

History & Fundamentals

Brief history; Adiabatic, isoperibol and dynamic calorimeter



Calorimeter basics and brief history

A bomb calorimeter is used to measure the heat created by a sample burned under an oxygen rich atmosphere in a closed vessel, which is surrounded by water, under controlled conditions. The measurement result is called the combustion-, calorific- or BTU-value. The result allows to make certain important quality, physiological, physical and chemical, as well as financial conclusions about the product.

The term "calorimeter" was first mentioned by Josef Black in 1770. One of the first calorimeters (ice-calorimeter/ phase transition calorimeter) was developed by Lavoisier and Laplace around 1780. The calorimetric bomb is also called "Berthelotsche Bomb". Marcellin Berthelot developed the combustion of samples in a closed pressure resisting vessel into a standard method. He was the first to use pure oxygen at higher pressures to get a faster and more complete combustion (1885). In 1892 the first patent for a calorimeter to measure the heating value of gaseous fuel was given to Hugo Junkers a German inventor and aircraft engineer. IKA® introduced their first bomb calorimeter in the 1920's. Since then our calorimeters have been continuously developed according to the latest standards and technologies.

There are many different types of calorimeters available on the market: Solution-, DSC-Differential-Scanning-, Titration-, Gas- and Reaction Calorimeters.

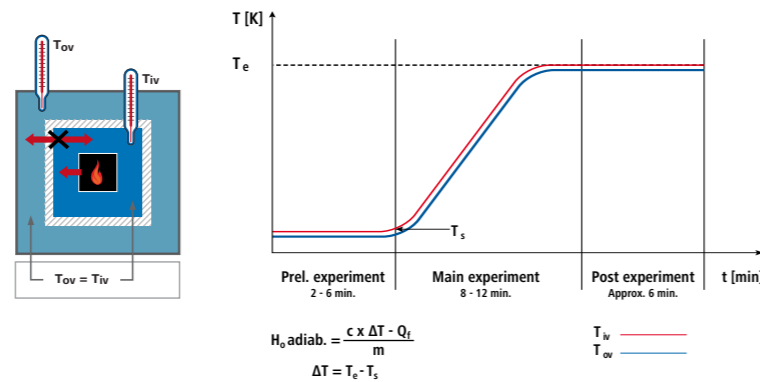
IKA® manufactures so called bomb- or combustion calorimeters.

About 1g of solid or liquid matter is weighed into a crucible and placed inside a stainless steel container. The decomposition vessel or bomb is filled with 30 bar of oxygen (quality 3,5: technical oxygen 99,95 %). The sample is ignited for example through a cotton thread connected to a solid ignition wire inside the decomposition vessel and burned. During the combustion the core temperature in the crucible can reach 1.000 °C, and the pressure rises as well. All organic matter is burned and oxidized under these conditions.

The heat created during the burning process can be determined using the isoperibol, adiabatic or dynamic measurement procedure.

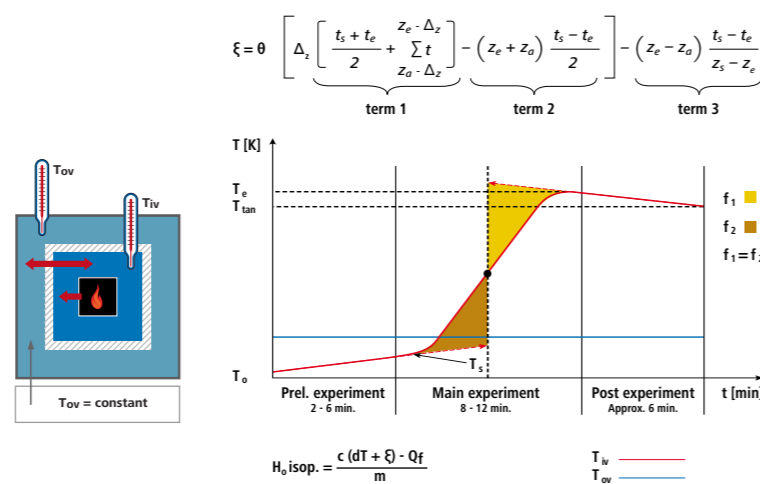
Adiabatic calorimeter

In an adiabatic calorimeter the temperature in the outer vessel (T_{ov}) is equal to the temperature of the inner vessel (T_{iv}) throughout the experiment. This is as close to a "perfect isolation" as possible. The influence of the environment has to be minimized using air-condition to keep the room temperature as constant as possible. No correction calculations need to be done compared to the isoperibolic calorimeter.



Isoperibol calorimeter

In an isoperibol calorimeter the temperature in the outer vessel (T_{ov}), is kept constant throughout the experiment. This does not allow a "perfect isolation". There are still small temperature exchanges. The influence of the environment has to be minimized by using air-condition to keep the room temperature as constant as possible. A correction factor (Regnault-Pfaundler = ξ) will be calculated after the experiment that takes these temperature exchanges into account.



Dynamic calorimeter

The dynamic IKA® designed modes are basically short versions of the original adiabatic and/ or isoperibolic measuring modes. The measurement results often still conform to the required Relative Standard Deviation (RSD) of the official standards.

