

BUSINESS GUIDELINE 8 GB

PRESSURE SURGE CALCULATIONS

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1. Introduction

Pressure waves propagate in liquids at the speed of sound. According to Bernoulli, the pressure energy in flowing liquids, which is made up of a static and a dynamic component and the friction losses, remains constant. This explains the pressure waves which arise in piping systems as a result of closing valves or the failure of a pump. This explains the pressure waves which arise in piping systems as a result of closing valves or the failure of a pump. This phenomenon, known as pressure surge, can lead to a considerable increase in pressure (static pressure) and can stress components subject to internal pressure to the point of bursting.

Pressure surge calculations can be used to determine the propagation speed of pressure waves and the course of pressure variations, and to decide whether measures must be adopted to avoid damage to the system, and if so what measures.

2. Calculation methods

There are two main methods of pressure surge calculation:

- 2.1 The Schnyder and Bergeron graphic method:
this is suitable for simpler or rough calculations which are commonly carried out when a plant is being designed. However, this method is less suitable for exact calculation of complicated systems where a large number of parameters are involved because of the volume of work required.
- 2.2 Characteristics method using digital computers:
exact calculations based on actual plant conditions and taking account of all operating states and essential parameters can be performed economically only by this method. Prerequisites for this approach are not only appropriate hardware and software but also qualified staff with an engineering background and particular expertise in programming.

3. Bases of pressure surge calculation

The customer must supply the supplier with all documents and information necessary for the conduct of the pressure surge calculations. These comprise specifically:

- Drawing of the entire system, routing and pipework layout
- Description of plant, method of operation, filling and draining procedures, startup and shutdown procedures, control and regulation procedures
- Parts lists, data sheet and where applicable characteristic curves for pipelines, tanks with internals, fittings and fluid-flow machinery (pumps, turbines and compressors)
- List of all critical operations and events causing pressure surges, such as power failures, opening and closing of shutoff devices, pipe failure, startup and shutdown of pumps, changeovers, filling and draining
- Defining the initial startup and commissioning conditions.

In the case of complicated pipeline systems or plant conditions, the documents necessary for the pressure surge calculation should preferably be discussed at a meeting between customer and supplier and the parameters to be examined in the calculation recorded in writing in the form of a kind of task assignment. A checklist to be drawn up by the supplier can be very useful here.

4. Presentation of results

The results of pressure surge calculations should be documented in appropriate form and presented in a calculation report, which should be structured approximately as follows:

- Brief description of calculation method used
- List of all symbols used in formulae
- Outline of task assignment
- Description of parameters examined
- Tabulation and where appropriate graphic presentation of calculation results
- Printouts of computer calculations
- Commentary on results
- Recommendations as to measures based on the results.

To release the supplier from the relevant responsibility all drawings and documents furnished by the customer for the pressure surge calculation should be returned to the customer with the calculation report.

5. Responsibility and liability

The supplier should state that his responsibility for pressure surge calculations is limited to the calculation carried out on the basis of the documents and information furnished by the customer and their accuracy. Even the measures recommended on the basis of the calculation results, as regards both their execution and their efficacy, do not fall within the responsibility of the supplier where they do not relate to the parts of the system provided by the supplier. All losses resulting therefrom and losses which, while attributable to the calculation itself, are due to incorrect or incomplete documents and information furnished by the customer are the responsibility of the customer; the supplier assumes no liability therefore.

6. Costs and charging

The cost of pressure surge calculations depends, according to what is involved (a) a rough calculation of the type generally carried out in design work or (b) an exact calculation based on detailed plant drawings, operational data, on the number of hours of engineers' and computer time, and on the extent of the documentation to be drawn up. Between 5 and 25 engineer hours should be charged for rough calculation plus the cost covering programming and operating the computer. In view of the multiplicity of possible plant parameters which decisively influence the volume of work required for exact pressure surge calculations, an appropriate cost estimate must be drawn up at the tendering stage. This should also include the charge for documentation, broken down by hours of engineers', programming and operating time, where appropriate separately for each pump.

7. Points to be taken into account

The costs of pressure surge calculations are increasingly threatening to become major fringe area costs. Planning and operating firms often try to assign these costs to the pump manufacturer and this needs to be considered in any pricing policy.

The following should be taken into account:

- Exact calculation of costs
- Separate item in the quotation in accordance with clause 6
- Definition of responsibility/liability in accordance with clause 5
- Examination of conditions of supply in connection with these services and agreement on specific points
- Separate item in the order-confirmation and invoice.

