



Fauske & Associates, LLC

Fully dedicated to customer satisfaction since 1980

Vent Sizing Package 2

VSP2TM



*Adiabatic Reaction Calorimeter
for Process Hazard
Characterization*

The Vent Sizing Package 2 (VSP2) calorimeter was originally developed through the AIChE DIERS research program to obtain test data for directly sizing emergency relief systems (Vent Sizing). Introduced in 1985, it was first referred to as the DIERS Bench Scale Apparatus, but was subsequently commercialized by FAI as the VSP, and with automation it became the VSP2. Prior to the VSP there was no calorimeter on the market that could directly simulate a runaway reaction in an adiabatic environment representative of actual process conditions. In particular, the DIERS program identified the need to have a light-weight test cell so that the thermal inertia of the test cell does not mask or dampen a chemical runaway relative to what would occur at process scale. The result was a patented low phi-factor apparatus whose data can be directly scaled up without resorting to tedious computational efforts.

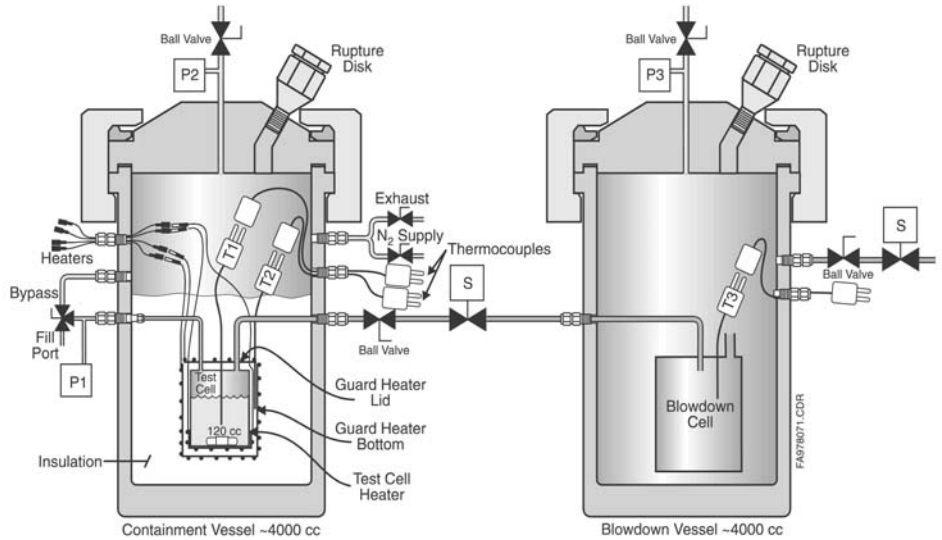
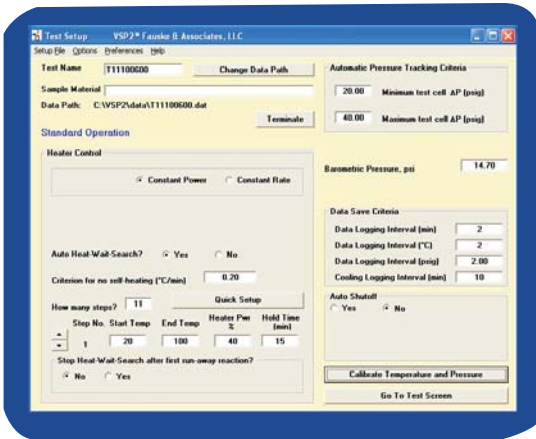
Over the last 20 years the VSP2 has been used extensively to simulate such upset scenarios as loss of cooling, loss of agitation, mischarge of reagents, batch contamination, and fire exposure heating. In recent years the VSP2 has also proved very useful in many areas besides vent sizing, since it is essentially a small chemical reactor and can be used for process development work as well as hazard assessment. The VSP2 has been used to study material compatibility, thermal and hydrodynamic effects of process mixing, stability of battery materials, and flammability of gas or vapor mixtures. Probably we would have chosen a different name for the VSP if we had known the extent of its applications!

