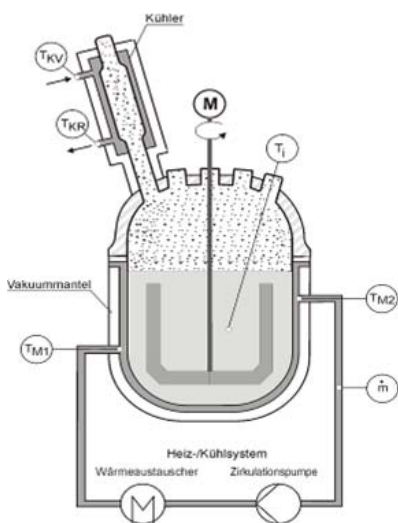




Here you will find:

-
- LabKit™-rcf Heat Flow Calorimetry (HFC)
 - LabKit™-rcb Thermal Balance Calorimeter
 - KalDas™ Calorimetry Evaluation
 - Reaction calorimetry components
-

Reaction Calorimeters



Until now, reaction calorimeters and automatic laboratory reactors, which were able to handle more than only simple syntheses, had to be regarded separately. The HiTec Zang LabKit-rc reaction calorimeters combine both devices, whereby a flexible system is generated in every respect. As a calorimeter, LabKit-rc offers different operation modes and measuring methods, and as a lab reactor system, the whole flexibility of the LabKit laboratory reactor technology and the LAB manager's research process control system.

Up to now, reaction calorimeters were very cost-intensive. Nevertheless, they are necessary. The knowledge of the heat tone of a process is required for the safety-related and energetic evaluation. Many users are therefore on the lookout for a cost-effective possibility to conduct calorimetric measurements already during process development.

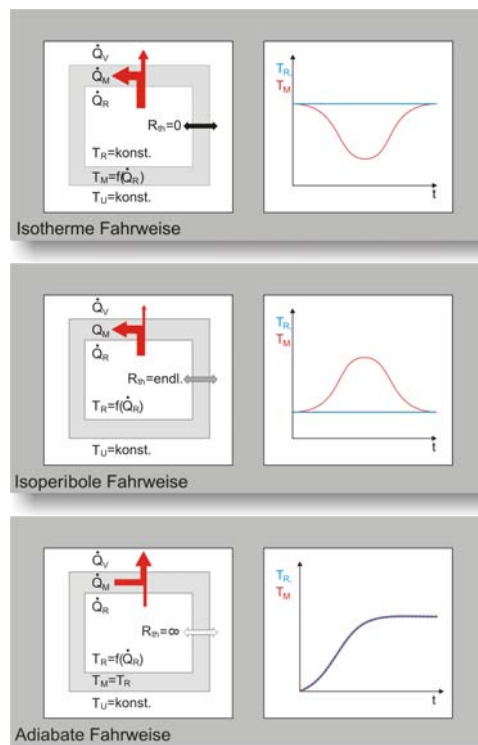
In addition, according to the opinion of leading scientists, the significance of reaction calorimetry for process analytics is underestimated by far. In the event of all exothermic and endothermic processes, the signal of the current heat output delivers additional information on the reaction progression, which is currently only rarely utilised.

The Advantages:

- Heat Flow and Thermal Balance are possible
- Isothermal, Isoperibole and Adiabate Mode of Operation
- Full ALR Functionality
- Uncomplicated Evaluation
- Easy-to-handle Open System
- Upgradeable at all Times
- Electrically lowerable Reactor Head
- Best possible Reproducibility
- GLP-conform Documentation
- Access via Network, e.g. from the Office
- Remote Maintenance (Tele-Service)

The range of possible applications is very versatile and goes far beyond the classical measurement of heat tone and thermal conversion.

LabKit-rc supports adiabate, isoperibole, and isothermal operation mode.



LabKit-rc Systems are ready-to-use reaction calorimeters.