Standards & Certificates











Calorimeter standards and certificates

Calorimeter standards

- GB/T 213-2008** Calorie testing method of coal
- ASTM - D240** Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter
- ASTM - D4809** Standard test method for heat of combustion of liquid hydrocarbon fuels by bomb calorimeter (precision method)
- ASTM - D5865** Standard test method for gross calorific value of coal and coke
- ASTM - D5468** Standard test method for gross calorific and ash value of waste materials
- ASTM - E711** Standard test method for gross calorific value of refuse-derived fuel by bomb calorimeter
- JIS M 8814** Coal and coke: determination of gross calorific value by the bomb calorimetric method, and calculation of net calorific value
- ISO 1928** Solid mineral fuels
Determination of gross calorific value by the bomb calorimetric method, and calculation of net calorific value
- ISO 1716** Reaction to fire tests for building products
- DIN EN ISO 9831** Animal feeding stuffs, animal products - feces or urine
determination of gross calorific value
- DIN EN 14582:2007** Characterization of waste - halogen and sulfur content
oxygen combustion in closed systems and determination methods
- DIN 51900-1** Testing of solid and liquid fuels - determination of gross calorific value by the bomb calorimeter and calculation of net calorific value
Part 1: Principles, apparatus, methods
- DIN 51900-2** Method using isoperibolic or static, jacket calorimeter
- DIN 51900-3** Method using adiabatic jacket

Calorimeter certificates awarded to IKA®



Coal and Coke <ul style="list-style-type: none"> • Anthracite coal • Hard coal • Brown coal • Bituminous coal • Coke 		Petroleum <ul style="list-style-type: none"> • Jet fuel • Kerosene • Liquid fuels • Gasoline • Oil • Bio-fuels 		
		Cement <ul style="list-style-type: none"> • Coke • Tires • Animal flour • Mixed waste material 		Waste Management/ Recycling <ul style="list-style-type: none"> • Tetra-pack • PVC powder • Printed circuit board • Lacquer • Waste solvent
Power Plants <ul style="list-style-type: none"> • Anthracite coal • Hard coal • Brown coal • Bituminous coal • Coke 				
Food <ul style="list-style-type: none"> • Noodles • Dried fruit • Fish • Milk • Chocolate • Cheese 				Biomass <ul style="list-style-type: none"> • Wood • Wood pellets • Saw dust • Hay • Grass • Corn • Bio-fuels
		Agriculture (Fodder) <ul style="list-style-type: none"> • Forage crops • Fodder for cats, dogs, cows, sheep, pigs, chicken • Animal urine and droppings 	Construction and Building Materials <ul style="list-style-type: none"> • Fleece • Insulation material • Styrofoam • Mortar • Rock wool 	
Universities and Research Institutes <ul style="list-style-type: none"> • Teaching thermodynamics • Enthalpy studies • Airplane covering • Ecological studies • Rats 				

Technical data	
Input power max.	120 W
Rated voltage	24 V DC, 5 A
Fuse	1 x 2.5 AT
Max. On-time	continuous operation
Range of measurement	40.000 J
Measuring mode /	isoperibol up to 17 min
Measuring time	dynamic up to 8 min
	manuel (isoperibol) up to 17 min
	time-controlled up to 14 min
Reproducibility based on analysis of 1 g benzoic acid NBS 39i	
	0,1 % RSD
Operating oxygen pressure	30 bar
General data	
Dimensions (W x D x H)	400 x 400 x 400 mm
Weight	21 kg
Protection class	III
Interfaces	1 x serial (RS 232) 1 x parallel (Centronics)
Ambient temperature	20 – 25 °C (constant)
Ambient humidity	80 %
Protection class according to DIN EN 60529	IP 21



	Ident. No.	
C 200	8802500	100 – 240 V 60 Hz
C 200 halogen resistant	8803700	100 – 240 V 50/60 Hz

C 200 C 200 halogen resistant

Compact low cost combustion calorimeter to determining calorific values of liquid and solid samples. Suitable for teaching and training (e.g. technical schools, universities) and for industrial laboratories with less need for analyses.

- In the manual mode (learning mode) the user triggers ignition and the end of measurement. The temperature changes are recorded at minute intervals. All calculations are manual.
- In the other operating modes ignition and calculation of calorific values are automatic. The calorific value is shown on the display. Acid correction of the calorific value and calculation of the heat values are performed manually.
- The C 5010 decomposition vessel can be equipped to use C 14 disposable crucible.
- Special halogen resistant vessel for quantitative decomposition of halogens and sulfur.
- The C 200 can also be operated with the "CalWin C 5040" calorimeter software. This enables control of up to eight C 200 measurement cells from a PC.

Functions:

- Working methods: isoperibol, manual, dynamic, time-controlled
- Validation according to DIN 51900, ISO 1928, ASTM D240, ASTM D4809, ASTM D5865, ASTM D1989, ASTM D5468, ASTM E711, GB/T 213-2008, EN 14582
- GOST-certified
- Automatic sample ignition
- Compact modular design
- Operator and maintenance friendly
- Complies with all global voltages, from 100 - 240 V
- Powered with a low operating voltage 24 V DC

C 200

Consisting of:

Basic device C 200 incl. power pack and ignition adapter
C 5010 Decomposition vessel standard
C 248 Oxygen station

C 200 halogen resistant

Consisting of:

Basic device C 200 incl. power pack and ignition adapter
C 5012 Decomposition vessel halogen resistant
C 200.2 Conversion kit
C 248 Oxygen station

C 2000 basic, C 2000 control, C 2000 basic high pressure and C 2000 control high pressure

The C 2000 basic and C 2000 control calorimeters are the tried-and-tested systems from IKA® for determining gross calorific values of liquid and solid samples. A high level of automation with extremely simple handling characterizes these instruments. In addition to the isoperibolic measurement procedure (static jacket), a dynamic (reduced-time) working method is also available. Halogen resistant decomposition vessels of the C 5012 series for quantitative decomposition of sulfur and halogens in parallel to determining gross calorific values are available. To provide the calorimeters with cooling water, they need to be connected to a thermostat. e.g. IKA® KV 600 or a firmly installed water supply. The C 2000 basic is equipped with a very convenient console to operate the unit. The C 2000 control is delivered with the proven C 5040 CalWin calorimeter software in order to control the system via PC. Network connection and special configuration for data exchange with LIMS can be implemented at any time.