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Typical Screens

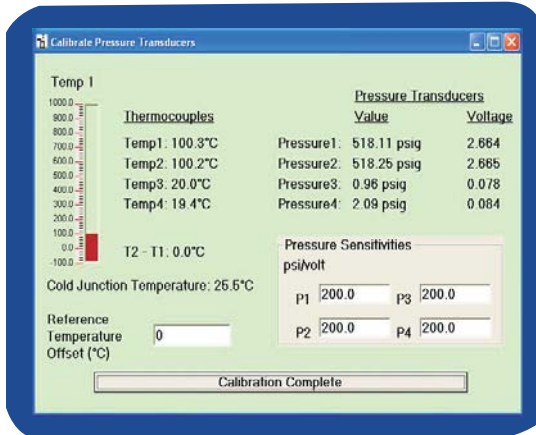
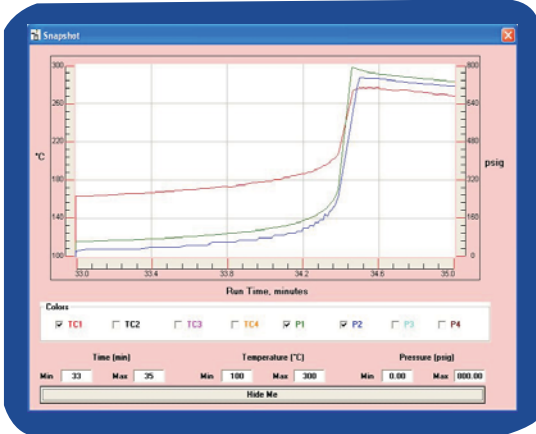
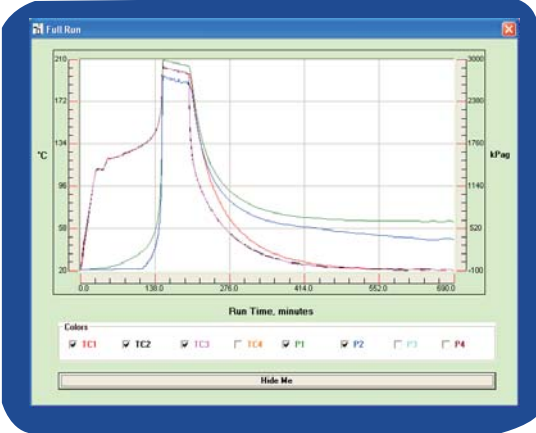


The VSP2 is a unique calorimeter that is the premier tool for obtaining process relief system design data

The Vent Sizing Package 2 (VSP2) utilizes the AIChE DIERS technology. It complements the Process Safety Management's (PSM's) process hazard analysis (PHA) with the most cost-effective tool available to obtain critical "off-normal" process design data.

Versatile design of experiments

VSP2 tests are used to simulate such upset scenarios as loss of cooling, loss of stirring, mischarge of reagents, mass-loaded upset, batch contamination and fire exposure heating. Tests can be run in a "closed" or "open" test cell mode, allowing for direct measurement of reacting system vapor pressure or large rates of gas evolution. Test data include adiabatic rates of temperature and pressure change which can be directly applied to process scale to determine relief vent sizes, quench tank designs and other relief system design parameters related to process safety management. The versatile design of the VSP2 also allows venting outside of the containment vessel to minimize cleanup between runs (for direct venting simulation) and to further guide selection of disposal systems. (See illustration above.)



FAI engineered and manufactured the first truly adiabatic calorimeter by introducing automatic pressure tracking (APT), which allows a "closed" test cell phi-factor design approaching 1.0. This development, together with pioneering the need for low-phi-factor "open" testing, facilitated for the first time safe, direct vent sizing (i.e., scale-up) from runaway reaction data without full-scale field verification.