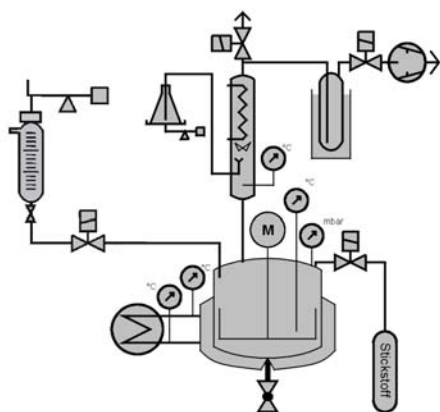
To allow upgrading or modernising of existing laboratory reactors or existing reaction calorimeters, all necessary components are also individually available.

The standard systems LabKit-rcf and LabKit-rcb depicted in the following, are complete, ready-for-commissioning, automatic reaction calorimeters, which can also be utilised as full-fledged Automatic Labor Reactor Systems (ALRS). They can be upgraded with the available additional modules and components of the LabKit program.

Next to the standard calorimeters depicted in the following, we also manufacture client-specific plants and also offer the renovation, repair, and expansion of existing reaction calorimeters of various manufacturers.

Information in regard to the individually manufactured reaction calorimeters can be found in the chapters Plant Construction, Mini-plant Technology, and Customised Reaction Calorimeters.

LabKit™-rcf Heat Flow Reaction Calorimeter



LabKit-rcf, heat flow calorimeter with extension options

Reaction calorimeter in a sophisticated configuration for heat flow calorimetry. The automatic laboratory reactor system is suitable e.g. for syntheses in the temperature range from -40 to +200 °C. The system is expandable with additional modules and components offered.

System Construction

As standard container, a double-walled 2 litre reaction vessel is used. Other containers are available.

The reaction vessel is kept at a moderate temperature by high performance heating/cooling thermostats, which enables fast temperature control for isothermic use.

Measurement Method

The heat flow method is based on the measurement of the temperature difference between the reactor contents and temperature medium in the container jacket. For the heat flow over the reactor wall the relationship applies:

$$\dot{Q}_{kond} = k_w A \cdot \Delta T_{R,J}$$

The heat transition coefficient cannot generally be theoretically calculated. Since it can vary significantly during reaction (e.g. by modification of the viscosity, the specific heat of the reaction mixture, or by boundary layer formation), it is determined by calibration with defined heat output before and after the reaction.

$$k_w A = \frac{\dot{Q}_{kond}}{\Delta T_{R,J}}$$

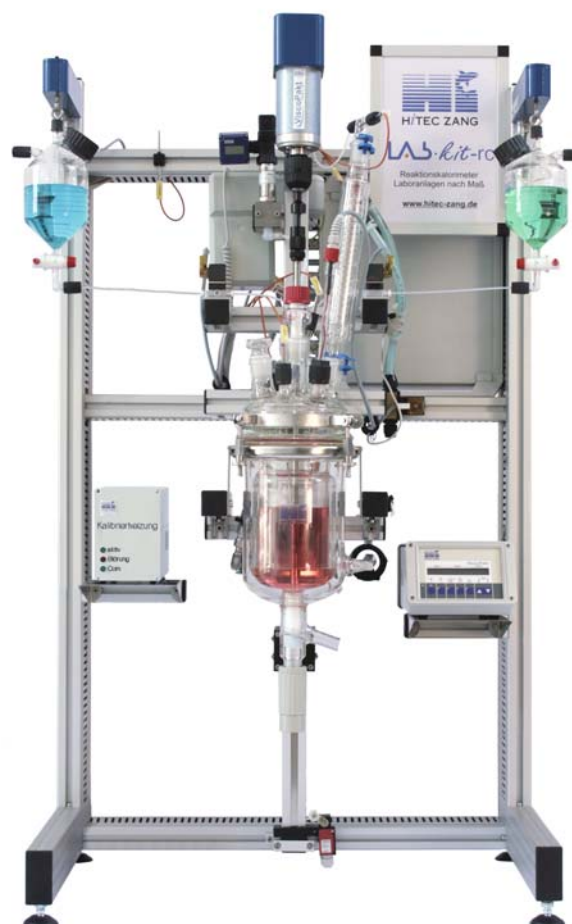
The reaction calorimeter is extendable for heat balance calorimetry and can be optionally upgraded by

- Online Evaluation
- Inerting
- Vacuum
- Distillation
- Reflux

For reflux distillation, the reflux separator ratio is adjustable over a programmable reflux separator.