- Functions:**
- Automatic water handling system includes tempering, filling and emptying of calorimeter inner vessel
 - Automatic oxygen filling of decomposition vessel
 - Automatic decomposition vessel identification
 - Automatic sample ignition
 - Validation according to DIN 51900, ISO 1928, ASTM D240, ASTM D4809, ASTM D5865, ASTM D1989, ASTM D5468, ASTM E711, GB/T 213-2008, EN 14582
 - GOST-certified
 - Operating methods:
 - isoperibol, measurement time: approx. 22 min
 - dynamic, measurement time: approx. 7 min
 - Compact, integrated modular design for convenient operation
 - Cooling water supply via thermostat, e.g. KV 600 or firmly installed water supply (C 25 pressure regulating valve recommended)
 - Interface connections for each of the following: scale, printer, monitor and sample rack C 5020
 - User-friendly software C 5040 CalWin for controlling the calorimeter and administrating measured data
 - LIMS integration is possible
 - Special halogen resistant vessel for quantitative decomposition of halogens and sulfur
 - The decomposition vessel can be changed to use disposable crucible C 14
 - Up to 8 calorimeters can be controlled by a single PC, using a multi-serial plug-in card

C 2000 basic Version 1

- Consisting of:**
 C 2000 basic
 C 5010 Decomposition vessel, standard

C 2000 basic Version 2

- Consisting of:**
 C 2000 basic
 C 5012 Decomposition vessel, halogen resistant

C 2000 basic high pressure

- Consisting of:**
 C 2000 basic
 C 62 Decomposition vessel, high pressure
 C 60 Conversion set

C 2000 control Version 1

- Consisting of:**
 C 2000 control
 C 5010 Decomposition vessel, standard
 C 5040 CalWin, calorimeter software

C 2000 control Version 2

- Consisting of:**
 C 2000 control
 C 5012 Decomposition vessel, halogen resistant
 C 5040 CalWin, calorimeter software
 C 2000 control high pressure

C 2000 control high pressure

- Consisting of:**
 C 2000 control
 C 62 Decomposition vessel, high pressure
 C 60 Conversion set
 C 5040 CalWin, calorimeter software

A PC is required to operate the C 2000 control.

C 2000 Extension device

- Consisting of:**
 C 2000 control (without calorimeter software, without decomposition vessel),
 C 5041.10 Connection cable
 (for 8 x interface box)

Technical data	
Input power max.	1,8 kW
Power ON-time	continuous operation
Range of measurement	40.000 J
Reproducibility	
based on analysis of 1 g	isoperibol 0,05 % RSD
benzoic acid NBS 39i	dynamic 0,1 % RSD
Working modes / Start temperature	isoperibol 25 °C / 30 °C
	dynamic 25 °C / 30 °C
Measurement time	isoperibol up to 22 min
	dynamic up to 7 min
Operating oxygen pressure	30 bar
Cooling medium	tap water
Min. flow rate	60 l/h
Operated with KV 600	
Pressure	0,3 bar
Temperature	
(depending on working mode)	18 / 25 °C
Operated at firmly installed water connection	
Pressure after C 25 pressure regulating valve	1 – 1,5 bar
Temperature	
(depending on working mode)	12 – 28 °C
Max. pressure at the tap	6 bar
General Data	
Dimensions (W x D x H)	440 x 450 x 500 mm
Weight	35 kg
Ambient temperature	20 – 25 °C (constant)
Ambient humidity	80 %
Protection class according to DIN EN 60529	IP 21



	Ident. No.		
Version 1	8802000	230 V	50/60 Hz
	8802001	115 V	50/60 Hz
Version 2	8802100	230 V	50/60 Hz
	8802101	115 V	50/60 Hz
High pressure	8802400	230 V	50/60 Hz
	8802401	115 V	50/60 Hz
Extension Device	8802200	230 V	50/60 Hz
	8802201	115 V	50/60 Hz



	Ident. No.		
Version 1	8801800	230 V	50/60 Hz
	8801801	115 V	50/60 Hz
Version 2	8801900	230 V	50/60 Hz
	8801901	115 V	50/60 Hz
High pressure	8802300	230 V	50/60 Hz
	8802301	115 V	50/60 Hz



max. 8 devices

C 5000 control

The IKA® calorimeter C 5000 is the only calorimeter in the world that offers 3 working methods. Thus, it is possible to perform determinations of gross calorific values of liquid and solid samples in adiabatic (approx. 14 - 18 min), isoperibolic (approx. 22 min) and dynamic (reduced time: approx. 10 min) mode.

A high level of automation in addition to an extensive range of accessories leaves nothing more to wish for.



	Ident. No.	
Package 1/10	8803000	230 V 50/60 Hz
	8803001	115 V 50/60 Hz
Package 1/12	8803300	230 V 50/60 Hz
	8803301	115 V 50/60 Hz

C 5000 control Package 1/10**Consisting of:**

C 5000 Controller
C 5003 Measurement cell
C 5010 Decomposition vessel, standard
C 5001 Cooling system

C 5000 control Package 1/12**Consisting of:**

C 5000 Controller
C 5003 Measurement cell
C 5012 Decomposition vessel, halogen resistant
C 5001 Cooling system

Functions:

- Automatic water handling system includes tempering, filling and emptying of calorimeter inner vessel
- Automatic oxygen filling and degassing of the decomposition vessel
- Validation according to DIN 51900, ISO 1928, ASTM D240, ASTM D4809, ASTM D5865, ASTM D1989, ASTM D5468, ASTM E711, GB/T 213-2008, EN 14582
- GOST-certified
- Interface connections for each of the following: scale, printer, monitor and sample rack C 5020
- User-friendly software C 5040 CalWin for controlling the calorimeter and administrating measured data
- LIMS integration is possible
- Special halogen resistant vessel for quantitative decomposition of halogens and sulfur (accessory)
- The decomposition vessel can be changed over to use disposable crucible C 14 burns during measuring