*Quickly obtain accurate data
directly applicable to process scale*

The VSP2 system utilizes a patented low thermal mass, temperature and pressure equalized 120-ml test cell configuration. This allows users to obtain accurate adiabatic temperature and pressure rate data even from the fastest runaway reactions. FAI's innovative pressure equalization system allows a relatively thin-walled, lightweight test cell to be used in a closed mode up to high pressure. The resulting low phi-factor test can be directly applied to process scale, thereby avoiding tedious computations to "correct" for the transient heat sink effects associated with heavy wall test cells.



A compact, easy-to-use system

The VSP2 system is presented in a compact, versatile and automated format to maximize its functionality and minimize required laboratory space and operator effort. Many of the manual operator actions associated with the original VSP are now fully automated in the VSP2. Recent developments include automatic temperature calibration and report generation features. Test data are stored in ASCII formatted tabular files that allow for convenient importation to standard application software such as spreadsheets.

Many available options

Test cells are available in stainless steel, Hastelloy C, Titanium, and glass. Glass lined stainless steel and Hastelloy C cells are also available. Replacement parts are kept to a minimum and are readily available as stock items from FAI (usually shipped same day). Technical support is available from FAI's team of expert engineers and technicians. FAI has developed and used this system for contract testing for over 350 customers worldwide.

Stirring can be achieved by use of the FAI Super Magnetic Stirrer for slurries or emulsion polymerizations, or by conventional magnetic stirrer for inviscid samples. Mechanical stirring is also available. Gas or liquid samples can be taken during a test. Isothermal aging experiments can be performed easily.



Super Magnetic Stirrer

Fauske & Associates, LLC was chosen by the AIChE to serve as the principal research contractor for the Design Institute for Emergency Relief Systems (DIERS) project begun in the late 1970's. Since completion of the DIERS project (1984), FAI has remained the world leader in providing innovative products and services to support widespread utilization of the DIERS methodology.

OSHA-29 CFR 1910.11 calls DIERS Technology, "An example of good engineering practice for process safety management of highly hazardous chemicals."



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VSP2 Specifications

Phi-Factor:	Typically 1.05 to 1.09, depending on sample mass and heat capacity.
Test Cell:	Cylindrical, 2" OD x 2¼" height, Volume 116 ml Fill line, optional vent line or dip tube and up to three thermocouples located directly in the sample.
Test Cell Material:	304SS, 316SS, Hastelloy C, Titanium, Glass
Sample Size:	From a few grams up to 100 ml
Sample Type:	Liquids, solids, slurries, emulsions, suspensions, and gas addition either above or sub-surface (e.g., chlorine, hydrogen, etc.) Test cells can have a large re-closable opening for solids addition.
Agitation:	"Super Magnetic" Stirrer (Rare Earth magnets) or Mechanical Stirrer (motor driven); both maintain good agitation even for slurries. Test cells can have baffles to prevent vortex formation.
Pressure Vessel:	PED Certified Parr Vessel Rated for 1900 psi (130 bar) at 350°C (standard) Higher pressure vessel ratings are also available.
Pressure Range:	Vacuum to 1900 psi (130 bar)
Pressure Balancing:	Typically up to 10,000 psi/min
Pressure Control:	PI control of pneumatic flow valves
Temperature Range:	-100°C to 1200°C
Temperature Tracking:	300°C/min with standard single zone guard heater 600°C/min with dual zone guard heater option
Temperature Measurement:	Type K Thermocouples with 0.3°C resolution
Exotherm Detection Sensitivity:	Typically 0.05°C/min; with effort can get 0.03°C/min
Heater Options:	Single-Zone (Standard Option) < 500 psi (35 bar) Multi-Zone (High Power Option) > 500 psi (35 bar)
Cooling Options:	External Cooling Coil
Dosing:	Syringe, injection piston, or syringe pump
Sampling:	Gas or liquid samples may be withdrawn during a test.
Data Logging Frequency:	Up to 100 points per second

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