For further information see "Components for reaction calorimetry"

Example Version:



LabKit-rcf with electrically lowerable 1000 ml reactor with vacuum jacket, two gravimetric and one volumetric dosing circuits, vacuum control, reflux distillation and inerting.

Specification

Rack	Square anodised aluminum profile, electrical fixture for lowering the reactor vessel, catch pan made of high-grade steel.
Reactor	2-Liter Double-walled glass container, tempering jacket, PTFE-bottom drain valve, Lid with Center neck and 6 Supports, safety-valve 200 mbar, ventilation valve
Stirrer	ViskoPakt rheo57 Precision stirrer drive with Speed control and Torque measurement, Anchor Stirrer
Heating/Cooling System	Heat-Cool-Thermostat -40 to +200 °C, Air-/ Compressor Cooling, Heating power 3 kW, Cooling power to 3 kW at 200 °C, 0,7 kW at 0°C
Dosing System	One GraviDos Dose circuit for Liquids (Regulated drop funnel), 500 ml feed tank, gravimetric regulated
Automation	LabManager. Interfaces: 8 Pt100 Precision-Temperature measurement inputs, 8 analogue inputs (Current & Voltage) of which 1 pH, 4 RS232, 4 GraviDos (DMS) Interfaces, 4 digital inputs, 8 digital Outputs (current & voltage), controllable calibration heating 50 W glass (optionally stainless steel). Sensor power supply 24 V 1,5 A, actor power supply 24 V 3 A. CA-ABK2, 22" Monitor, Uninterrupted Power Supply with UPS-Management Software
Sensors	Calibrated temperature sensor for: reactor, thermostat, flow line, reflux, head and environment temperature, flowmeter in the heat carrier, pressure measurement 0...1600 mbar abs., stirrer: rotational speed, torque
Materials	Mainly borosilicate glass, PTFE, PVDF, Viton, Stainless steel 1.4571 (changes possible)
Evaluation	see KalDas

Order Code	Description
VL-LABKITRCF1	Reaction calorimeter for heat flow calorimetry
VL-LABKITRCONLF	Online-heat flow-Evaluation

Special equipment is available e.g. for inerting, vacuum, reflux boiling and reflux distillation using the programmable reflux separator and intensive cooler in a mirrored glass vacuum jacket,

as well as balancing of the cooling water and distillate. See lab kit structure system.

Recommended software packages:

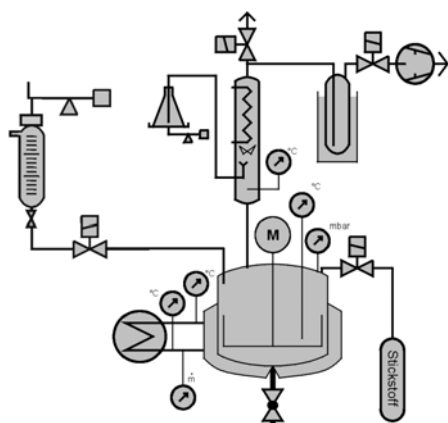
Order Code	Description
SL-LABVIPBATE	Software Package for LabManager1 for Operation of medium-sized Batch-Processes
SF-PID8	Controller Module with 8 PID- and application oriented controllers
SA-KALDAS3	Evaluation Program for Heat Flow and Thermal Balance Calorimetry on KabKit-rcb

Recommended upgrades

- MoleculeEye with fibre optic probe for differentiated, cinetic analysis

Further information can be find in the chapter Process Analytics and Sensorics.

LabKit™-rcb-Heat balance - Reaction Calorimeter



LabKit-rcb, heat balance calorimeter with expansion.

Reaction calorimeter in a sophisticated configuration for heat flow and heat balance calorimetry. The automatic lab reactor system is suitable e.g. for syntheses in the temperature range from -40 to +200 °C. The system is expandable with the offered additional modules and components.

System Construction

As standard container for heat balance calorimetry, a triple wall, 2 litre reaction container with evacuated outer jacket is used. Other containers are available.

The reaction container is kept at a moderate temperature by high performance heating/cooling thermostats, which enables a fast temperature control for isothermic operation mode.

