

# IKA

designed for scientists

## IKA C 3000 isoperibol



Operating instructions

EN



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## Declaration of conformity

We declare under our sole responsibility that this product corresponds to the regulations 2006/42/EC, 2011/65/EU, 2014/30/EU and 2014/35/EU and conforms with the standards or standardized documents EN 61010-1, EN 61010-2-051, EN 61326-1, EN60529 (A1+A2) and EN ISO 12100.

A copy of the complete EU Declaration of Conformity can be requested at [sales@ika.com](mailto:sales@ika.com).

## Explication of warning symbols



Indicates an (extremely) hazardous situation, which, if not avoided, will result in death, serious injury.



Indicates a potentially hazardous situation, which, if not avoided, can result in death, serious injury.



Indicates a potentially hazardous situation, which, if not avoided, can result in injury.



Indicates practices which, if not avoided, can result in equipment damage.

## Safety instructions



**Read the operating instructions in full before starting up and follow the safety instructions.**

- Keep the operating instructions in a place where they can be accessed by everyone.
- Ensure that only trained staff work with the device.
- Follow the safety instructions, guidelines, occupational health and safety and accident prevention regulations.
- The **IKA C 3000 isoperibol calorimeter system** may be used only in conjunction with the decomposition vessels C 6010 or C 6012 for determination of the calorific values of solid and liquid substances to national and international standards (such as ISO 1928, ASTM 240, ASTM 5865, GB T213 und ASTM 4809).
- The maximum extra energy added to the decomposition vessel must not exceed **40,000 J** (select the test mass accordingly). The permitted operating pressure of **230 bar (23 MPa)** must not be exceeded. The maximum permitted operating temperature must not exceed **50 °C**.
- When burning substances containing metals, ensure that the maximum energy input is not exceeded!
- Only fill the decomposition vessel with oxygen to a maximum pressure of **40 bar (4 MPa)**. Check the pressure setting on the pressure reducer for your oxygen supply. Perform a leakage test before each combustion process (see section "Leaktightness testing").
- Some materials tend to explode when combusted (e.g. due to formation of peroxides), which could cause the decomposition vessel to crack. **The IKA C 3000 isoperibol calorimeter may not be used for testing explosive samples.**
- If the burning behaviour of a material is unknown, it must be tested before combustion in the decomposition vessel (risk of explosion). If you are burning **unknown samples**, leave the room or **keep your distance** from the calorimeter.
- Benzoic acid may only be combusted in its pressed form! Flammable dust and powder must be first pressed. Oven-dry dust and powder such as splints, hay, straw etc. explode when combusted! Always wet these materials first! Highly flammable liquids with a low vapour pressure (e.g. tetramethyl dihydrogen disiloxane) must not directly touch the cotton thread!
- Furthermore, toxic combustion residue in the form of gases, ashes or condensation, for example, is possible in the inner wall of the decomposition vessel.



**WARNING**

**Observe the accident prevention requirements applicable to the activity and the work station. Wear your personal protective equipment.**

- When handling combustion samples, combustion residue and auxiliary materials, please observe the relevant safety regulations. The following materials, for example, could pose a risk:
  - corrosive
  - highly flammable
  - explosive
  - bacteriologically contaminated
  - toxic
- Please observe the relevant regulations when handling **oxygen**.



**DANGER**

**Warning: oxygen as a compressed gas is oxidising; intensively aids combustion; can react violently with flammable materials.**

**Do not use oil or grease !**



**DANGER**

**Combustion gases are hazardous to health, therefore the venting hose must be connected to a suitable gas cleaning system or extraction system.**

- Tubes and screwed joints for oxygen must be kept free of grease.
- At the end of the work period, close the main valve for the oxygen supply.
- Perform servicing work only when the equipment is depressurised.
- When using **stainless steel crucibles** thoroughly check their condition after each experiment. If the material gets thinner, the crucible may catch fire and damage the decomposition vessel. Crucibles must not be used for more than 25 combustions for safety reasons.
- The decomposition vessel is manufactured in accordance with the directive for pressure equipment 2014/68/EU. This is indicated by the **CE symbol** with the ID number of the notified body. The decomposition vessel is a category III pressure device. The decomposition vessel has undergone an EC prototype test. The CE declaration of conformity confirms that this decomposition vessel corresponds to the pressure device described in the EC prototype test certificate. The decomposition vessel has undergone a **pressure test** with test pressure of **33 MPa** and a leakage test with oxygen at **3 MPa**.
- Refer also to the operating instructions for the C 6010/ 6012 decomposition vessel, see chapter "maintenance of the decomposition vessel".
- Decomposition vessels are experiment autoclaves and must be tested by a technical expert after each use.
- Individual use is understood here to include a series of experiments performed under roughly the same conditions in terms of pressure and temperature. Experiment autoclaves must be operated in special chambers
- The decomposition vessels must undergo repeated tests (internal tests and pressure tests) performed by the **technical expert**. The frequency of these tests is to be determined by the operator on the basis of experience, type of operation and the material used in the decomposition vessel.
- The declaration of conformity becomes invalid if mechanical modifications are carried out to the experiment autoclaves or if tightness can no longer be guaranteed as a result of major corrosion (e.g. pitting by halogens).
- In particular the threads on the pressure vessel and the union nut are subject to considerable stress and must therefore be checked regularly for wear.
- The condition and function of the seals must be checked and ensured by way of a **leakage test** (see the operating instructions for the C 6010/ 6012 decomposition vessel, section "Leaktightness testing").



**DANGER**

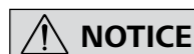
**If the maintenance, and especially the pressure testing, is not performed**

med or is performed incorrectly, there is a risk the decomposition vessel may burst or an uncontrolled internal fire may occur at the electrodes which could burn away the seals (oxyacetylene torch effect), thus posing a risk to life and limb.

- Only **technical experts** may perform pressure tests and service work on the decomposition vessel.
- **We recommend that you send the decomposition vessel to our factory for inspection, and if necessary, repair after 1000 tests or after one year or sooner depending on use**
- A pressure test must be performed after a decomposition vessel has reached or exceeded the recommended number of ignition cycles. Once the pressure test has been performed a release code can be entered to enable the decomposition vessel to be used for further measurements (see the sections "Maintenance of the Decomposition Vessel" and "Inputting a Service Code").  
The warning message will then disappear!  
*Note: You can then continue to use the device / decomposition vessel.*
- Contact the **IKA Service Department** to perform the pressure test. Comply with the safety instructions in this respect. The

user will be given specific instructions on the relevant screen. For the purposes of these operating instructions a **technical expert** is someone:

1. who guarantees to conduct the tests properly on the basis of his training, knowledge and experience gained through practical work,
2. who is sufficiently reliable,
3. who is not subject to any instructions in terms of the test activity,
4. who has suitable test equipment if necessary,
5. who can provide appropriate proof of the requirements listed in 1.



### NOTICE

**National directives and laws must be observed for operating pressure vessels!**

- Anyone operating a pressure vessel must keep it in a proper condition, operate it properly, supervise it, carry out the necessary maintenance and repair work immediately and implement the safety measures required in the circumstances.

## Correct use

The **IKA C 3000** isoperibol calorimeter system is used for calorific value determination of solid and liquid substances.

This is done by placing a known quantity of a substance in a decomposition vessel which is surrounded by a water jacket. The sample is then combusted in an oxygen atmosphere. The calorific value of the sample can then be calculated from the resulting increase in temperature, the sample mass and the known thermal capacity of the overall system.

The **IKA C 3000** isoperibol calorimeter system is subject to the Pressure Vessel Directive 2014/68/EU comply with the safety instructions accordingly.

For adaptation to individual laboratory tasks, use original **IKA** consumables and accessories.

## User instructions

In this chapter you can find out how to work through these Operating Instructions most effectively to be able to work reliably with the calorimeter system.

**The instructions in the section "Safety instructions" must be complied with.**

The chapters are designed for you to work through them in order. The section "Transport, storage" is relevant for system reliability and for ensuring high measuring accuracy.

The section "Description of system components" describes the system components, and the section "The standard calorimetric procedure" describes the essentials of calorimetry.