Technical data

Input power max. (with one measuring cell)		1,3 kW
Power ON-time		continuous operation
Range of measurement		40.000 J
Reproducibility		
based on analysis of 1 g	adiabatic / isoperibol	0,05 % RSD
benzoic acid NBS 39i	dynamic	0,1 % RSD
Working modes		adiabatic isoperibol dynamic

Measurement time	adiabatic	up to 15 min
	isoperibol	up to 22 min
	dynamic	up to 10 min

Operating oxygen pressure	30 bar
Cooling medium (C 5004)	tap water
Flow rate	18 – 42 l/h

Operated (C 5004) with KV 600

Temperature	15 – 20 °C
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Operated at firmly installed water connection

Min. / max. temperature	10 / 19 °C
Max. pressure at the tap	9 bar

General Data

Dimensions (W x D x H)	
C 5000 control Package 1	740 x 380 x 400 mm
C 5000 control Package 2	560 x 380 x 400 mm
Weight Package 1	61 kg
Ambient temperature	20 – 25 °C (constant)
Ambient humidity	80 %
Protection class according to DIN EN 60529	IP 21

C 5000 control Package 2/10

Cooling water supply via thermostat KV 600 or firmly installed water connection.

Consisting of:

C 5000 Controller
C 5003 Measurement cell
C 5010 Decomposition vessel, standard
C 5004 Heat exchanger

C 5000 control Package 2/12

Cooling water supply via thermostat KV 600 or firmly installed water connection.

Consisting of:

C 5000 Controller
C 5003 Measurement cell
C 5012 Decomposition vessel, halogen resistant
C 5004 Heat exchanger



	Ident. No.	
Package 2/10	8803200	230 V 50/60 Hz
	8803201	115 V 50/60 Hz
Package 2/12	8803400	230 V 50/60 Hz
	8803401	115 V 50/60 Hz

C 7000

The C 7000 is the first IKA® calorimeter with a completely dry system for measuring the gross calorific value of solid and liquid samples. The temperature is measured directly in the decomposition system. This results in measurement times in the range of 3 to 7 minutes (depending on the sample). The system can manage up to 8 different decomposition vessels using a code ring scheme.



Functions:

- High sample frequency
- Precise and reproducible determination of gross calorific values according to ISO 1928
- Reduction of routine task through automatic application flow
- Automatic decomposition vessel identification
- Interface connections for scale, printer and PC
- User-friendly software C 5040 CalWin for controlling the calorimeter and administration of measuring data
- Special halogen resistant vessel for quantitative decomposition of halogens and sulfur
- The decomposition vessel can be changed to use disposable crucibles C 14

C 7000 basic equipment set 1

- Consisting of:
- C 7000 Measurement cell
 - C 7010 Decomposition vessel, standard
 - C 7002 Cooling system
 - C 48 Oxygen station

Ident. No.	
8800900	230 V 50/60 Hz
8800901	115 V 50/60 Hz

C 7000 basic equipment set 2

- Consisting of:
- C 7000 Measurement cell
 - C 7012 Decomposition vessel, halogen resistant
 - C 7002 Cooling system
 - C 48 Oxygen station

Ident. No.	
8801400	230 V 50/60 Hz
8801401	115 V 50/60 Hz

Technical data	
Input power max.	0,1 kW
Power ON-time	continuous operation
Range of measurement	30.000 J
Reproducibility based on analysis of 1 g benzoic acid NBS 39i NBS 39i	0,2 % RSD
Working modes	patented double dry
Measurement time	3 – 7 min
Operating oxygen pressure	30 bar
Cooling medium (C 7002)	tap water
Flow rate (C 7002)	2 – 3 l/h
Temperature	12 – 30 °C (cooling water)
Operated at firmly installed water connection	
Max. pressure at the tap	9 bar
General Data	
Dimensions (W x D x H)	310 x 490 x 395 mm
Weight	43 kg
Ambient temperature	18 – 30 °C (constant)
Ambient humidity	80 %
Protection class according to DIN EN 60529	IP 21

C 5040 CalWin

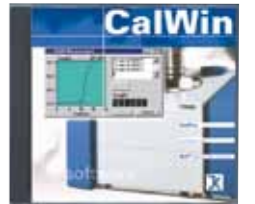
CalWin is a control and evaluation software for all IKA® calorimeters (C 2000, C 4000, C 5000, C 7000).
PC operating system requirements:
Windows 95 / 98 / ME / NT / 2000 or XP, at least one free serial interface and 50 MB of available disc space.

- Control, monitor and view operational procedures
- Print and save measurement protocols
- Identify and record samples
- Administration of sample racks
- Flexible administration and evaluation of calibrations

Technical data	
Diameter support rod	10 mm
Dimension (W x D)	242 x 355 mm
Height	370 mm
Max.load	0,7 kg
Stroke	–

Technical data	
Temperature range	-20 – 40 °C
Temperature setting	digital
Temperature display	digital
Temperature sensor internal	PT 100
Resolution of display	0,1 K
Temperature stability at -10 °C	1 K
Refrigerating capacity at 15 °C	0,3 kW
at 0 °C	0,2 kW
at -10 °C	0,14 kW
at -20 °C	0,07 kW
Refrigerant	R134a
Max. delivery capacity of pressure pump	12 l/min
Delivery pressure (head)	max. 0,2 bar
Delivery suction pressure (head)	max. 0,1 bar
Pump connection	M 16 x 1
Pump connection for hose	NW8/12
Bath volume	4 l
General Data	
Dimensions (W x D x H)	225 x 360 x 380 mm
Power supply requirement	208 – 240 V 1 50/60 Hz
Power input	0,77 kW
Fuse	16 A
Min. ambient temperature	5 °C
Max. ambient temperature	32 °C

- Flexible administration and grouping of measurements
- Printing and saving calibration and result protocols suitable for certification
- Library functions
- Data transmission via RS232 interface to Microsoft® EXCEL and Microsoft® Access applications
- Preprocessed work sheets for Microsoft® EXCEL (configurable by user)



Ident. No. 3045000

C 26 Prep stand

Enables a quick and more efficient sample preparation process when loading the C 5010 and C 5012 decomposition vessels. The lid of the decomposition vessel containing the electrodes and crucible holder is fastened with a clamp. This allows the user the freedom to use both hands while feeding the cotton thread through the electrode and into the crucible.



