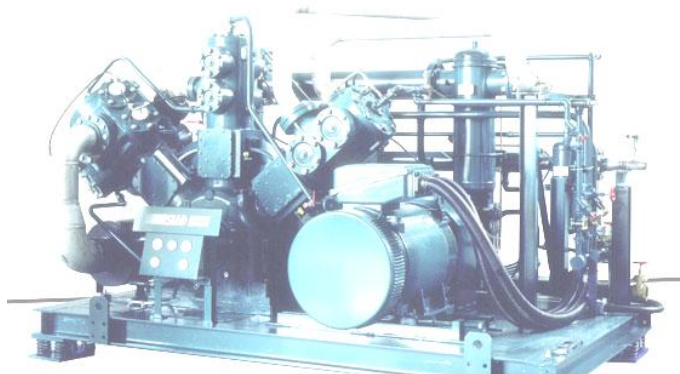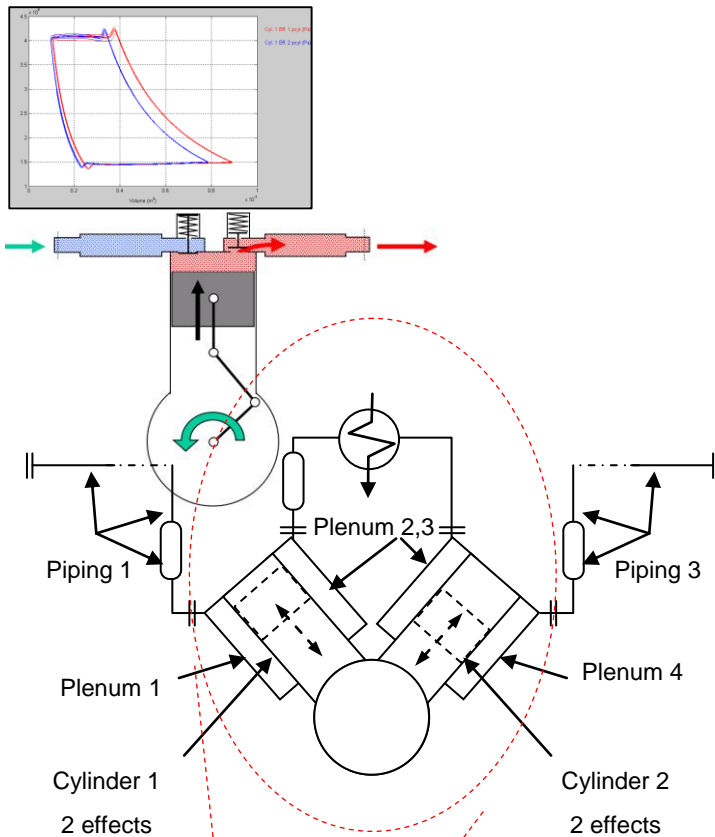# ACUSCOMP™

A PROGRAM FOR THE SIMULATION OF RECIPs CYCLES, PRESSURE PULSATIONS AND TRANSIENTS IN PIPING & PLANTS

OVERVIEW

The response of a general piping system to predefined disturbance signals, generated at any interface with the gas flow, can be analysed through a linear model, allowing transfer function and forces analysis to focus the intrinsic piping response and flow resonance attitude in the frequency and time domain. This approach, which is covered by the S.A.T.E. product ACUSYS, is possible only if the signals (either in terms of pressure or mass flow rate) can be either calculated or known in advance, based on preliminary analyses of the generating source.

However, stringent rules such as API 618 require that the interaction between the machine thermodynamics, the valves mechanics and the fluid exchange process are taken into account together with the piping flow dynamics.

To fulfil this requirement the time domain non-linear modelling of the entire system, including cylinder thermodynamics, suction and discharge valves and piping, connected to the compressor has to be performed.