It is upgradeable with options, e.g.:

- Online-Evaluation
- Vacuum
- Distilling
- Reflux
- Inerting

When distilling with reflux separators, the reflux component ratio can be regulated via an electrically controllable reflux separator.

For further information, see „Components for Reaction Calorimetry“.



LabKit-rcf with electrically lowerable 1 litre reactor with vacuum jacket, 3 gravimetric dosing circuits, vacuum control, reflux distillation and inerting.

Measurement Method

The heat balance method is based on the balancing of the tempering medium at the feed and discharge opening of the container jacket. The temperatures and the flow of the heat carrier are measured.

$$\dot{Q}_{Kond} = \dot{m}_{öl} \cdot c_{p_{öl}} \cdot \Delta T_{RJVR}$$

The heat transition coefficient (KwA) is not required for the evaluation. This is particularly important in case of reactions where a coating develops at the vessel walls, as for example, during polymerisations and dispersions.

Specifications

Rack	Square anodised aluminum profile, electrical fixture for lowering the reactor vessel, catch pan made of high-grade steel.
Reactor	2Liter Double jacket glass container with vacuum jacket, temper jacket, PTFE-bottom drain valve, lid with centre neck and 6 supports, safety valve 200 mbar, ventilation valve
Stirrer	ViskoPakt rheo57 Precision-stirrer drive with speed control and torque measurement, Anchor Stirrer
Heating/Cooling System	Heat-cool-Thermostat, -40 to +200 °C, Air/ Compressor cooling, heating power 3 kW, cooling power up to 3 kW (200 °C), 0,7 kW (0°C)
Dosing System	One GraviDos Dose circuit for liquids (regulated Drop funnel), 500 ml Feed tank, gravimetric regulated
Automation	LabManager. Interfaces: 8 Pt100 Precision-Temperature measurement inputs, 8 analogue inputs (Current & Voltage) of which 1 pH, 4 RS232, 4 GraviDos (DMS) Interfaces, 8 digital inputs, 8 digital Outputs (current & voltage), controllable calibration heating 50 W glass (optionally stainless steel) CA-ABK2, 22" Monitor, Uninterrupted Power Supply with UPS-Management Software
Sensors	Calibrated temperature sensor for: reactor, thermostat, flow line, reflux, head and environment temperature, flowmeter in the heat carrier, pressure measurement 0...1600 mbar abs., stirrer: rotational speed, torque
Materials	Mainly glass, PTFE, PVDF, Viton compound, stainless steel material 1.4571 (subject to changes)
Evaluation	see KalDas

Order Code	Description
VL-LABKITRCB1	Reaction calorimeter for Heat balance calorimetry
VL-LABKITRCMDM	Mass flow meter for the heat carrier
VL-LABKITRCONLB	Online heat balance evaluation

Optional equipment is available, e.g. inerting, vacuum, reflux boiling and distilling via a electrically controlled reflux separator and intensive cooler made of metallised glass, with vacuum jacket as well as balancing of the cooling water and the distillate.

For further information see LabKit system construction.

Recommended software packages:

Order code	Description
SL-LABVIPBATE	Software Package for LabManager1 for Operation of medium-sized Batch-Processes
SF-PID8	Controller module with 8 PID and application oriented controller
SA-KALDAS3	Evaluation Program for Heat Flow and Thermal Balance Calorimetry on KabKit-rcb

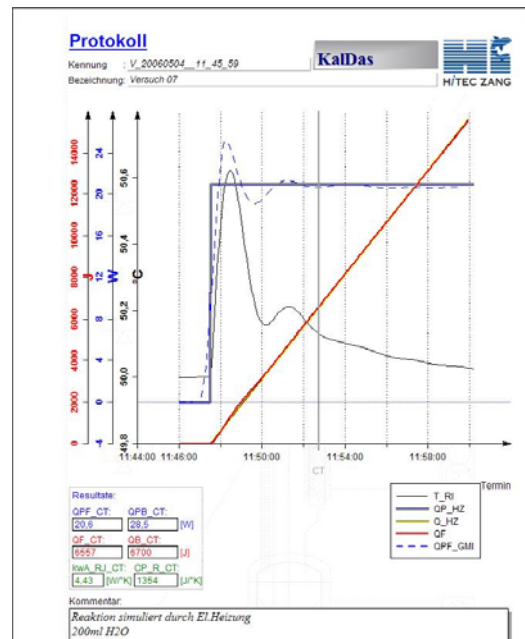
Recommended upgrades

- MoleculeEye with fibre optic probe for differentiated, cinetic analysis

Further information can be find in the chapter Process Analytics and Sensorics.