The calorimeter system is ready to perform measurements once you have completed the procedures in the section "Setting up and commissioning", "Preparing a measurement" and "Starting a measurement".

## System properties

The calorimeter system **IKA C 3000** isoperibol is routinely used for determination of gross calorific values of solid and liquid substances. The accessories of the system ensure customized adaptation to laboratory tasks.

The system is characterized by the following features:

- Relieves you of routine tasks through automated measurement procedure
- Integral oxygen filling
- Operation without the cooling unit: Connection to a water faucet with the pressure valve **IKA C 25**; temperature range 12 °C

upto 27 °C; water consumption per measurement about

- 4 l; water pressure max. 1 bar upto 1.5 bar.
- Operation with active cooling unit 17-27 °C (e.g. **IKA RC2**; optional)
- Measurement and calculation of gross calorific value according to ISO 1928, ASTM D4809, ASTM D5865, ASTM 240, GB T213
- Calculation of net calorific value according to ASTM D4809, ASTM D5865, ASTM 240, GB T213.
- Measurement range: max. 40,000 J (This corresponds to an increase in temperature in the decomposition vessel of approx. 5 K).



### WARNING

**Pressure vessels must not be used if they have defects which could pose a risk to staff or third parties.**

- PC-operation of one or several calorimeters (Software Cal-Win®)
- USB printer port is available
- Operating mode based on the isoperibolic or dynamic principle at 22 °C or 30 °C (the beginning temperature of the water in the inner vessel) depending on the cooling water temperature.

Cooling water temperature	Mode of operation	Working mode	Ambient temperature
12 °C to 20 °C	Isoperibolic 22 °C Dynamic 22 °C	Isoperibolic 22 °C Dynamic 22 °C	22 °C
23 °C to 27 °C	Isoperibolic 30 °C Dynamic 30 °C	Isoperibolic 30 °C Dynamic 30 °C	30 °C

- Differences between the room temperature and working temperature have an influence on accuracy in dynamic mode; as a result, the working temperature should always be kept similar to the room temperature.

## Transport and storage

### Transport and storage conditions

The system must be protected against mechanical impact, vibrations, dust deposits and corrosive ambient air during transportation and storage. It is also important to ensure that the relative humidity does not exceed 80 %.

The appliance must be completely emptied before storing and transportation.

In case of repair the device has to be cleaned and free from any materials which may constitute a health hazard..

## Unpacking

### Unpacking

- Unpack the device carefully
- Any damage should be notified immediately to the shipping agent (post office, railway network or transport company)

### Scope of delivery

- **Calorimeter IKA C 3000 isoperibol**
- C 60.1012 Organizer
- C 723 Benzoic acid
- Stylus for touch screen operation
- Mains connection cable
- Venting knob
- C 1.104 Water bath admixture
- Tool
- Double head wrench DIN 895, Spanner single SW 17, Filter wrench
- Warranty card
- Operating instructions

- Hoses:

Discharge hose (1.5 m) (EMPTY)	
Inflow pipe (in)	
Return pipe (out)	
O <sub>2</sub> connection tube (in)	M 8 x 1



## Commissioning

### Place of installation

A constant ambient temperature is an important requirement for ensuring the high measuring accuracy of the system. The following conditions must therefore be fulfilled at the place of installation:

- No direct solar radiation
- No draughts (e.g. beside windows, doors, air conditioning)
- Sufficient distance to radiators and other heat sources
- The minimum distance between the wall and the rear side of the device must be at least 25 cm.
- The system must not have laboratory hardware such as shelves, wire ducts, ring lines, etc. installed above it.
- The room temperature should be constantly.
- The system must be set up on a horizontal surface.

For operation of the system the following must be available at the place of installation:

- A power supply corresponding to the nameplates on the system components,
- An oxygen supply (99.95 % pure oxygen, quality 3.5; pressure 30 bar) with pressure gauge.

A shut-off valve for the oxygen supply must be installed. Observe the instructions on handling oxygen given in the chapter "Safety instructions".

Please read these operating instructions carefully. **IKA** consider themselves responsible for the safety, reliability and performance of the appliance only when

- the device has been operated in accordance with the operating instructions
- the specifications for the place of installation have been met.

**WARNING** Do not use distilled or demineralized water (increased risk of corrosion)!

Fill the cooler according to the cooler operating instructions. is recommended in drinking tap water quality. Mix in (max. 1 ml for 4-5 l of water) of the supplied water additive. Thus, the durability of the water is improved.

### Connection to the condenser



Rear view without hoses attached



Make sure the filter casing is always securely closed (see "Servicing and cleaning the filter")!

Insert the inflow pipe into the "IN" port until it clicks home. Connect the other end of the pipe to the "OUT" port of the condenser (water pressure max 1.5 bar).

Insert the return pipe into the "OUT" port until it clicks home. Connect the other end of the pipe to the "IN" port of the condenser.

The connection "EMPTY" is intended only for emptying the device, e.g. for transport purposes. In normal operation the discharge hose need not be inserted!

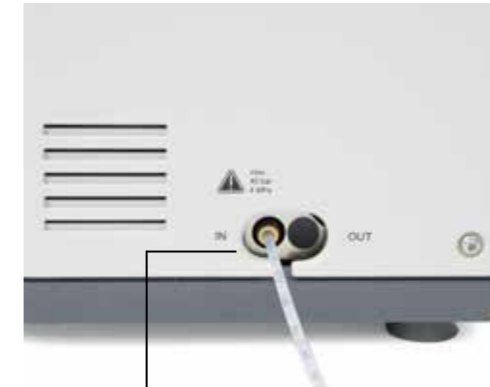
### Connection to the water

**NOTICE** Operation is only allowed with the pressure regulating valve IKA C 25!

The **IKA C 25** pressure regulating valve is absolutely essential on the water faucet for operation of the calorimeter, and it must be preset to an output pressure of approximately 1.5 bar.

The valve is installed into the line of the water connection, see operating instruction **IKA C 25**.

### Connecting the oxygen supply



O<sub>2</sub> connection tube IN  
max. 4 MPa

Insert the O<sub>2</sub> connection tube into the calorimeter "IN" port until it clicks home and connect the free end to the pressure reducer, using the adapters supplied if necessary. **IKA C 29**. Removal entails the same operations performed in the reverse sequence.

**Note: The O<sub>2</sub> connection tube can be removed only after it has been depressurised.**



IKA C 29

### Connection to the mains power supply



Check that the available mains power supply matches the mains power supply particulars listed on the rating plate.



**NOTICE** While the peripheral devices are being connected, they and the calorimeter must be turned-off on the mains power switch!

**RS 232 PC**  
Serial connection for controlling the calorimeter using CalWin® or operating with serial printer C 1.50.

Standard setting: Baud rate: 9600  
Data bits: 8  
Stop bits: 1  
Parity: none  
Handshake: none

**RS 232 BALANCE**  
Interface for connecting scales (Mettler, Ohaus, Sartorius, Kern).

Standard setting: Baud rate: 1200  
Data bits: 7  
Parity: odd  
Stop bits: 1  
Handshake: none

**ETHERNET**  
Network connection for data transfer via the network, e.g. to a network printer.

**USB-DEVICE**  
USB interface (only for service).

**USB-HOST**  
Interface for connection of a printer or with a USB mouse.

On/off switch



**NOTICE** Switch the device off at the on/off switch only when directed to do so by the menu command. Data may be lost if the appliance is switched off other than by following the menu commands.

The device is switched on and off via the on/off switch located on the right-hand side.

Switch the device off at the on/off switch.  
→ Lift moves upwards.

Switch the appliance off only by using the menu commands.  
→ Lift moves downwards.

