

# PULS

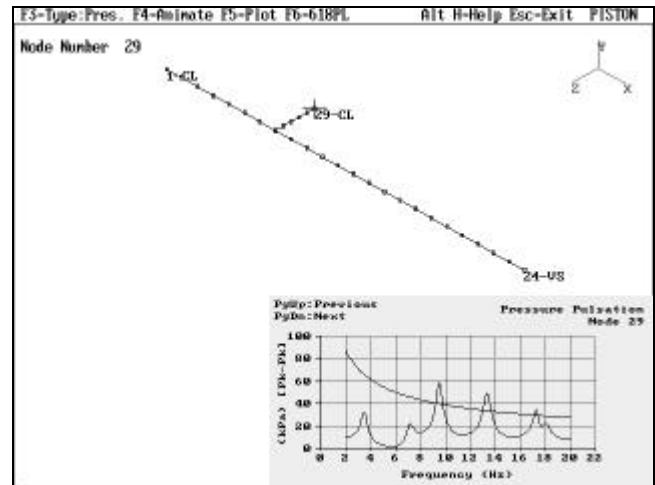
## Piping Pulsation Analysis Software

PULS is an interactive simulation program for the dynamic response analysis of fluid flow under steady state pulsating flow conditions in piping networks. PULS is based on one-dimensional plane wave theory, and employs an efficient transfer matrix approach.

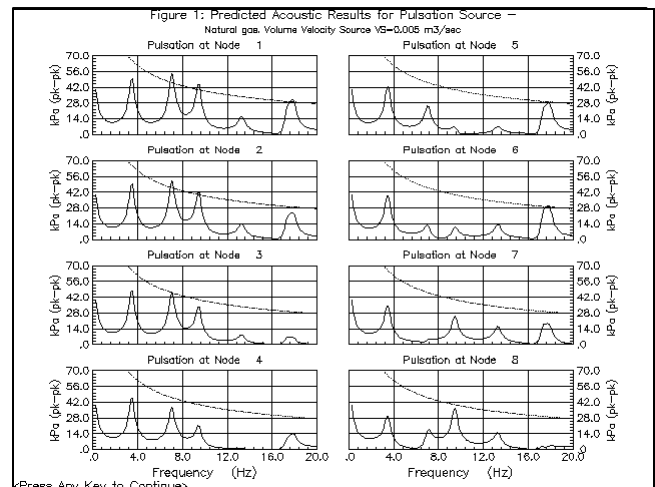
PULS is ideal for predicting pressure pulsation levels and acoustic shaking forces. The program may be used for solving performance problems caused by reciprocating equipment or flow generated sources in piping and pipeline systems, and in compressor, pump, control valve, and meter stations. Unlike older analog computing methods, PULS provides a state-of-the-art digital solution. The technology is based on methods developed and proven under a multi-million dollar research program at Nova Corporation of Alberta.

### Benefits

- Easy to use, menu driven PC program
- Save on expensive consulting fees
- Reciprocating compressor and pump boundary conditions
- Fast transfer matrix solution gives the results in less than a minute compared to several hours using time domain methods
- Ability to check pulsations against API 618 guidelines
- Ability to predict and eliminate problems at the design stage
- Model archiving for 'what-if' analysis in retrofit work
- Flow induced vibrations
- Ability to import models from AutoCAD® based AutoPLANT® software, and from AutoPIPE® pipe stress analysis program
- Ideal for troubleshooting vibration problems, and for acoustic filter design
- Ability to model both gas and liquid systems
- Automatic generation of gas properties for common natural gas mixtures
- Pulsation sources include pressure, volume flow velocity, orifice plate, ball or globe valve, reciprocating compressor, and reciprocating pump
- Elements include pipes, volume, pressure drop, tees, orifice plates and valves. Pipe elements include damping due to viscous, thermal, and frictional effects



*PULS' powerful interactive plots allow easy access to frequency plots or PV cards at any point in the system.*



*PULS' batch reports produce results of pulsation levels and shaking forces to include in project reports.*

# PULS — Piping Pulsation Analysis Software

## Easy to Use

PULS has a sophisticated user-friendly menu driven interface for quickly developing system models while minimizing data entry. Model verification is rapid via extensive graphics that highlight model features at any point in the model building process. PULS performs consistency checks to identify errors, and supports English (Imperial) or SI units. Customized units can also be specified.