Calorimetry Evaluation Program KalDas™

Uncomplicated Evaluation!



KalDas is a new development in the field of reaction calorimetry. KalDas provides you with data that you need for model evaluations (e.g. scale up) and for energy and safety considerations.

KalDas is based on the flexible control and data analysis software platform HiText and can therefore be easily customised to your special requirements.

The acquired data can be evaluated at the push of a button and the results are displayed in a free configurable and a clearly arranged protocol.

KalDas was primarily developed for the HiTec reaction calorimeter. However, there is no constriction to any specific calorimeter, i.e. the program may be adapted to any other device.

It is also possible to adjust the programming for special evaluations or data transfer, e.g. to programs for reaction kinetics.

Heat inflow and dissipation of the stirrer, condenser, dosage flow as well as accumulated heat is considered in the calculation. If needed, the calculations may be expanded to heat balance calorimetry or other methods.

KalDas is deployed for:

- Product Development
- Process Optimisation
- Quality Assurance
- Scale Up Tests
- Plant Safety

KalDas3 was completely newly designed based on the proven KalDas2. The programming in HiText

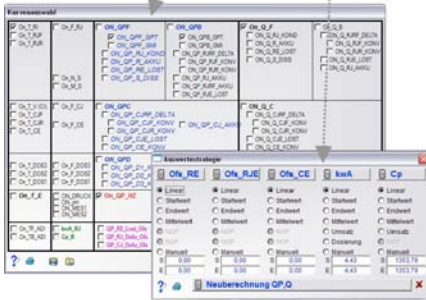
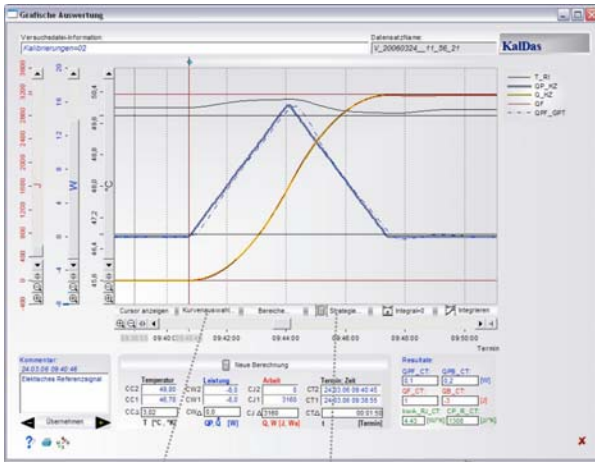
warrants for optimal cooperation with LabVision and enables online calorimetry.

KalDas ideally operates combined with the HiBatch Recipe Control. The steps related to reaction calorimetry are integrated like normal basis operations in the recipe.

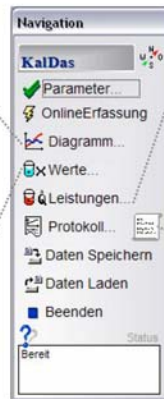
The delays of the measurement signals which lead to distortions in the course of the power output evaluation are corrected by special algorithms. This allows realistic presentation of the output power progression.