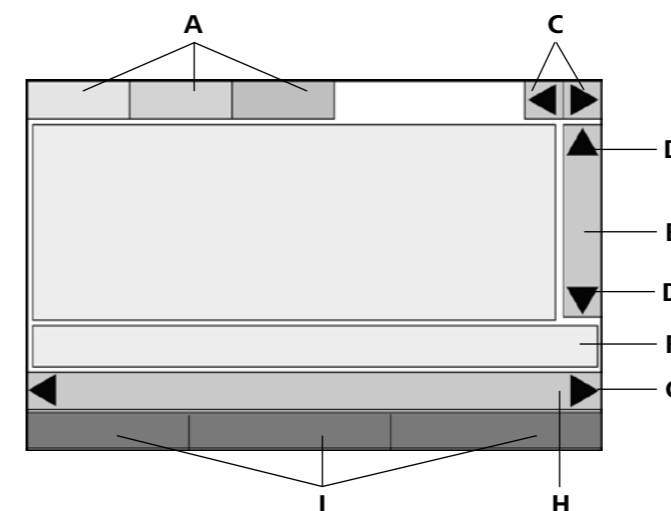
Display and operating elements



After the IKA C 3000 isoperibol calorimeter has been switched on, the touch screen display is active and can be operated using the stylus or finger.

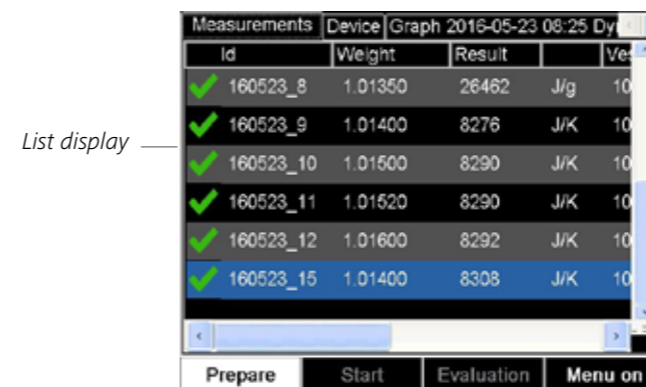
Explanation of the screen display

Schematic representation of the display components

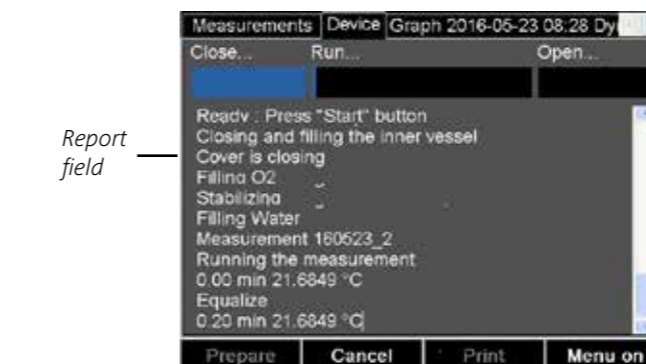


Pos.	Designation
A	Tab
C	Arrow symbol, tabs
D	Arrow symbol, vertical scroll bar
E	Vertical scroll bar
F	Info line
G	Arrow symbol, horizontal scroll bar
H	Horizontal scroll bar
I	Control button

Other view-based presentations of display components are described in the relevant section.



List display









Report field

The contents of the screen display are often distributed over several tabs. You can switch between tabs at any time by clicking on them. Thus for instance the screen display during the calorimetric standard procedure consists of the three views "Measurements", "Device" and "Graphics".

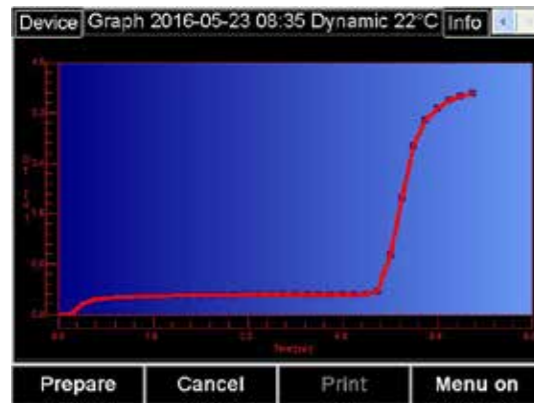
List displays and report fields have scroll bars. Clicking on the pale areas of the scroll bar scrolls the list display or report field. Clicking in the dark area and dragging it allows you to move continuously through the display, as does clicking on the arrow symbols and maintaining the selection.

Note: Greyed-out fields cannot be selected.

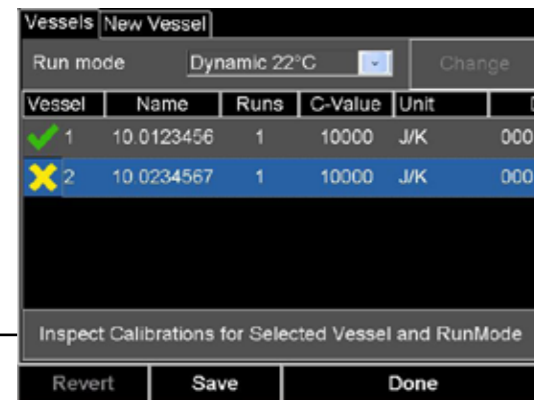
### Status symbols

	<u>Green tick</u> : Measurement completed but not yet evaluated, or selection acknowledgement.
	<u>Pocket calculator</u> : Measurement completed and evaluated, evaluation inputs can no longer be changed.
	<u>Blank tick</u> : Measurement prepared but not yet performed.
	<u>Yellow X</u> : Field property not selected, or cancelled before ignition.
	<u>Red X</u> : Cancellation after ignition.
	<u>Circle</u> : Measurement running.

The view "Graph" shows the temperature by time.



The most important actions available at any point in time are gathered together as clickable buttons along the bottom edge of the screen.



Switch

To initiate an action it is sufficient to click on one of the discrete areas showing the relevant images or text. For instance during the "Preparation for measurement" dialogue the most important actions are explained below.

<u>Weighted sample</u>	Permits manual input of a weight value using the virtual keyboard.
<u>Calibration</u>	Selection field for marking a calibration (on/off).
<u>Decomposition vessel</u>	Manual selection box for the decomposition vessel.
<u>Name</u>	Alphanumeric editable field.
<u>User</u>	Alphanumeric editable field.
<u>Properties</u>	Alphanumeric editable field.
<u>IKA_thread</u>	Selection box which allows a selection list to be opened.

### Weighted sample



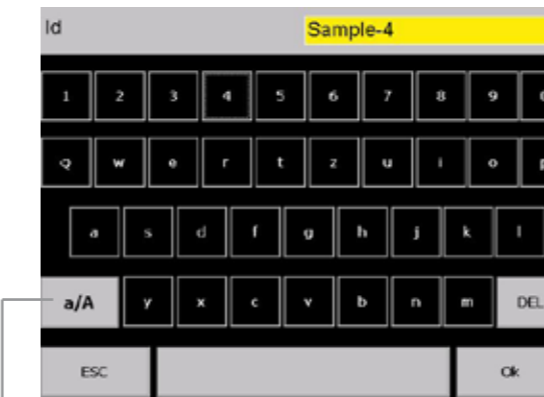
Selection box

**Input of a numerical value, such as weighted sample:**  
The entire area with the exception of the "Scale" button is available to be clicked here. A numerical virtual keyboard is opened and can be used to input the value:

After the virtual keyboard has been closed with "OK", the value in the input field is loaded. Alternatively, clicking on the "Scale" button automatically loads a value from a connected balance.

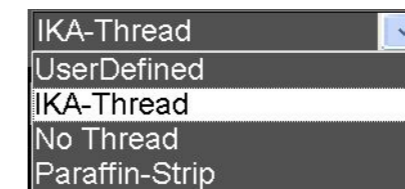


**Input of an alphanumeric value, such as "Designation" :**  
Here again the entire area is available to be clicked. A complete virtual keyboard is opened.  
*Note: The maximum input is 23 characters.*



Shift key for upper and lower case letters and special characters

After the virtual keyboard has been closed with "OK", the value in the input field is loaded.



**Select from a selection box, e.g. for the ignition aid:**

After the selection box has been clicked, a list of the options is displayed. The option that is clicked is selected.



Single selection field, such as calibration :

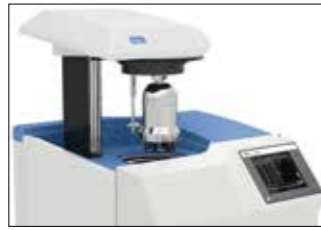


Clicking on the entire area allows the prepared measurement to be marked as a calibration.



