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Specification Book

Process Safety and Scale-up

Hazard screening, reaction calorimetry and adiabatic calorimetry solutions for process safety and scale-up



Product Range Overview

Specification Point	TSu	Phi-TEC I	Phi-TEC II	Simular
Measurement Type	Temperature and Pressure Analysis	Adiabatic Calorimetry	Adiabatic Calorimetry	Reaction Calorimetry
Selected Key Data	- Onset Temperature - Temperature and Pressure Rise - Rate of Temperature and Pressure Increase	As TSu, plus: - Adiabatic Temperature Change (ΔT_{ad}) - Time to Maximum Rate (TMR) - Global Reaction Kinetics data	As Phi-TEC I, plus: - DIERS Relief Sizing Data - Venting Behavior - Flow Regime	- Reaction Enthalpy (ΔH_r) - Maximum Temperature of Synthesis Reaction (MTSR) - Scale-Up Data (Heat Transfer, Cooling Duty) - Reaction Kinetics
Adiabatic Calibration Method	N/A	Online Calibration	Online Calibration	N/A
Downward Compatibility	N/A	Y	Y	N/A
Vessel Types	High Phi-Factor Test Cells	High Phi-Factor Test Cells	High and Low Phi-Factor Test Cells	Insulated Reactors*
Vessel Volume	0.5 ml to 10 ml	0.5 ml to 10 ml	0.5 ml to 110 ml*	500 ml to 2 L
Temperature Range	Ambient to 500 °C	-40 °C* to 500 °C	Ambient to 500 °C	-80 °C to 350 °C*
Detection Threshold to Exothermic Activity	N/A	0.02 °C/min	0.02 °C/min	N/A
Max. Tracking Rate	N/A	100 °C/min	200 °C/min	N/A
Pressure Range	1 to 200 bara	1 to 200 bara	1 to 137 bara	0 to 200 bara*
Pressure Compensation Rate	N/A	N/A	Up to 100 bara/min	N/A
Stirring	N	Y	Y	Y
Reagent Addition	N	Y	Y	Y
Gas Sampling	N	N	Y	Y
Control & Analysis Software	Y	Y	Y	Y
Data Acquisition Rate	Up to 10 Hz	Up to 10 000 Hz*	Up to 10 Hz	Up to 10 Hz
Safety features	Automatic	Automatic	Automatic	Automatic
Dimensions in mm (w x d x h)	260 x 230 x 320	600 x 600 x 750*	600 x 600 x 750*	Single 850 x 650 x 1200* Dual 1100 x 650 x 1300*
Additional Options	N/A	- Low Temperature - Bespoke Test Methods - Safety Release Valve - High Data Rate Acquisition - Advanced Modelling Software	- Bespoke Test Methods - External Pressure Vessel - High Data Rate Acquisition - Advanced Modelling Software	- Reactor Vessel Types - Operational Modes - Reagent Feed Sensors - Control and Sampling - Advanced Modelling Software