Ident. No. 8804000

KV 600 digital

KV 600 digital is an active condenser with air-conditioned refrigerator featuring a user-friendly microprocessor controller with large temperature display. The temperature consistency is 1 K. The heat rejection rate and flow rate of the KV 600 are customized to the IKA® Calorimeter C 2000, C 5000 control pack 2, and C 7000.



Ident. No. 3410500 230 V 50/60 Hz
3410501 115 V 50/60 Hz

Calorimeters accessories

for C 200	Ident. No.
C 5010 Decomposition vessel, standard	7114000
C 5012 Decomposition vessel, halogen resistant	7215000
C 5010.4 Attachment for combustible crucible C 14 (for C 5010 / C 5012)	3016900
C 5010.5 Crucible holder, big (for C 5010 / C 5012)	3055900
C 5030 Venting station (for C 5010 / C 5012) with gas wash bottle acc. to DIN 12596 (for gas absorption)	7198000
C 5040 CalWin	3045000
C 5041.10 Connection cable (PC / Calorimeters)	3036000
C 21 Pelleting press	1605300
C 26 Prep stand	8804000
C 29 Pressure gauge, oxygen	0750200
C 248 Oxygen station	3520000
C 200.1 Measuring cup 2.000 ml	3548900
C 200.2 Conversion kit for C 5012	4028800

for C 2000	Ident. No.
C 5010 Decomposition vessel, standard	7114000
C 5012 Decomposition vessel, halogen resistant	7215000
C 62 Decomposition vessel, "high pressure"	3265000
C 60 Conversion set for C 62	3187400
C 5010.4 Attachment for combustible crucible C 14 (for C 5010 / C 5012)	3016900
C 5010.5 Crucible holder, big (for C 5010 / C 5012)	3055900
C 5030 Venting station (for C 5010 / C 5012) with gas wash bottle acc. to DIN 12596 (for gas absorption)	7198000
C 5020 Sample rack	7145000
KV 600 Cooling water supply (230 V)	3410500
KV 600 Cooling water supply (115 V)	3410501
C 25 Pressure regulating valve to operate with firmly installed water connection	3197200
C 5040 CalWin	3045000
C 5041.10 Connection cable (PC / Calorimeters)	3036000
C 21 Pelleting press	1605300
C 26 Prep stand	8804000
C 29 Pressure gauge, oxygen	0750200
C 58 Set of wearing parts (for C 2000 high pressure)	3296300
C 59 Combustion crucibles for C 62 (for C 2000 high pressure)	3266000

for C 5000	Ident. No.
C 5010 Decomposition vessel, standard	7114000
C 5012 Decomposition vessel, halogen resistant	7215000
C 5010.4 Attachment for combustible crucible C 14 (for C 5010 / C 5012)	3016900
C 5010.5 Crucible holder, big (for C 5010 / C 5012)	3055900
C 5030 Venting station (for C 5010 / C 5012) with gas wash bottle acc. to DIN 12596 (for gas absorption)	7198000
C 5020 Sample rack	7145000
KV 600 Cooling water supply (230 V)	3410500
KV 600 Cooling water supply (115 V)	3410501
C 5040 CalWin	3045000
C 5041.10 Connection cable (PC / Calorimeters)	3036000
C 21 Pelleting press	1605300
C 26 Prep stand	8804000
C 29 Pressure gauge, oxygen	0750200

Calorimeters accessories

for C 7000	Ident. No.
C 7010 Decomposition vessel, standard	3015000
C 7012 Decomposition vessel, halogen resistant	3017000
C 7010.8 Venting handle (for C 7010 / C 7012)	7095000
C 7030 Venting station (for C 7010 / C 7012) with gas wash bottle acc. to DIN 12596 (for gas absorption)	3013300
C 5040 CalWin	3045000
C 5041.10 Connection cable (PC / Calorimeters)	3036000
C 7002 Cooling system (230 V)	7011000
C 7002 Cooling system (115 V)	7011001
KV 600 Cooling water supply (230 V)	3410500
KV 600 Cooling water supply (115 V)	3410501
C 21 Pelleting press	1605300
C 29 Pressure gauge, oxygen	0750200
C 48 Oxygen station	1560000
C 5010.4 Attachment for combustible crucible C 14 (for C 5010 / C 5012)	3016900
C 5010.5 Crucible holder, big (for C 5010 / C 5012)	3055900