## Work with the device

### Switching on the device



The **IKA C 3000** isoperibol is switched on with the On/off switch. The cover opens automatically. A start screen appears for about 30 seconds, during which the hardware is initialised and the software is loaded.

### System test

The system test is performed automatically every time the **IKA C 3000** isoperibol is switched on.



During the system test the start screen is shown again; clicking on the "Show details" button provides detailed information.



Safety instructions regarding information on and activation of the calorimeter are then shown on the **IKA** Homepage.

The system test includes the following steps:

- Testing the external water circuit with the circulation pump and heater (approx. 30 to 45 seconds).
- Testing the internal water circuit with the condenser and water supply, plus the heater once again (approx. 30 to 45 seconds).
- Testing whether the temperature of the cooling waters is correct for the selected function of the **IKA C 3000** isoperibol. (approx. 60 to 180 seconds).

If any one of these steps is not performed successfully, the system test stops with an error message. After all the components have been checked the system test can be restarted the same as after a manual cancellation. To do this, press the "Restart" button.

With the system test in standby, no measurements can be made.

However it is possible to select some menu options. If the cooling water conditions are not correct for the selected function of the **IKA C 3000** isoperibol, you can select a different function from those currently available. Make sure however that the system conditions are stable.



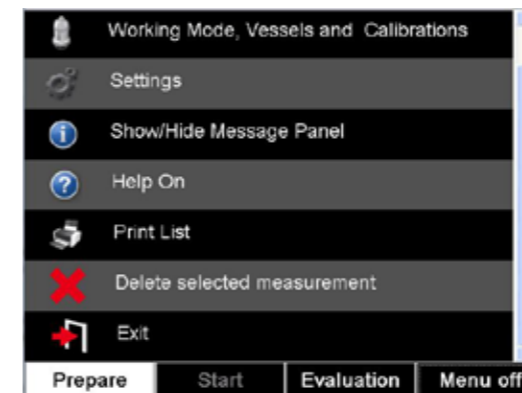
The following are the default modes that are set:  
 - Isoperibol 22 (**IKA C 3000** isoperibol)  
 If the system is changed to a different function it must be recalibrated.

#### First commissioning

At first commissioning you must register a decomposition vessel:

- To do this, press "Menu on" button.
- Select the "Function..." menu item.
- Select the "New vessel" tab and follow the instructions.

### Switching off the device



"End": This saves the measurements taken during the day; the cover of the calorimeter is closed and the software shut down. After this, switch off the calorimeter and all the accessories.

**Never switch the device off without previously having run "End", otherwise data may be lost!**

### The standard calorimetric procedure

#### Determining the calorific value

##### Test condition

Combustion is carried out in a calorimeter under specific conditions. The **IKA C 3000** isoperibol is filled with a weighed fuel sample, the fuel sample is ignited and the temperature increase in the calorimeter system measured.

The specific calorific value of the sample is calculated as follows:

- Weight of fuel sample
- Heat capacity (C-value) of calorimeter system
- Calculated temperature increase of water in the calorimeter system

**For complete combustion the decomposition vessel is filled with pure oxygen (quality 3.5). Adjust the pressure of the oxygen atmosphere in the decomposition vessel at 3 MPa (possible max. 4 MPa). The exact determination of the gross calorific value of a substance requires that the combustion proceed under precisely defined conditions. The applicable standards are based on the following assumptions:**

- Depending on the start temperature that is set, the temperature of the fuel before the combustion is 20 °C upto 30 °C.
- The water contained in the fuel before the combustion and the water that is formed when compounds comprising the fuel containing hydrogen undergo combustion is present in a liquid state.
- No oxidation of the atmospheric nitrogen has taken place.
- The gaseous products after combustion consist of oxygen, nitrogen, carbon dioxide, sulfur dioxide and the oxidation products of the sample.
- Solid substances may be formed (for example ash).

Often, however, the combustion products that form the basis of the standards are not the only products that are formed. In such cases, an analysis of the fuel sample and the products of combustion are necessary to provide data for a correction calculation. The standard gross calorific value is then determined from the measured gross calorific value and the analysis data.

The gross **calorific value Ho** is formed as the quotient of the amount of heat liberated upon total combustion of a solid or liquid fuel and the weight of the fuel sample. The compounds comprising the fuel that contain water must be present in liquid state after the combustion.

The formula for the calorific value is

$$Ho = (CV * DT - Qext) / m$$

where

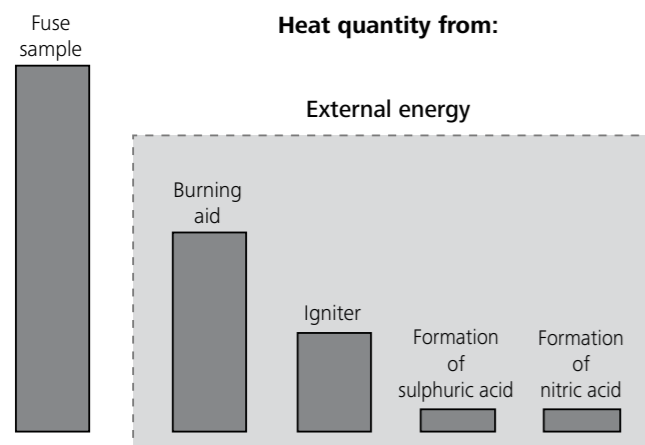
Ho	Calorific value
m	Mass of the sample
DT	Measured and corrected increase in temperature
Qext	All external energy originating from the ignition wire, the ignition aids, the combustion aids and the formation of acids
CV	C value (thermal capacity) of the calorimeter

The **heat value Hu** is equal to the gross calorific value less the energy of condensation of the water that was contained in the fuel and was formed by the combustion. The heat value is the more important quantity for technical purposes, since in all important technical applications, the heat value is the only quantity that can be evaluated in terms of energy.

**For information on the fundamental principles of calculation for gross calorific value and heat value, please refer to the applicable standards (for example: ISO 1928, ASTM 240, ASTM 5865 and ASTM 4809, GB T213).**



## Corrections



The combustion heat of the cotton thread that ignites the sample and the electrical ignition energy would result in distorted values of the measurement. This effect is taken into consideration in the calculation with a correction value.

Substances with low flammability or substances that burn poorly undergo combustion in combination with **combustion aids**. The combustion aid is first weighed and then added to the crucible with the sample. From the weight of the combustion aid and its known specific gross calorific value, it is then possible to determine the quantity of heat that is introduced thereby. The result of the experiment must be corrected by this amount of heat.

The **C 14 disposable crucible** is a combustible crucible that can be used instead of a traditional crucible. The disposable crucible undergoes total combustion with no residue. If a disposable crucible is used, there is then no need for a cotton thread. The crucible is in direct contact and is ignited by the fixed ignition wire of the decomposition vessel.

The sample is weighed directly into the disposable crucible. In most cases, no additional combustion aid is necessary because the disposable crucible itself acts as the combustion aid.

### Note on the sample

The calorimeter system **IKA C 3000 isoperibol** is a precision measuring instrument for the routine determination of calorific values of solid and liquid substances. Exact measurements can however be achieved only if the individual steps of the trial are performed with care. The procedure as described in the "For your safety" section and in the following sections must therefore be adhered to exactly.



**If you are burning unknown samples, leave the room or keep well away from the calorimeter!**

A few points should be noted in respect of the substances to be combusted:

- Normally, solid substances can be burned directly in powder form. Rapidly burning substances (for example benzoic acid) must not undergo combustion in loose form.

Benzoic acid must only be burned in the form of pellets! Combustible dust and powder must be compressed into pellets before

As determined by the system, during a combustion experiment, not only is heat generated from the combustion of the sample, but heat also occurs in the form of external energy.

This may fluctuate considerably in proportion to the heat energy of the fuel sample.

### Acid correction

Almost all substances to be analyzed contain sulfur and nitrogen. Under the conditions that prevail during calorimetric measurements, sulfur and nitrogen undergo combustion and form  $\text{SO}_2$ ,  $\text{SO}_3$  and  $\text{NO}_x$ . Sulfuric and nitric acid arise in combination with the water resulting from combustion and humidity. Heat of solution is also generated. To obtain the standard gross calorific value, the effect of the heat of solution on the gross calorific value is corrected. To obtain a defined final status and to record all acids quantitatively, distilled water or another suitable absorption solution is placed in the decomposition vessel before the trial *according to the relevant standards*. With this absorption fluid and the combustion water, the combustion gases form acids.