* Further details can be found on the instrument specific page

TSu

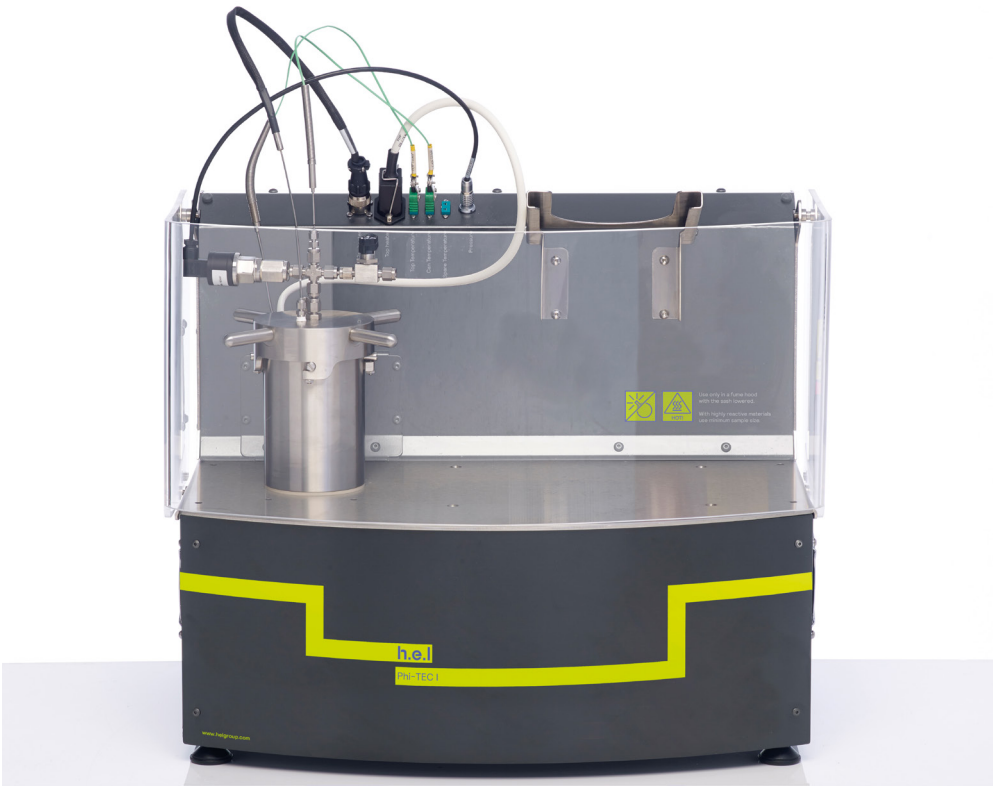
Specification Point	TSu
Measurement Type	Temperature and pressure analysis
Key Data	- Onset temperature of exotherm - Heat release (semi-quantitative) - Rate of temperature rise - Pressure increase - Rate of pressure rise
Vessel Types	Standard spherical & high Phi-factor test cells - Available in stainless steel, hastelloy and glass
Vessel Volume	0.5 ml to 10 ml
Temperature Range	Ambient to 500 ºC
Temperature Measurement Method	Direct sample measurement
Pressure Range	1 to 200 bara
Control & Analysis Software	Common control software (WinISO) and analysis package (iQ)
Operating Modes of the Software	Screening tests: - Ramp - Isothermal - Combination
Data Acquisition Rate	- Sampling rate automatically adjusts to allow greater resolution when tracking exothermic events. - Default sampling rate up to 10 Hz.
Safety Features	Automatic shutdown procedures if a safety condition is exceeded to ensure user safety
Dimensions (w x d x h)	260 x 230 x 320 mm



Phi-TEC I

Specification Point	Phi-TEC I
Measurement Type	Adiabatic calorimetry
Adiabatic Calibration Method	Online calibration
Key Data	- Onset temperature of exotherm - Heat release (quantitative) - Rate of temperature rise - Pressure increase - Rate of pressure rise - Adiabatic temperature change (ΔT_{ad}) - Time to maximum rate (TMR) - Global reaction kinetics data
Downward Compatibility	Compatible with TSu
Vessel Types	Standard spherical & high Phi-factor test cells - Available in stainless steel, hastelloy and glass
Vessel Volume	0.5 ml to 10 ml
Temperature Range	- Ambient to 500 °C - **Optional:** Low temperature addition (starting at -20 °C or -40 °C dependant on oil circulator) for testing of highly unstable chemicals available
Temperature Measurement Method	Direct sample measurement
Detection Threshold to Exothermic Activity	0.02 °C/min
Max. Tracking Rate	100 °C/min
Pressure Range	1 to 200 bara
Stirring	Indirect agitation with magnetic stirrer bar as standard; fixed stirring rate of 300 rpm
Reagent Addition	**Optional:** Not standard, but possible with certain test cell designs