ACUSCOMP is a PC based simulation software, which helps analysing these situations and provides the designer quantitative information to complete the plant's design.
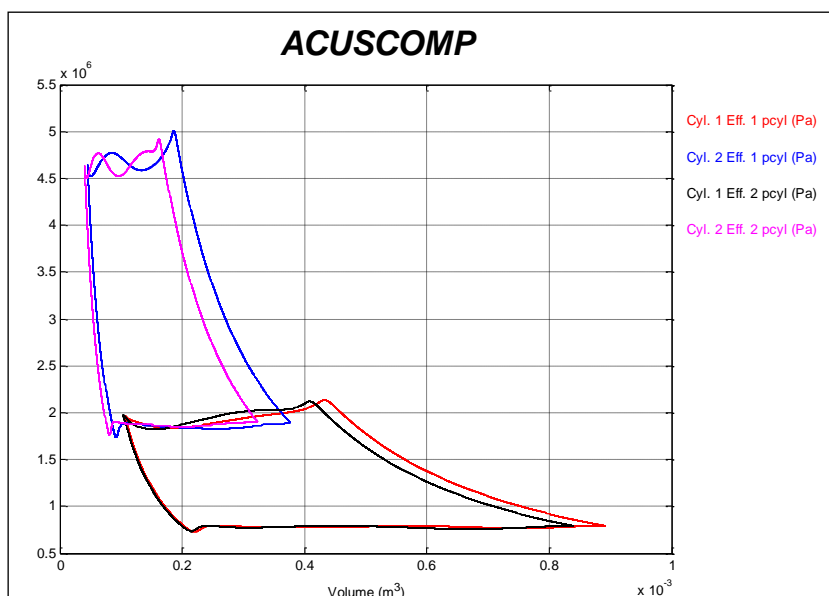
PROGRAM DESCRIPTION

ACUSCOMP simulates, in the time domain, the dynamic response of the gas medium in a plant, described by the following components:

- Piping state space matrixes, i.e. the overall dynamic characteristics of each piping side (suction or discharge) connected to one or more cylinders. These state space matrixes are calculated by **ACUSYS**.

- Single or double effect cylinders, which include inside:

  o Suction and discharge valve dynamics, as function of either mechanical commands (i.e. cam shaft) or differential pressure drive, between the cylinder and the plant side (both dynamically calculated by Simulink)
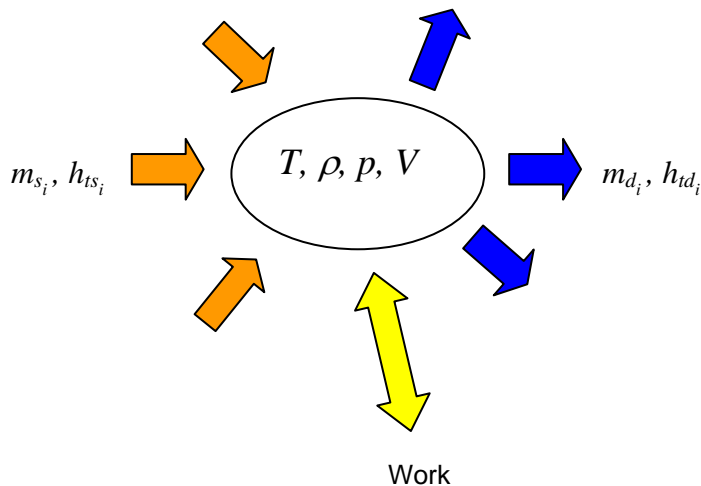
General mass-energy balance representation of an element with variable volume implemented in **ACUSCOMP**

- o Cylinder thermodynamics, which include both the open phase (exchange with the piping) and closed phase (closed valves).

- o Leakages through piston and rod seals.

- Plena, i.e. buffer volumes that are at the interface of the machine, between the valves and the piping

- Valves and restrictions, i.e. equivalent pressure loss elements that can be used in place of entire piping to analyse the behaviour of the machine without the high frequency dynamic behaviour of the piping (i.e. steady state interface pressure).

USER FRIENDLY

ACUSCOMP runs under The Mathworks' MAT-LAB/SIMULINK™ environment, a very powerful, qualified mathematical solver and systems simulation tool. It is friendly interfaced to the user by graphic buttons and menu driven commands, which only require knowledge of basic commands.

ACUSCOMP is provided with a customised library of plants schemes. The user will be able, after practising with **ACUSCOMP** and MATLAB-SIMULINK®, to implement his own schemes or modify existing ones, following the instruction provided in the manual. The program is available in English language.

SIMULATION SERVICES

ACUSCOMP is also used as a tool for engineering services that S.A.T.E. provides customers wishing not to enter the functions and details of the program. In this case the results of the simulations are produced as reports, together with comments and guidelines for plant modifications.

ONLINE SIMULATION SERVICES

ACUSCOMP results for a reciprocating compressor

ACUSCOMP is available online through the **SSO™ - SATE simulators online**, a facility that allows users to access on demand SATE's server, use **ACUSCOMP** interactively, limiting the use costs to the strict needs of their projects.

VALIDATION

ACUSCOMP was tested and validated with experimental data, comparison with other commercial software and theoretical solutions relevant to real compressors.