After the combustion, the decomposition vessel is thoroughly washed with distilled water so as to collect the condensate that has settled on the inner wall of the vessel as well. The solution obtained in this manner can now be examined with a suitable peripheral detection device for aqueous decomposition into the respective acid content.

For more information on this subject, please contact **IKA**, or your nearest authorized dealer.

combustion. Oven-dry dust and powder such as wood chips, hay, straw etc. burn in an explosive manner! They must be moistened first! Readily combustible liquids with a low vapor pressure must not be come in direct contact with the cotton thread (e.g. tetramethyl dihydrogen disiloxan).

Rapidly burning substances **tend to squirt**. Such substances **must be pressed into tablets before combustion**. Suitable for this is e.g. the **IKA-pelleting press C 21**, see "Accessories".

- Most liquid substances can be weighed directly into the crucible. Liquid substances exhibiting turbidity or containing water that will settle out must be dried or homogenized before they are weighed in. The water content of these samples must be determined.
- Highly volatile substances are placed in combustion capsules (gelatin capsules or acetobutyrate capsules, see "Accessories") and undergo combustion together with the capsules.

- For substances with low flammability or low calorific substances use combustion aids (see "Accessories"). Before the capsules or the combustion bag is filled with the substance to be determined, it must be weighed in order to determine the additional extraneous energy introduced into the system from the weight and the gross calorific value. This is taken into consideration with  $Q_{\text{Extern}2}$ . The amount of combustion aid should be as little as possible.
- Under the conditions that prevail during calorimetric measurements, sulfur and nitrogen undergo combustion and form  $\text{SO}_2$ ,  $\text{SO}_3$  and  $\text{NO}_x$ . Sulfuric and nitric acid arise in combination with the water resulting from combustion. Heat of solution is also generated. This heat of solution is taken into consideration in calculating the gross calorific value. In order to quantitatively record and determine all acids that have been formed, about 5 ml of distilled water or another suitable substance can be added to the decomposition vessel before the experiment.

### Complete combustion

To correctly determine the gross calorific value, it is of fundamental importance that the sample undergoes complete combustion. After each experiment, the crucible and all solid residues must be examined for any signs that combustion was not complete.

In case of using substances tending to squirt it is not possible to ensure complete combustion. **Substances with low flammability** (substances with a high content of mineral matter and low-calorific substances) will often undergo complete combustion only with the aid of combustion capsules or combustion bags (C 10/ C 12 see "Accessories").

### Calibration

To ensure precise, reproducible results of the measurement, the calorimeter system is calibrated after it is initially placed in service, after service jobs, after parts are replaced and at specific time intervals. During calibration, the heat capacity of the calorimeter system is redetermined.

**Regular calibration is absolutely essential to obtain accurate measurements!**

For this purpose, a specific quantity of a reference substance undergoes combustion in the **IKA C 3000 isoperibol** under the conditions of the experiment. Since the gross calorific value of the reference substance is known, it is possible after combustion has occurred to calculate the heat capacity based on the increase in temperature of the calorimeter system.

The reference substance for calorimetry on an international level is benzoic acid of the National Bureau of Standards (NBS Standard Sample 39 J) with a guaranteed gross calorific value.

The thermal capacity is derived from the formula for the calorific value.

$$CV = (Ho * m + Q_{\text{ext}}) / DT$$

Depending on the standard used, determination of the thermal capacity may require performance of several measurements. Using various statistical criteria the average value is calculated and is used as the thermal capacity for subsequent determinations of calorific values.

For more detailed information on calibration please see the relevant standards. If the **IKA C 3000 isoperibol** is operated with several different decomposition vessels, you will need to determine the heat capacity of the system for each decomposition vessel. The parts of each decomposition vessel must then not be swapped

**The calibration of the system must have been performed in accordance with the instructions!**

After combustion, the water that was added, is collected and the decomposition vessel is rinsed thoroughly with distilled water. The rinsing water and the solution formed from the water that was added are combined and the acid content of the combined solution is examined. If the sulfur content of the combustion aid and the nitric acid correction are known, the water does not need to be analyzed.

To increase the service life of parts to wear and tear (O rings, seals etc.) we recommend to work with water added to the experiment as a matter of general principle.



**Caution! Risk of corrosion! Substances with high halogen content must not be combusted in the C 6010 decomposition vessel; instead use the C 6012 decomposition vessel.**

It is also possible to use liquid combustion aids such as paraffin oil. The combustion aids as well (for example the cotton thread) must undergo complete combustion. If unburned residues are left over, the experiment must be repeated.

with parts from other vessels.

In addition the thermal capacity depends to a small extent on the measurement procedure used. The thermal capacity determined for each measurement procedure that is used.

### Instructions on calibration

Ensure that calibration is carried out under the same conditions as the subsequent tests. If substances are used in the decomposition vessel in combustion tests (e.g. distilled water or solutions), you must use exactly the same amount of this substance for calibration.

For determination of calorific values the increase in temperature must be about as great as for the calibration (e.g.: 2 tablets = approx. 1 g benzoic acid = ~ 3 K). The optimum sample quantity must be determined by several trials where necessary.

## Preparing measurements

The term "measurements" below refers to both the measurements to calibrate the calorimeter system (calibration measurements) and the actual measurements for determining the calorific value. The difference lies mainly in the evaluation (see the section "Working with the device" and "Settings"), whilst preparation and performance make virtually no difference.

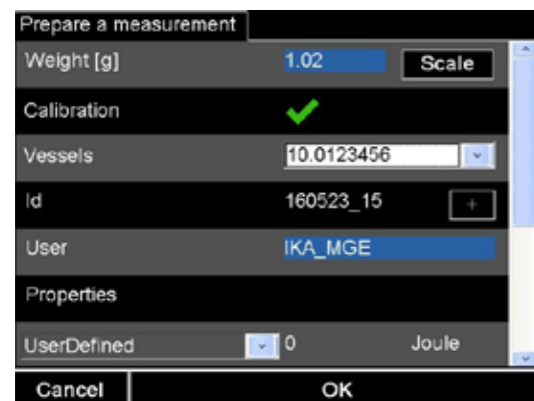
The following preparations must be performed in order to prepare the system to take a measurement:

1. With the decomposition vessel open, attach a cotton thread to the centre of the ignition wire using a loop.
2. Weigh out the substance directly into the crucible with an accuracy of 0.1 mg. If necessary put some distilled water or a solution into the decomposition vessel.

The maximum acceptable weight of the sample that is added is restricted to a value of 5 g.

To prolong the life of wearing parts (o-rings, seals, etc.) we recommend that you always work with a water trap.

As a rule the weighted sample must be selected in such a way that the temperature increase during the measurement is below 5 K and comes close to the temperature increase of the calibration (max. extra energy: 40,000 J). Failure to observe these instructions could result in damage to the decomposition vessel.



If the maximum energy input is exceeded, we recommend that the calorimeter is sent back for repair.

When working with unknown substances, at first select only very small weighted samples (approx. 0.25 g) to determine the energy potential. If you are burning unknown samples, leave the room or keep well away from the calorimeter.

If substances such as distilled water or solutions are added to the decomposition vessel for combustion tests, you must use exactly the same amount of those substances during calibration.

Refer also to the operating instructions for the C 6010/C 6012 decomposition vessel.