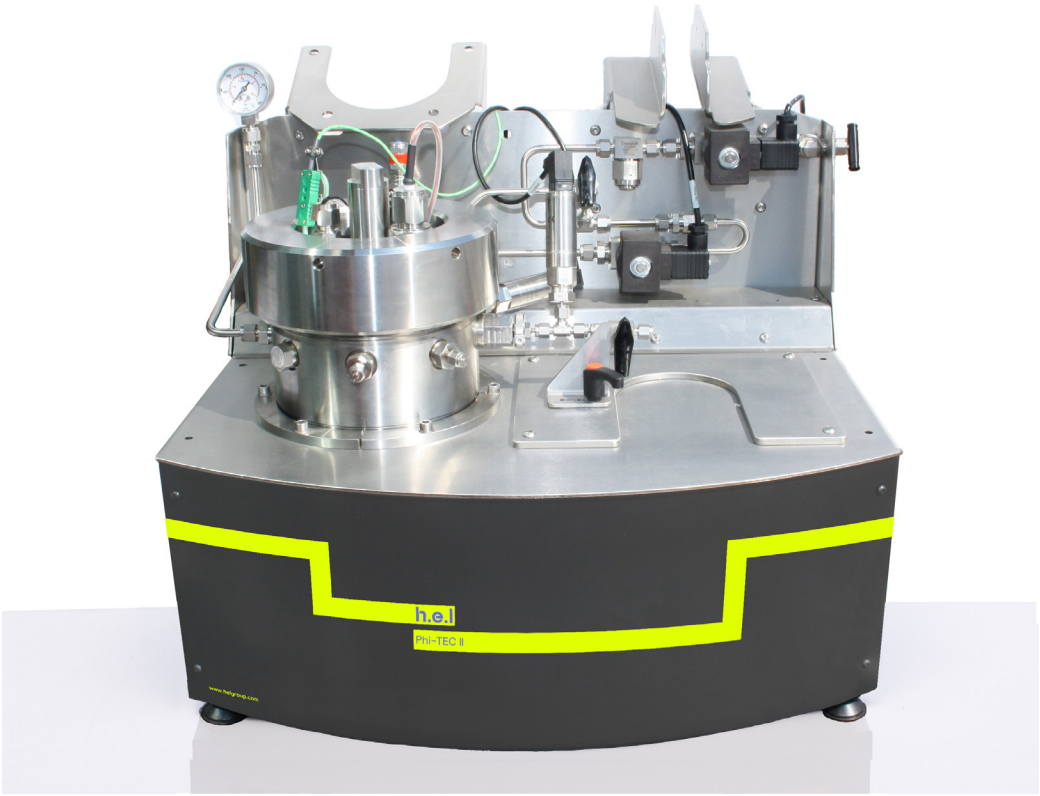
Specification Point	Phi-TEC I
Control & Analysis Software	- Common control software (WinISO) and analysis package (iQ) - **Optional:** advanced modelling software Phi-TEC Pro (ARKS-AC)
Operating Modes of the Software	Adiabatic calorimetry - Closed cell tests (adiabatic tracking) - Open cell tests - Heat-Wait-Search test - Heat-Wait-Search with adiabatic aging Screening Tests - Ramp - Isothermal - Combination **Optional:** bespoke testing methods
Data Acquisition Rate	- Sampling rate automatically adjusts to allow greater resolution when tracking exothermic events. - Default sampling rate up to 10 Hz. - **Optional:** High data rate acquisition available for characterizing extremely fast reactions (up to 10 000 Hz)
Safety Features	- Automatic, user-configurable, shutdown procedures if a safety condition is exceeded to ensure user safety - **Optional:** Safety release valve
Dimensions (w x d x h)	600 x 600 x 750 mm (With lid up and in holder)



Phi-TEC II

Specification Point	Phi-TEC II
Measurement Type	Adiabatic calorimetry
Adiabatic Calibration Method	Online calibration
Key Data	- Onset temperature of exotherm - Heat release (quantitative) - Rate of temperature rise - Pressure increase - Rate of pressure rise - Adiabatic temperature change (ΔT_{ad}) - Time to maximum rate (TMR) - Global reaction kinetics data - Venting behaviour (gassy, tempered, hybrid) - Flow regime (Single phase, Two phases) - DIERS relief sizing data
Downward Compatibility	Compatible with Phi-TEC I and TSu
Vessel Types	- Thin-walled, low Phi-factor test cells. - Compatible with standard spherical, high Phi-factor test cells - Available in stainless steel, hastelloy and glass.
Vessel Volume	- Up to 10 ml in high Phi-factor test cells - 10ml to 110 ml in low Phi-factor test cells
Temperature Range	Ambient to 500 °C
Temperature Measurement Method	Direct sample measurement
Detection Threshold to Exothermic Activity	0.02 °C/min
Max. Tracking Rate	200 °C/min
Pressure Range	1 to 137 bara
Pressure Compensation Rate	Up to 100 bara/min
Stirring	- Indirect agitation with magnetic stirrer bar as standard; fixed stirring rate of 300 rpm - **Optional:** Direct overhead stirring available for metal test cells for effective agitation of highly viscous samples
Reagent Addition	- **Optional:** High pressure liquid feed pump for dosing of a critical ingredient at a controlled rate to the reaction vessel. • Available with 0.02 to 40 ml/min feed rate at 100 bara or with 0.01 to 20 ml/min feed rate at 200 bara. - **Optional:** High pressure injector for rapid addition of a critical ingredient to the test cell, replicating plant-scale conditions. • Available in stainless steel or hastelloy (40 ml to 100 ml)
Gas Sampling	**Optional:** External vent/blowdown vessel for measurement of gas produced when studying reactions with a high absolute pressure rise. Can be used for vent sizing, blow down and tempering test as per DIERS methodology.