Consumables for all Calorimeters

	Ident. No.
C 5003.1 Aqua Pro stabilizing agent (20 ml)	7207700
C 710.4 Cotton thread, cut to length (500 pieces)	1483700
C 5010.3 Ignition wire, spare (5 pieces)	7122800
C 5012.3 Ignition wire, platinum (2 pieces)	2994900
C 4 Quartz dish	1695500
C 5 Set of VA combustion crucibles (25 pieces)	1749500
C 6 Quartz dish, big	0355100
C 710.2 Set of VA combustion crucibles, big (25 pieces)	1483500
C 9 Gelatine capsules (100 pieces)	0749900
C 10 Acetobutyrate capsules (100 pieces)	0750000
C 12 Combustion bags 40 x 35 mm (100 pieces)	2201400
C 12 A Combustion bags 70 x 40 mm (100 pieces)	2201500
C 14 Combustible crucible (100 pieces)	7224500
C 15 Paraffin strips (600 pieces)	3131100
C 16 Parafilm, 1.000 x 50 mm	3801100
C 17 Paraffin, liquid, 30 ml	3801200
C 43 Benzoic acid NIST 39i (30 g)	0750600
C 723 Benzoic acid, blister package (50 pieces)	3243000
C 723 Benzoic acid, blister package (450 pieces), big pack	3717400
AOD 1.11 Control standard for sulfur and chlorine (50 ml)	3044000
AOD 1.12 Control standard for fluorine and bromine (50 ml)	3080200
C 58 Set of wearing parts (for C 2000 high pressure)	3296300
C 59 Combustion crucibles for C 62 (for C 2000 high pressure)	3266000
C 08 Pure iron ignition wire (for C 2000 high pressure) (200 m coil)	0749600



Protective device AOD 1.3

As per Pressure Vessel Directive 97 / 23 / EC (not included with delivery)
Ident. No. 3308000

Oxygen filling station C 48

For filling decomposition vessel with oxygen, 30 ba
Ident. No. 1560000

Venting station C 7030

With DIN 12596 gas wash bottle, for gas absorption (not included with delivery)
Ident. No. 3013300

Control standard AOD 1.11 (without fig.)

For sulfur and chlorine
Ident. No. 3044000

Decomposition vessel AOD 1.1

High-alloy, halogen-resistant stainless steel
Ident. No. 3303000

External ignition unit AOD 1.2

Ignition triggered by pressing the Ignite button
Cable length: 5 m
Ident. No. 3348000

AOD 1 Decomposition system

Consisting of:

- AOD 1.1 Decomposition vessel
- C 48 Oxygen station
- AOD 1.2 External ignition unit
- AOD 1.11 Control standard (50 ml)

- Oxidative decomposition of solid and liquid organic samples under pressure in a closed system
- Quantitative decomposition of all halogens, sulfur, as well as volatile metals, e.g. As and Hg
- Absorption of the combustion products in an aqueous medium
- Catalytic support of the oxidation process with auto-regenerating catalytic inside walls of the decomposition vessel
- Pressure vessel of high-grade stainless steel
- Decomposition temperature up to 1.200 °C
- Max. operating pressure during decomposition 195 bar
- Decomposition time < 3 min
- The decomposition vessel can be changed to use disposable crucibles C 14
- Control standards for Cl, S, F and Br
- Introduction of the combustion gases into the absorption solution via venting station C 7030

Ident. No. 8801300

Technical data	
Decomposition time	< 3 min
Core temperature	> 1.200 °C
Max. operating temperature	50 °C
Max. operating pressure	195 bar
Volumen of decomposition vessel	210 ml
Oxygen pressure	30 bar

Important information:

If protective device AOD 1.3 is not used, an AOD 1.13 remote ignition head is required.

The AOD principle is based on the bomb method as per DIN 51577, Part 1 of 1982. Other standards: DIN / EN 14582, „Characterisation of waste - Halogen and sulphur content“ and DIN 51727, Testing of solid fuels - Determination of chlorine content.

AOD 1.3 Protective device

For use with decomposition vessel AOD 1.1 operated in accordance with Pressure Vessel Directive 97/23/EC. If the unit is used improperly (e.g. use of unknown explosive substances or high energy overloads) or if the decomposition vessel is worn, bursting can not totally excluded. In this case the protective device protects the user from inquiry.



Ident. No. 3308000

C 7030 Venting station

The controls venting of the combustion gases after decomposition. Complete with DIN 12596 gas wash bottle. For use with decomposition vessels AOD 1.1, C 7010 and C 7012.



Ident. No. 3013300

Decomposition system accessories

	Ident. No.
AOD 1.1 Decomposition vessel	3303000
AOD 1.2 External ignition unit	3348000
AOD 1.13 Remote ignition head (required where AOD 1.3 is not used)	3348100
AOD 1.3 Protective device	3308000
C 21 Pelleting press	1605300
C 29 Pressure gauge, oxygen	0750200
C 48 Oxygen filling station	1560000
C 5010.4 Attachment for combustible crucible, C 14	3016900
C 7030 Venting station	3013300

Decomposition system consumables

	Ident. No.
C 4 Quartz dish	1695500
C 9 Gelatine capsules (100 pieces)	0749900
C 10 Acetobutyrate capsules (100 pieces)	0750000
C 12 Combustion bags 40 x 35 (100 pieces)	2201400
C 12 A Combustion bags 70 x 40 mm (100 pieces)	2201500
C 14 Combustible crucible (100 pieces)	7224500
C 15 Paraffin strips (600 pieces)	3131100
C 5012.3 Platinum ignition wire (2 pieces)	2994900
C 710.4 Cotton thread, cut to length (not suitable for trace range)	1483700
AOD 1.11 Control standard for sulfur and chlorine (50 ml)	3044000
AOD 1.12 Control standard for fluorine and bromine (50 ml)	3080200
C 723 Benzoic acid, blister package (Combustion aid) (50 pieces)	3243000
C 723 Benzoic acid, blister package (450 pieces), big pack	3717400



Calorimeters

C 1



The traditional heavy screw threaded bomb has been replaced by a light combustion chamber



Automatic oxygen filling, venting and flushing



Software provides control chart view and correction calculation of globally used standards



RFID technology used for decomposition vessel identification



Easy bomb preparation due to new "turned around" crucible holder technology

C 6000



Technical data

Maximum energy input
Resolution of the temperature sensor
Power ON-time
Operating oxygen pressure