A complete measurement can be performed in accordance with the following steps without making further changes to the settings:

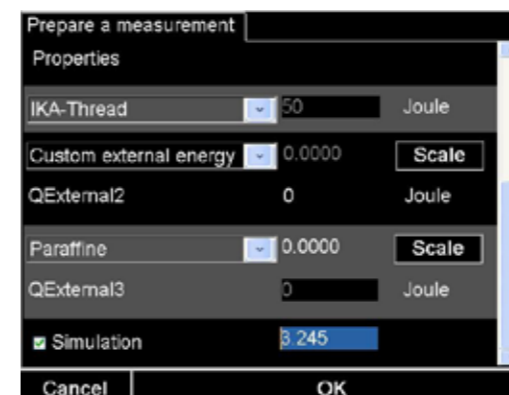
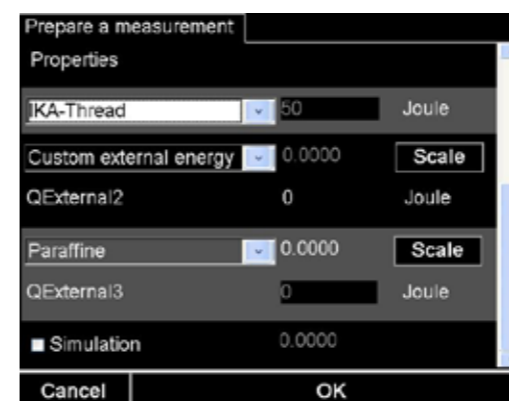
Click on the "Preparation" button in order to prepare for a new measurement. The following screen appears:

Click on "Weighted Sample" to open a virtual keyboard. Click on the necessary figures and the decimal point, and press "OK" to confirm the input.

You can also load the weight from a connected balance or request it by clicking on the "Balance" button. The value is then entered automatically.

All other inputs are optional.

Note: Weight must be between 0,001 g and 5 g.



An alphanumeric virtual keyboard appears for the input options "Designation", "User", "Properties":

Click on OK to complete the respective input.

There is a special procedure for the designation: the default is that the designation for a sample is constructed from the current date and a sequential number. For instance JJMMTT07 denotes the seventh sample processed on TT.MM.JJ.

This designation is also displayed the next time. If the last characters of the designation is numeric, this is incremented by one. You can stop the use of the user-specific designation again every time: call up the "Designation" dialogue, delete the designation and click on "OK".

Highlight the "Calibration" field if you wish to perform a calibration. From the list, select a decomposition vessel.

The scroll bar allows you to access additional input fields for inputting the external energies. If no special application procedures must be observed you can here specify use of the "IKA ignition thread", "User-defined" = 0, "User-defined" = 0 default settings. This means that the default IKA ignition thread will be used as the ignition aid and that no further combustion aids will be used.

**Pay attention to the maximum permissible energy input!**

You can also select specific types of combustion aids from the list. In such cases you must enter the weight of this combustion aid so that the external energy can be calculated.

You can also load these weights directly from a balance: The most flexible way is to click on the relevant "Scale" button. The value is then loaded to the right place.

If the balance cannot receive commands, still click on the "Scale" button and then press the "Transfer" button for the balance.

You can also load weights without clicking on the "Scale" button: If the "Preparation for measurement" screen has not yet been opened, open it. The weights are input in the following sequence:


- Weight of combustion aid 2 (if defined)
- Weight of the sample
- Weight of combustion aid 3 (if defined).

### Simulation

In some circumstances it may be helpful to check some calorific value tests or to calculate possible test results without actually performing the combustion test. This is particularly useful when a calibration has been carried out instead of a calorific value determination or vice versa. This can be corrected by simulation using the increase in temperature from the wrongly interpreted measurement.

1. Start the simulation.
2. Enter the temperature increase.
3. Select the decomposition vessel used.
4. Click "OK" to confirm. The result will be shown in measurement screen.

## Charging the decomposition vessel

 Please refer to the operating instructions for the C 6010/ C 6012 decomposition vessels.

Measurements	Device	Graph	Hardware details	Help
Id	Weight	Result		Ver
✓ 160523_8	1.01350	26462	J/g	10
✓ 160523_9	1.01400	8276	J/K	10
✓ 160523_10	1.01500	8290	J/K	10
✓ 160523_11	1.01620	8290	J/K	10
✓ 160523_12	1.01600	8292	J/K	10
✓ 160523_15	1.01400	99999		10

Inspection  
Vessel closed safely? **Confirm**

After the preparation for measurement, a message appears requiring secure closure of the decomposition vessel, despite there being no decomposition vessel hung in the calorimeter cover. When you confirm the prompt, the "Start" button will be enabled. Hang the decomposition vessel in the calorimeter and press "Start". The cover will close automatically. If you accidentally press the "Start" button before you have hung a decomposition vessel in the calorimeter you will receive an error message when you close the calorimeter cover.

## Starting the measurement



Securely screw the decomposition vessel together and hang it in the calorimeter cover, see operating instruction decomposition vessel C 6010/C 6012.

The decomposition vessel must be positioned centrally within the filling head of the inner cover. When it is correctly positioned you can feel it click home.



Measurements	Device	Graph	Hardware details	Help
Id	Weight	Result		Ver
✓ 160523_8	1.01350	26462	J/g	10
✓ 160523_9	1.01400	8276	J/K	10
✓ 160523_10	1.01500	8290	J/K	10
✓ 160523_11	1.01620	8290	J/K	10
✓ 160523_12	1.01600	8292	J/K	10
✓ 160523_15	1.01400	99999		10

Prepare **Start** Evaluation Menu on

You can then click on the "Start" button.

Device	Graph	Hardware details	Help	Info	Adjust	R
Close...	Run...	Open...				
Inspection Vessel closed safely? Ready : Press "Start" button Closing and filling the inner vessel Cover is closing Filling O2 Stabilizing Filling Water Measurement 160523_15 Running the measurement 0.00 min 21.6849 °C						

Prepare **Cancel** Print Menu on

The screen switches to the "Device" tab.

You can trace the progress of the measurement both in this tab and also in the "Graphics" tab. In the area above the record, progress bars for the individual phases of the measurement are shown. Once the measurement has been correctly completed the calculated calorific value and the calculated thermal capacity also appear here.

Device	Graph	Hardware details	Help	Info	Adjust	R
Close...	Run...	Open...				
Closing and filling the inner vessel Cover is closing Filling O2 Stabilizing Filling Water Measurement 160523_15 Running the measurement 0.00 min 21.6849 °C Equalize 0.20 min 21.6849 °C 0.40 min 21.8353 °C						
<b>WARNING</b> Cancel the measurement ?						
Yes No						

Prepare **Cancel** Print Menu on

You can cancel the measurement at any time by clicking on "Cancel".

Measurements	Device	Graph	Hardware details	Help
Id	Weight	Result		Ver
✓ 160523_2	1.01400	8281	J/K	10
✓ 160523_3	1.01420	8282	J/K	10
✓ 160523_4	1.01380	8280	J/K	10
✓ 160523_5	1.01440	8282	J/K	10
✓ 160523_6	1.01480	26454	J/g	10
✓ 160523_7	1.01500	26459	J/g	10
✓ 160523_8	1.01350	26462	J/g	10

Prepare **Start** Evaluation Menu on

After a measurement, the screen switches automatically to the "Measurements" tab. You can now evaluate the completed measurement. You can also delay the evaluation until later and after opening and cleaning the decomposition vessel proceed to prepare and perform the next measurement as described.

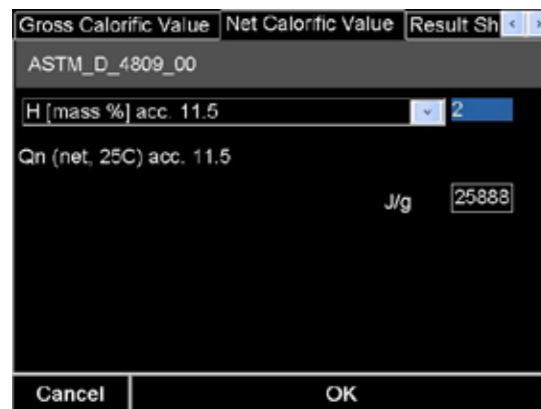
Instructions for cleaning the decomposition vessels can be found in the section "Cleaning the system".





Click on the measurement to be evaluated. Then click on the "Evaluation" button. The following screen with several tabs appears. The parameters for the evaluation are distributed across the "Gross Calorific Value" and "Net Calorific Value" tabs.

**Note:** The "Net Calorific Value" tab is not shown at calibration.



Now you can input the parameters required for the standard that was selected (here: ASTM D 4809). The purpose and meaning of these parameters and the relevant calculation formulae for the complete results can be found in the respective standard. The screens are adapted to suit the standard that was selected.



When you have completed the inputs, switch to the "Results Sheet" tab.