Advantages:

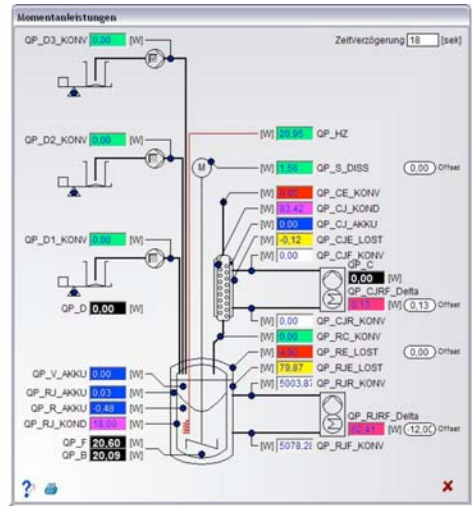
- Simple Handling
- Online and Offline Evaluation in one Program
- Flow and Balance Evaluation simultaneously possible
- Dosing, Reflux, and Dissipation are considered
- Intermediate Values (Outputs) are made transparent
- Fully integrated in LabVision, optional Stand-alone Version
- First Analyses are already possible during the running Test
- Alignment to your possibly already existing Equipment is possible
- Application-specific Expansions are possible due to HiText Programming
- Full Functionality of an Automatic Laboratory Reactor is supported
- Multi-stage Recipe-controlled syntheses are possible



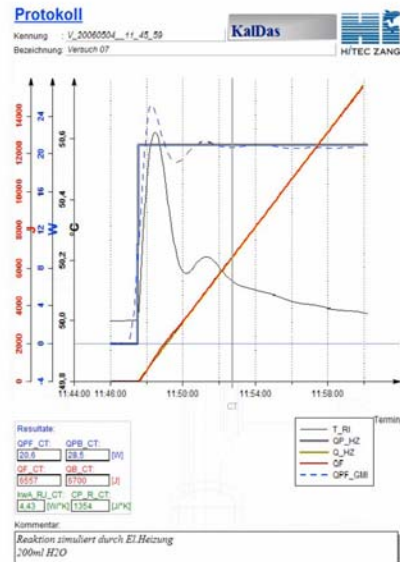
The multitude of display and evaluation options enables the adaptation of the program to individual requirements to a large extent.



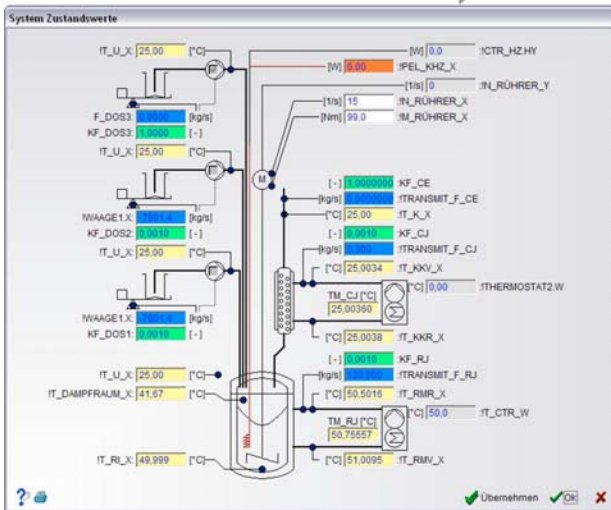
All main windows can be reached via the central navigation menu.



Visualisation of amount and location of every individual performance



The protocol can be freely designed with a form editor and automatically be established at the end of a test.



Condition values are clearly presented with local allocation in the plant display

Product Description	Menu-controlled evaluation program for calorimetry data, compilation of measurement data, characteristics determination, graphic presentation, inter alia of output and heat curves, etc.
Delivery Scope	CD-ROM, manual
Order Code	Description
SA-KALDAS3	Evaluation Program for the Reaction Calorimetry on LabKit-rcf and -rcb

For control operations, see LabVision Basis Operations.
KalDas can also be aligned to your equipment!

Components for Reaction Calorimetry

Calibration Heating



The calibration heating is required when conducting calorimetric measurements in reaction calorimeters or laboratory reactors. In particular for the establishment of the thermal capacity of a material within the scope of a heat flow calorimetry, a high-precision calibration heating is required which compensates the thermal resistance, e.g. as a result of aging and temperature influences. The heating output of the following devices can be steplessly

programmed. They are usually deployed for the calibration of a reaction calorimeter. Amongst other applications, it is also possible to simulate exothermic reactions and to test the time response of a calorimeter.

The heating cartridge is integrated in a glass or high-grade steel rod with a connection cable.

They can be manufactured according to client specifications.