Measuring modes / Measurements per hour

Start temperature settings

RSD
(using NIST benzoic acid 39j)

Number of decomposition vessel per unit

C 1	
Maximum energy input	40,000 J
Resolution of the temperature sensor	0.0001
Power ON-time	100 %
Operating oxygen pressure	30 bar
Measuring modes / Measurements per hour	Static jacket (Regnault Pfaundler) 4
Start temperature settings	2 possible settings: 22 °C or 30 °C
RSD (using NIST benzoic acid 39j)	Static jacket (Regnault Pfaundler) 0.15%
Number of decomposition vessel per unit	up to 4
	C 1 Ident. No. 0003825000
	C 1 h Ident. No. 0004505000
	C 1 Package 1/10 Ident. No. 0008804900
	C 1 h Package 1/12 Ident. No. 0008805000
	C 1 Package 2/10 Ident. No. 0008805100
	C 1 h Package 2/12 Ident. No. 0008805200

C 6000 isoperibol	
replaces C 2000	40,000 J
	0.0001
	100 %
	30 bar
Measuring modes / Measurements per hour	Isoperibol (Regnault Pfaundler) 4 Dynamic 6
Start temperature settings	3 possible settings: 22 °C, 25 °C, 30 °C
RSD (using NIST benzoic acid 39j)	Isoperibol (Regnault Pfaundler) 0.05% Dynamic 0.15%
Number of decomposition vessel per unit	up to 4
	Package 1/10 Ident. No. 0008804500
	Package 1/12 Ident. No. 0008804600
	Package 2/10 Ident. No. 0008804700
	Package 2/12 Ident. No. 0008804800

C 6000 global standards	
replaces C 2000; C 5000	40,000 J
	0.0001
	100 %
	30 bar
Measuring modes / Measurements per hour	Adiabatic 5 Isoperibol (Regnault Pfaundler) 4 Dynamic 6
Start temperature settings	3 possible settings: 22 °C, 25 °C, 30 °C
RSD (using NIST benzoic acid 39j)	Adiabatic 0.05% Isoperibol (Regnault Pfaundler) 0.05% Dynamic 0.15%
Number of decomposition vessel per unit	up to 4
	Package 1/10 Ident. No. 0008804100
	Package 1/12 Ident. No. 0008804200
	Package 2/10 Ident. No. 0008804300
	Package 2/12 Ident. No. 0008804400

Technical data

Maximum energy input
Resolution of the temperature sensor
Power ON-time
Operating oxygen pressure

Measuring modes / Measurements per hour

Start temperature settings

RSD
(using NIST benzoic acid 39j)

Number of decomposition vessel per unit

C 200	
Maximum energy input	40,000 J
Resolution of the temperature sensor	0.0001
Power ON-time	continuous operation
Operating oxygen pressure	–
Measuring modes / Measurements per hour	Isoperibol 3 Dynamic 5 Manual (Isoperibol) 3 Time-controlled 4
Start temperature settings	18 – 25 °C
RSD (using NIST benzoic acid 39j)	Isoperibol 0.1 % Dynamic 0.1 % Manual (Isoperibol) 0.1 % Time-controlled 0.1 %
Number of decomposition vessel per unit	up to 4
	C 200 Ident. No. 0008802500
	C 200 h Ident. No. 0008803700

C 2000	
Maximum energy input	40,000 J
Resolution of the temperature sensor	0.0001
Power ON-time	continuous operation
Operating oxygen pressure	30 bar
Measuring modes / Measurements per hour	Isoperibol 3 Dynamic 6
Start temperature settings	2 possible settings: 25 °C or 30 °C
RSD (using NIST benzoic acid 39j)	Isoperibol 0.05% Dynamic 0.1 %
Number of decomposition vessel per unit	up to 4
	basic Version 1 Ident. No. 0008801800
	basic Version 2 Ident. No. 0008801900
	control Version 1 Ident. No. 0008802000
	control Version 2 Ident. No. 0008802100
	Extension device Ident. No. 0008802200

C 5000	
Maximum energy input	40,000 J
Resolution of the temperature sensor	0.0001
Power ON-time	continuous operation
Operating oxygen pressure	30 bar
Measuring modes / Measurements per hour	Adiabatic 4 Isoperibol 3 Dynamic 6
Start temperature settings	Package 1: 22 °C / Package 2: 25 °C
RSD (using NIST benzoic acid 39j)	Adiabatic 0.05 % Isoperibol 0.05 % Dynamic 0.1 %
Number of decomposition vessel per unit	up to 4
	Package 1/10 Ident. No. 0008803000
	Package 1/12 Ident. No. 0008803300
	Package 2/10 Ident. No. 0008803200
	Package 2/12 Ident. No. 0008803400

Package details on page 94

Package details on page 94
For accessories, see pages 86-88



C 1 Accessories and consumables

	Ident. No.
C 1.20	0004501000
Water heater	
C 1.50	0004500600
Dot matrix printer	
C 1.35	0004500800
Venting bottle	
C 1.1012	0004500700
Organizer	
C 1.30	0004500900
Gas washing station	
C 1.10	0004500300
Inner vessel, complete	
C 1.12	0004500400
Inner vessel, complete, halogen resistant	
C 1.101	0004502200
Set of spare parts, approx. 1000 experiments	
C 1.121	0004502300
Set of spare parts, halogen resistant, approx. 1000 experiments	

C 1 and C 6000 consumables

	Ident. No.
① C 1.103	0004579300
Ignition wire, standard, Kantal, 5 pcs.	
② C 1.123	0004500200
Ignition wire, platinum, 2 pcs.	