## PULS Piping System Model

Nodes defining system geometry are assigned with inter-connecting elements. The elements include components such as pipes, tees, reducers, valves, and orifice plates. Element transfer matrices are integrated into an overall system matrix composed of linear equations with complex coefficients and variables. The variables include RMS values of pulsating pressure and volume flow velocity at each node. A sparse variant of Gaussian elimination for the solution of unsymmetrical equations solves for the results. The transfer matrices are based on a comprehensive body of semi-empirical equations and data acquired through a rigorous, experimental testing program conducted at the Nova facilities and the University of Calgary. Gas properties are calculated using Benedict-Webb-Rubin-Starling (BWRS), Soave-Redlich-Kwong (SRK), or Peng-Robinson (PR) equations of state. PULS also accepts user-defined fluid properties.

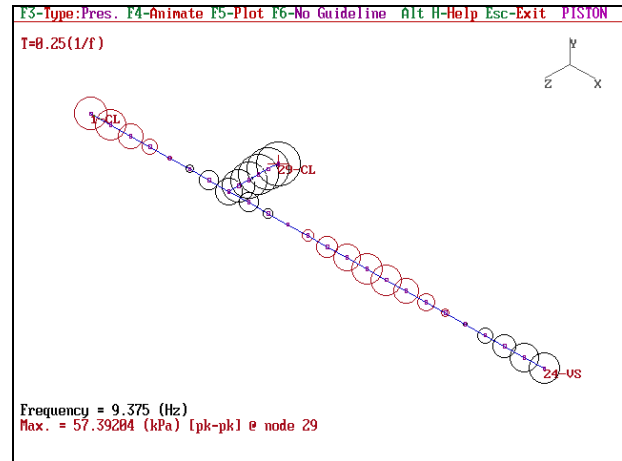
## Post Processing

PULS provides both batch output and interactive plotting in which the acoustic resonance shapes can be animated. Key results include: pulsation ratios based on API 618 guidelines, spectral plots of pulsation pressures, volume flow velocities, impedance, shaking forces, and cylinder pressure-volume trace card (PV card). Shaking forces can be automatically transferred into AutoPIPE in order to calculate dynamic piping responses.

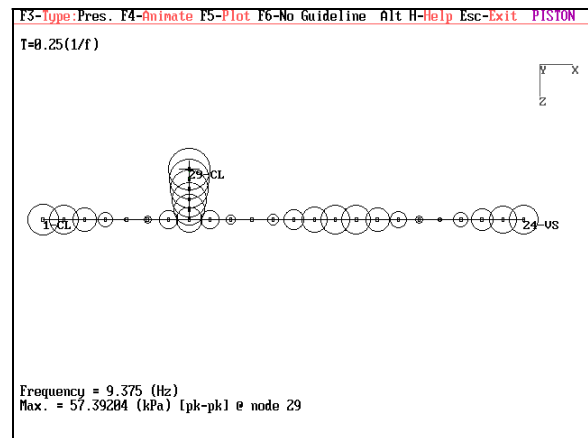
## Platforms and Versions

PULS runs as a DOS shell under Windows 3.1x, Windows NT, or Windows 95.

*Experience this software application first hand.  
Call (925) 933 2525 for a free demonstration copy of PULS pulsation analysis software, or visit our World Wide Web site at <http://www.rebis.com> for more information.*



*PULS acoustic mode shape and results display allow visualization of system characteristics to help in system modification for pulsation reduction.*



*PULS PV card plots help design systems with the highest efficiency.*