Particular properties:

- High precision heat source
- Continuously controllable heating capacity
- Long-lasting stability due to electronic power control
- Current and voltage monitoring

The heating capacity can be adjusted steplessly from 0 to 50 W and 100 W respectively.

The aging of the heating element will be adjusted automatically.

Technical Data

Power consumption	230 V, 100 W / 150 W
Delivery of power	0 ... 50 W , 0 ... 100 W, 100 % duty cycle
Uncertainty	<100 mW
Control	Capacity setpoint via RS232
Capture	Capacity current value via RS232
Dimensions of heating element	Length across axis 460 mm, Diameter 10 mm. Other dimensions upon request

Delivery Scope :	Control device with power supply, manual
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Order Code	Description
IL-KALKALIB50	Control device for calibration heating 30V, 50 Watt
IL-KALKALIB100	Control device for calibration heating 100 Watt

Heating Rods

Dimensions of heating element	Length above axis 460 mm, Diameter 10 mm. Other dimensions upon request
Delivery Scope	Heating rod calibrated, calibration certificate

Order Code	Description
IL-KALHEIZG50	Heater rod in glass with heating element 30 V, 50 W
IL-KALHEIZE50	Heater rod in stainless steel with heating element 30 V, 50 W, pressure resistance 15 bar
IL-KALHEIZP50	Replacement element 30 V, 50 W
IL-KALHEIZGL100	Heater rod in glass with heating element 30V, 100 W
IL-KALHEIZES100	Heater rod in stainless steel with heating element 30V, 100W, pressure resistance 15 bar
IL-KALHEIZP100	Replacement element 30V, 100W

Turbine Flowmeter for Heat Carrier Oil

Thermal balance calorimetry requires the exact measurement of the flow rate of the heat carrier oil. The flow sensors are especially suited for this purpose and are frequently used as an alternative to the significantly more expensive Coriolis mass flow meters.



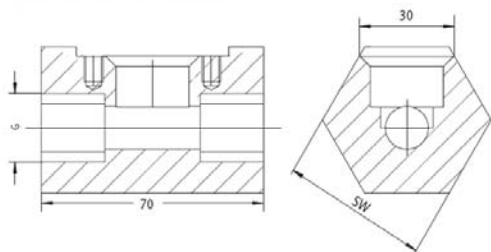
In the sector of reaction calorimetry, they are particularly suited for the flow measurement of the heat carrier oil at temperatures of up to 350 °C.

They are deployed as standard in our thermal balance calorimeters.

Technical Data

Linearity	+/-2 % v.M.
Reproducibility	+/-0.5 %
Media Temperature	-20 to 120, 180 or 350 °C
Max. Working Pressure	20 bar
Viscosity	0,1 to 6 mm ² /s
Materials	High-grade steel 1.4305 and 1.4122, ceramic
Seal	Viton or Graphite
Content of delivery:	Sensor with mounted impulse amplifier

Order code	Description
IS-F-TDMtc-tb-sa	Turbine Flowmeter
IS-F-TDMMV-AK-I	LAB-PI Connection Cable for Turbine Flow Sensor , 4..20 mA
IS-F-TDMMV-AK-F	LAB-PI Connection Cable for Turbine Flow Sensor, NPN-OC



tc = up to 10 litres/min: 06 / up to 30 litres/min: 09

tb = Temperature Range 120,180, or 350 °C

sa = Output Signal 4..20 mA: I / or frequency-analogue NPN-OC: F

They function according to the principles of a turbine-type meter:

Type	Measuring Range in l/min	Impulse/Litre	Connection G
TDM06	1 to 10	2000	½ inch
TDM09	3 to 30	980	½ inch

The Advantages:

- Compact
- Maintenance-Free
- Resistant against high Temperatures
- Low Pressure Loss
- High Working Pressure Range
- Small Time Constant due to low-mass Rotor

Example for an order:

Flow sensor for 0-10 litres/min, max. temperature 180 °C, frequency-analogue output, open collector:

IS-F-TDM06-180-F

Information in regard to the individually manufactured reaction calorimeters can be found in the chapters **Plant Construction**, **Miniplant Technology**, and **Customised Reaction Calorimeters**.