C 6000 Accessories and consumables

	Ident. No.
C 6010	0003770000
Decomposition vessel, standard	
C 6012	0004504000
Decomposition vessel, halogen resistant	
C 6030	0004504100
Gas washing station	
C 60.1012	0004504200
Organizer	
C 6000.10	0004504300
Set of spare parts, approx. 1000 experiments	
C 6000.12	0004504400
Set of spare parts, approx. 1000 experiments	

Accessories for all Calorimeters

	Ident. No.
C 29	0000750200
Pressure gauge, oxygen	
KV 600	0003410500
Cooling water supply, 230 V	
C 21	0001605300
Pelleting press	
C 5010.8	0004579800
Crucible holder, small	
C 5010.5	0003055900
Crucible holder, big	

C 200 accessories

	Ident. No.
C 248	0003520000
Oxygen station	
C 200.1	0003548900
Measuring cup, 2000 ml	
C 200.2	0004028800
Conversion kit for C 5012	



C 200, C 2000, C 5000 accessories

	Ident. No.
C 5010	0007114000
Decomposition vessel, standard	
C 5012	0007215000
Decomposition vessel, halogen resistant	
C 5030	0007198000
Venting station	
C 5010.4	0003016900
Attachment for combustible crucible C 14	
C 5010.5	0003055900
Crucible holder, big	
C 26	0008804000
Prep stand	

C 2000, C 5000, C 6000 accessories

	Ident. No.
C 5020	0007145000
Sample rack	

C 2000, C 6000 accessories

	Ident. No.
C 25	0003197200
Pressure regulating valve	

C 7000 accessories

	Ident. No.
C 7000	0003008000
Measurement cell	
C 7010	0003015000
Decomposition vessel, standard	
C 7012	0003017000
Decomposition vessel, halogen resistant	
C 7002	0007011000
Cooling system	
C 48	0001560000
Oxygen station	
C 7030	0003013300
Venting handle	
C 7010.8	0007095000
Venting station	
C 5010.4	0003016900
Attachment for combustible crucible C 14	
C 5010.5	0003055900
Crucible holder, big	

Consumables for all Calorimeters

	Ident. No.
③ C 5003.1	0007207700
Aqua Pro stabilizing agent, 2 x 20 ml, except for C1	
④ C 710.4	0001483700
Cotton thread, cut to length, 500 pcs.	

C 710.8	0004579900
Cotton thread, cut to length, thick, 500 pcs.	

⑤ C 4	0001695500
Quartz dish	
⑥ C 5	0001749500
Set of VA combustion crucibles, 25 pcs.	
⑦ C 6	0000355100
Quartz dish, big	
⑧ C 710.2	0001483500
Set of VA combustion crucibles, 25 pcs.	
⑨ C 9	0000749900
Gelatine capsules, 100 pcs.	
⑩ C 10	0000750000
Acetobutyrate capsules, 100 pcs.	
C 12	0002201400
Combustion bags, 40 x 35 mm, 100 pcs	
C 12 A	0002201500
Combustion bags, 70 x 40 mm, 100 pcs	
C 15	0003131100
Paraffin strips, 45 x 3 mm, 600 pcs.	
C 16	0003801100
Parafilm, 1000 x 50 mm	
⑪ C 17	0003801200
Paraffin, liquid, 30 ml	



AVAILABLE 2014

Calorimeters | Accessories and consumables

IKA® offers more



Comprehensive Worldwide Service

Our dedicated team of engineers provides comprehensive worldwide technical service. Please feel free to contact your dealers or IKA® directly in case of any service queries.

Hotline: In the event of an equipment malfunction or technical questions regarding devices and spare parts:
call 00 8000 4524357 (00 8000 IKAHELP)



IKA® Application Support

Our Application Center spans 400 sqm and offers modern facilities for presenting and testing lab devices and processes. This brings us even closer to our customers and improves our service. Here, prospective buyers and customers can test out processes that involve stirring, shaking, dispersing, grinding, heating, analyzing and distilling. In addition, it also further extends the opportunity to test your own devices and to develop new models.



12	C 43	0000750600
	Benzoic acid, NIST 39j, 30 g	
13	C 723	0003243000
	Benzoic acid, blister package, 0.5 g, 50 pcs.	
	C 723 Big pack	0003717400
	Benzoic acid, blister package, 0.5 g, 450 pcs.	
14	AOD 1.11	0003044000
	Control standard, 50 ml, for Sulfur and chlorine	
15	AOD 1.12	0003080200
	Control standard, 50 ml, for fluorine and bromine	
	C 200, C 2000, C 5000 and C 7000 consumables	
		Ident. No.
	C 5010.3	0007122800
	Ignition wire, spare, 5 pcs.	
	C 5012.3	0002994900
	Ignition wire, platinum, 2 pcs.	
	C 14	0007224500
	Combustible crucible, 100 pcs.	
	C 58	0003296300
	Set of wearing parts	
	C 59	0003266000
	Combustion crucibles for C 62	
	C 08	0000749600
	Pure iron ignition wire, 200 m coil	

Calorimeter instructions

Instruction on the IKA® Calorimeter system

Decomposition system

		Ident. No.
AOD 1		0008801300
	Decomposition system	

Decomposition accessories

		Ident. No.
AOD 1.1		0003303000
	Decomposition vessel	
AOD 1.2		0003348000
	External ignition unit	
AOD 1.3		0003308000
	Protection device	
AOD 1.13		0003348100
	Remote ignition head	



C 6040 CalWin

Hardware and software requirements:
requirements: Windows XP (SP2), Windows Vista, Windows 7, Windows 8 and at least one free USB or RS 232 (9 pin Sub-D (M)) serial interface. Processor with min. 1.6 GHz (single core-Processor); 2 GB RAM; 2.5 GB free hard-disc space; DVD-ROM-drive
Ident. No. 0004040500