Specification Point	Phi-TEC II
Control & Analysis Software	- Common control software (WinISO) and analysis package (iQ) - **Optional:** Advanced modelling software Phi-TEC Pro (ARKS-AC)
Operating Modes of the Software	Adiabatic calorimetry - Closed cell tests (adiabatic tracking) - Open cell tests - Heat-Wait-Search test Screening Tests - Ramp - Isothermal - Combination **Optional:** Bespoke testing methods
Data Acquisition Rate	- Sampling rate automatically adjusts to allow greater resolution when tracking exothermic events. - Default sampling rate up to 10 Hz.
Safety Features	Automatic, user-configurable, shutdown procedures if a safety condition is exceeded to ensure user safety
Dimensions (w x d x h)	600 x 600 x 750 mm (With lid up and in holder)



Simular

Specification Point	Simular
Platform type	Reaction Calorimeter
Typical applications	- Process safety - Process scale-up - Process development and optimization
Vessel material	Glass, 316 Stainless steel, and Hastelloy C276
Vessel volume	250ml to 20 L*
Dual vessel	A dual vessel option is available (typically with a glass, ambient pressure vessel and a metal, high-pressure vessel) including a larger dual frame and switching between reactors
Temperature range	-80°C to 350°C (reactor material dependent)*
Pressure range	Vacuum to 200 bar (reactor material dependent)
Stirring	Standard unit includes an automatically controlled 100 Ncm torque motor (Reactor material dependent)*
Sensor options	Temperature, pressure, pH, turbidity, and other sensors are available. Integration of third-party probes is possible, such as in-situ FTIR, particle sizing probes and Raman probes with software integration.
Reagent addition	Prominent Pump and balance combination for glass reactors and HPLC pump for metal reactors. Optional feeds: – Pressurized vessels for highly volatile reagents – Mass flow controller for gas feeds (0 to 2000 mln/min)
Gas evolution measurement	Off-gas flow rate measurement (reactor material dependent)

* Contact your local H.E.L group representative to discuss additional options

Specification Point	Simular
Control & analysis software	– Easy to use, powerful software designed both advanced users and beginners. – Intelligent automation: Customizable interface with real-time sensor readings, allowing for feedback loops, and reactor parameters based on user preferences. User-defined experiment plans covering simple to advanced reactions. – Common software across H.E.L group process safety product range for ease of use and to save time on training
Calorimetry modes	Isothermal calorimetry: – Power compensation calorimetry – Heat flow calorimetry Optional: Reflux calorimetry Other methodologies: – Isoperibolic calorimetry
Safety features	Automatic user-configurable shutdown procedures if a safety condition is exceeded to ensure user safety
Dimensions (w x d x h)	– Single Simular: 850 x 650 x 1200 mm – Dual Simular: 1100 x 650 x 1300 mm Caution: Excludes circulators, pumps, balances, and other optional accessories. Extra width should be allowed. Larger reactors could be taller. The distillation kit option increases the overall height to 2000mm.

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About H.E.L Group

H.E.L Group's mission is to work together with chemistry, safety and biotechnology experts to engineer and unleash the full potential of the scientific community. To this end, H.E.L develops and manufactures innovative scientific instruments and software designed to optimize the efficiency, safety and productivity of key processes in chemistry and biology applications.

The H.E.L team of 70 includes highly skilled process and software engineers, based at their extensive research and manufacturing facilities in the UK, as well as sales and support offices around the world.

H.E.L has a long history of solving complex challenges for customers. For more than 30 years the Company has worked with businesses and laboratories globally, providing proprietary automated solutions for the pharma, biotechnology, chemical, battery and petrochemical sectors.
H.E.L is accredited with ISO 9001 : 2015

- With a strong focus on the customer, our **service and support** enables our customers to keep working efficiently
- Our **wide range of customizable products** put the customer at the heart of what we do, with solutions designed around their needs

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