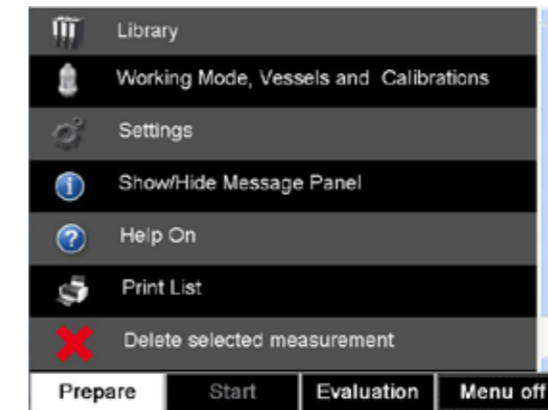
Here the complete data and results of the measurement are presented. You can save and print this form.

Click on OK to finish the evaluation. On each occasion you can correct and extend the evaluation for these measurements by looking them up in the daily list or the library and selecting "Evaluation".

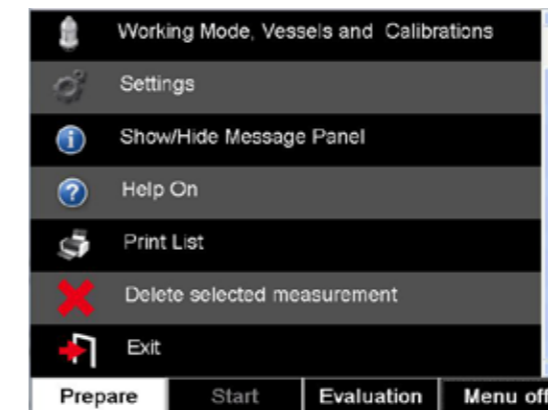


You can view the trial parameters once again under the "Sample" tab.

## Menu



Click the "Menu on" button to display the menu.



Use the scroll bar to display all the menu options.

If a measurement has been prepared or selected you will see only a restricted selection of the menu options.

**"Show/Hide Message Panel":** an information field above the button toolbar is displayed or hidden.

**"Help On":** This added the "Help", "Servicing" and "Hardware details" tabs to the screen view and displays an information window with system information.

**"Print List":** The list of measurements currently displayed is printed (not in combination with serial printer C 1.50!).

**"Delete selected measurement":** This deletes the selected measurement from the displayed list and also from the library. Sequential measurements and those associated with a result cannot be deleted.

**"Exit":** This saves the measurements taken during the day; the cover of the calorimeter is closed and the software shut down. After this, switch off the calorimeter and all the accessories.

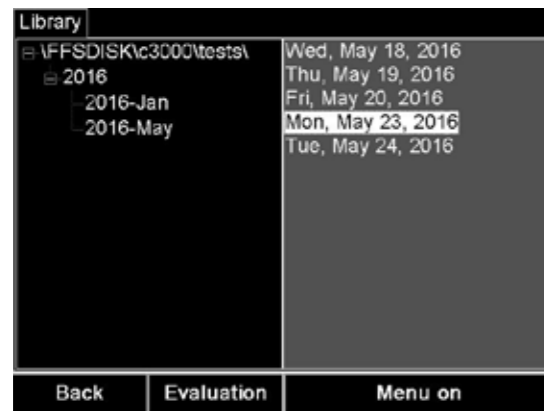
**Never switch the device off without previously having run "End", otherwise data may be lost!**

## Library



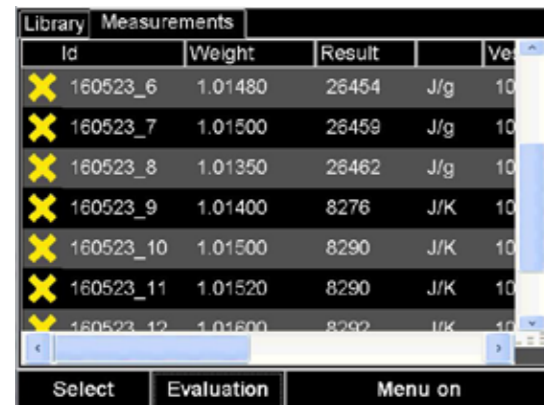
The library screen shows all the measurements within the memory location \\FFSDISK\c3000\tests.



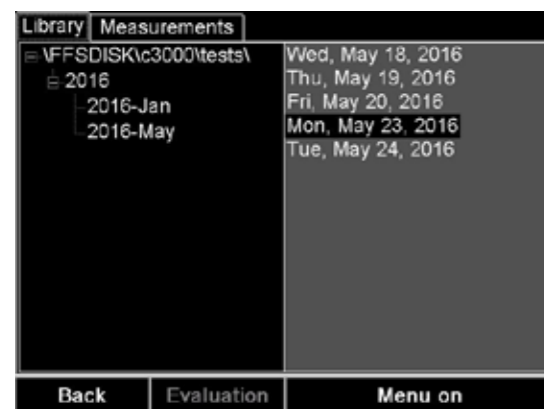


In the left hand selection field you can also extend a directory tree which is organised by years and months. Within each month the right hand window then displays the measurement organised by days.

Select the desired day and click on the "Evaluation" button.



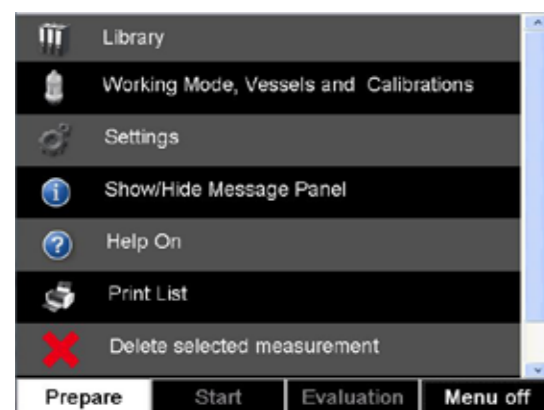
The list of the measurements on the selected day is displayed. You can select a measurement then click on the "Evaluation" button for the measurement to evaluate it for the first time or to reevaluate it, chapter "Evaluation".



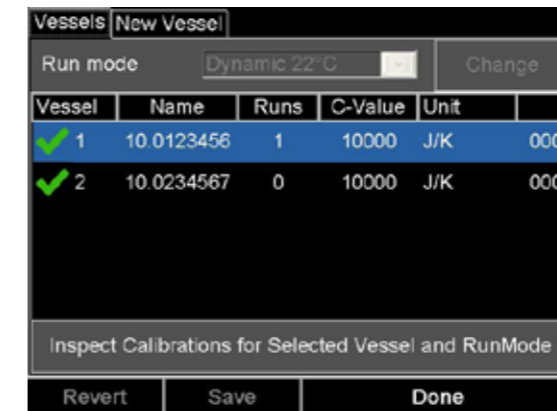
Alternatively you can use the actions provided by the menu as described above.

Once you have completed the work on the measurements for the selected day, switch back to the "Library" tab. Once you have completed all the library work, click on the "Back" button.

## Working Mode, Vessels and Calibrations

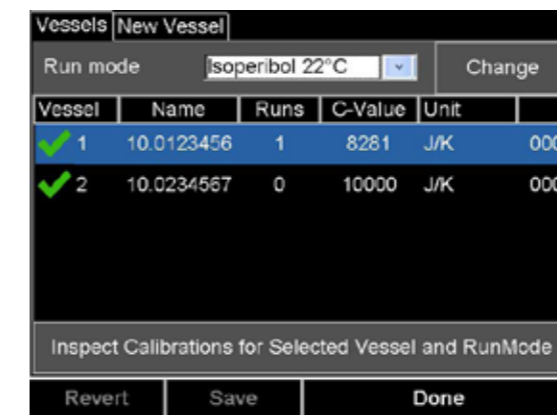


For management of the decomposition vessels and their associated settings, click on the "Menu" button and then the menu item "Function, decomposition vessels and calibration".



