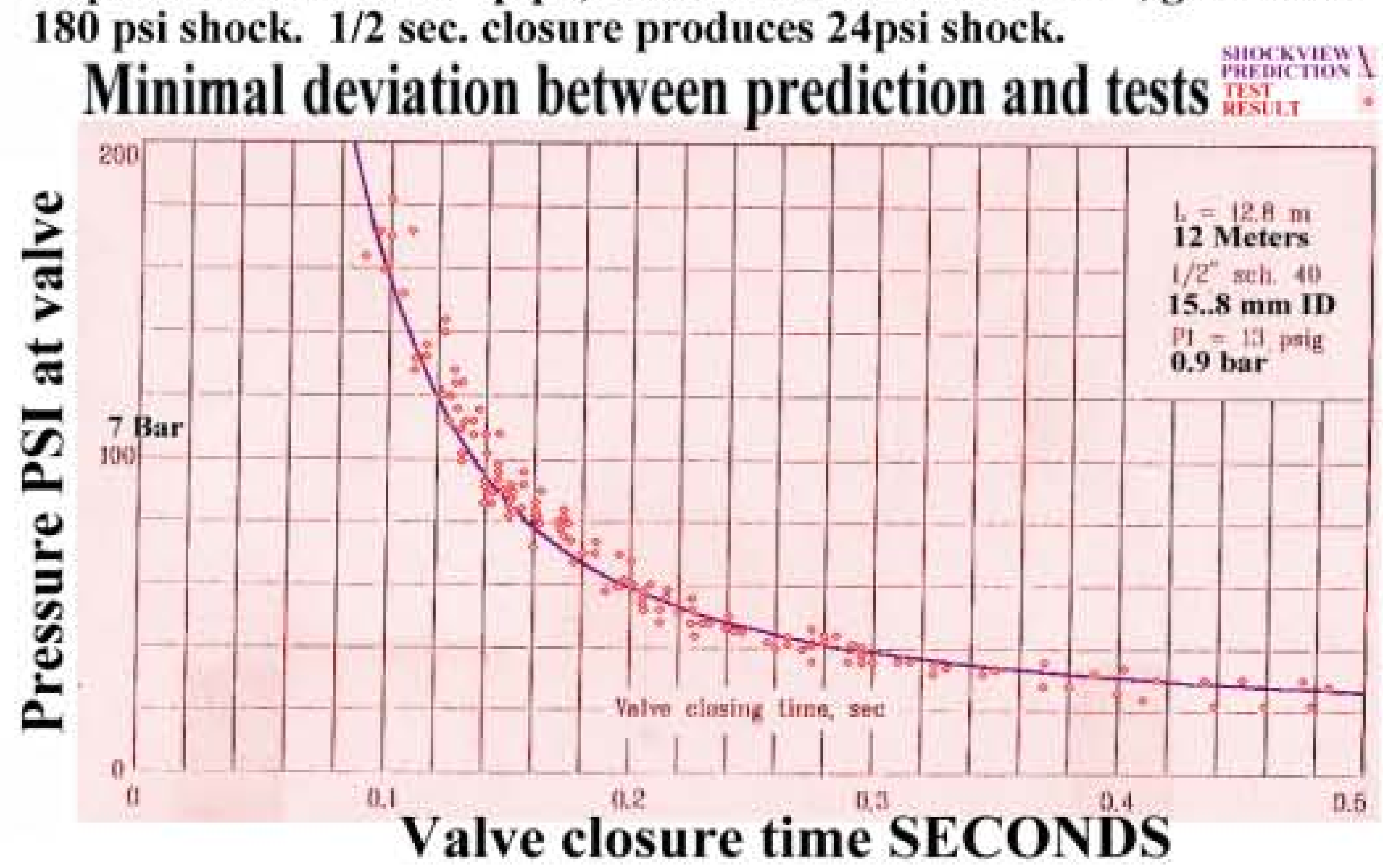
C. **The time chosen to run this model was a total of 21 seconds. At the end of this time, the peak has only degenerated down to 21 bar (305 psi). The shock wave has travelled the length of the pipe and back 44 times (at at 2.1 Hz.) and is resonating.**





VERIFICATION of *SHOCKVIEW* ACCURACY

13 psi in 39 feet of 1/2" pipe, 1/10th second valve closure, generates 180 psi shock. 1/2 sec. closure produces 24psi shock.



Other tests were performed on 3 diameters of 2 pipe materials in 10 lengths & 3 closure times.

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