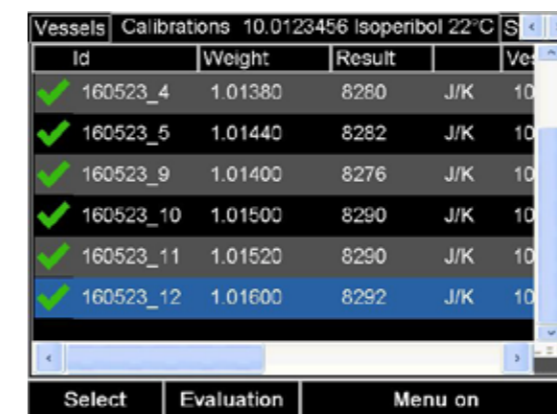
This list shows all the decomposition vessels assigned to the calorimeter. The mark on the left in each line shows whether the decomposition vessel is actually being used. When preparing the sample you can only select the decomposition vessels which are enabled. These are marked with the green tick mark. For reasons of safety decomposition vessels cannot be deleted. Each decomposition vessel is uniquely identified by the serial number. In addition the C values for the current function, the date of last calibration and the number of ignitions are displayed. Click on the "Check calibration for selected decomposition vessels and functions" button. Three additional tabs appear listing the calibration, a check chart of the calibration and the calibration statistics for the selected function and decomposition vessel.

You can select the function of the IKA C 3000 isoperibol from a list.



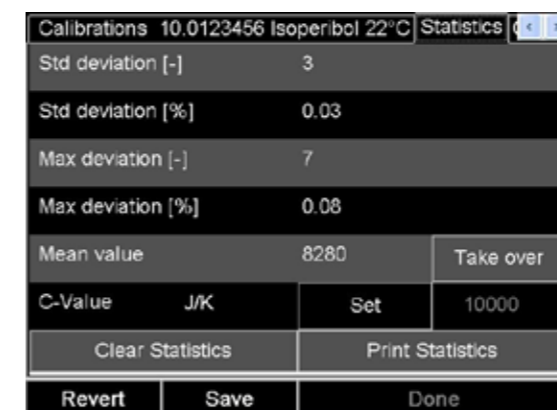
If you wish to change the function for subsequent measurements, click on the "Change" button to start the system check for the new function.

Alternatively you can select a decomposition vessel from the updated list of decomposition vessels.



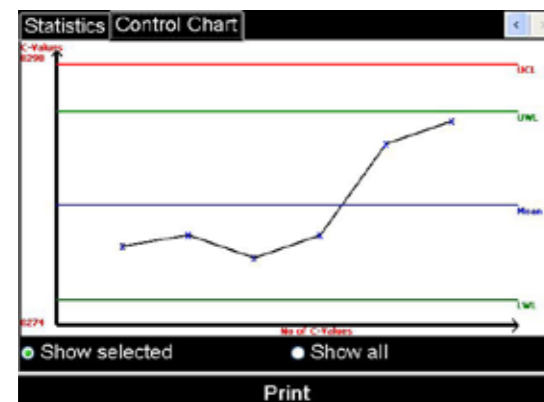
### "Calibration" tab

You can select each calibration individually and click on the "Select" button, or double click on the calibration to reference this calibration in the calculation of the C mean value (or to exclude it if it had previously been selected). Then switch to the "Statistics" tab.



### "Statistics" tab

Average value, standard deviation and maximum deviation relate to the calibration selected. Click on the button "Apply" to load the average value of the calibrations as the new C value. You can also press the "Set" button to input the new C value manually. Press the "Confirm" button to load the value. Press the "Print statistics" button to print the complete statistics on a connected printer. Press the "Delete statistics" button to delete the selection from the statistics that are referred to during calibration. Click on the "Save" button, to use all the changes for the selected decomposition vessel and the selected function. If you click on the "Revert" button, you can completely undo these changes. If you press "Done" you save the inputs, exit this menu, and revert to the overview of the measurements. If you press "Save" you remain in this menu and can select other actions (such as "Check chart").



### "Control chart" tab

This displays the graphics for the selected calibration with the upper and lower warning and control limits. The scaling is adapted automatically.

#### LWL/UWL and LCL/UCL

The LWL and UWL (lower and upper warning limits) define the area within which 95% of the calibration measurements should lie.

The LCL and UCL (lower and upper control limits) define the area within which 99.7% of the calibration measurements must lie in order for the device to fulfil statistical controls.

This means that if 5% of the points (one in twenty) lie outside the warning limits or any points lie outside the control limits, the calorimeter must be verified.

Calculation of the limits, where sigma = standard deviation; sqrt = square root and N = number of measurements:

$$UCL - \text{mean value} + 3 \times \text{sigma} / \text{sqrt}(N)$$

$$UWL - \text{mean value} + 2 \times \text{sigma} / \text{sqrt}(N)$$

$$LWL - \text{mean value} - 2 \times \text{sigma} / \text{sqrt}(N)$$

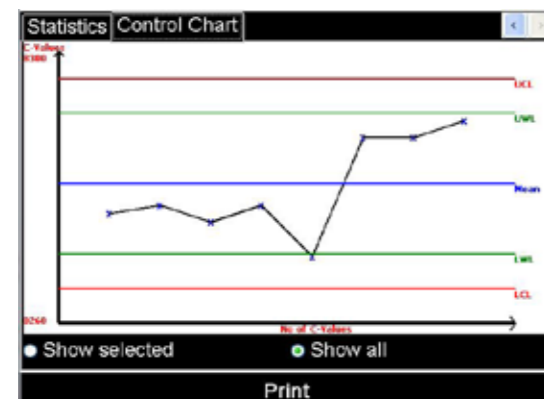
$$LCL - \text{mean value} - 3 \times \text{sigma} / \text{sqrt}(N)$$

If you click on "Show all", all calibrations not just those selected are shown in the graphics. This is useful if there are several series of calibrations or additional check calibrations. You can use the check and warning lines to decide whether the C value has shifted and therefore a reselection and recalculation is necessary.

To exit this menu you must use the arrow keys to switch to the "Decomposition vessels" tab.

Exit with "Done".

If you wish to print the check chart, press the "Print" button.



### "New Vessel" tab

New decomposition vessel: click on the "New vessel" button to assign a new decomposition vessel to the calorimeter. Click on the "Serial number" field and enter the engraved serial number (9 characters) for the new decomposition vessel. Finally click on the "Add" button.

**Please note that the addition of a new decomposition vessel cannot be undone.**

## Servicing the decomposition vessel

Servicing the decomposition vessel: when you wish to start using a decomposition vessel again after servicing or repair, click on the "Servicing the decomposition vessel" button.

You will now see the serial number of the selected decomposition vessel. Input the Service Code for it and click on the "Renew" button. You will receive your service code once you have registered on the IKA homepage.

Switch to the "Decomposition vessel" tab and click on the "Save" button, then on the "Done" button to revert to the main screen.

## Other settings

### Evaluation

### "Evaluation" tab

**Default evaluation:** After a measurement has been completed, as a rule the results are extended and corrected in accordance with the applicable national or international standards.

Select from the list:

The selected standard will be applied to all the subsequent measurements.

Evaluated measurements will comply with this standard: if a measurement has already been evaluated, the evaluation procedure will be used for any subsequent re-evaluation. Otherwise the current setting for the evaluation procedure will be used.

Measurements evaluated previously are not affected by this change.

**Display unit:** This sets the display units for the calorimetric results. Select them from the list.

The selected range of units applies to the display of energy values [J], calorific values [J/g] and thermal capacities [J/K].

**Reference combustion value:** Input here the calorific value of the substance used for calibration. As a rule this substance is benzoic acid with a calorific value certified by the manufacturer.



**"Measurement" tab**

**Double test:** If this menu item is activated, two measurements are basically combined into a group.

The suffix GRP\_x is added onto the end of the testing code. (X = 0, 1 or 2).

In the process, the first two calorific values are checked to ensure they fall within 120 J. If the difference between them is greater than 120 J, a warning appears that a third measurement is required.


The third measurement must then fall within 120 J of one of the first two measurements.

If the first two measurements fall within 120 J of each other, the next measurement creates a new group.

**Take over:** Some parameters from the previous measurement (Name, User, Properties, ignition and combustion aid) can be retained when preparing for a new measurement.

**Restart:** If a measurement is cancelled prior to ignition, after rectifying the cause of the cancellation you can restart the measurement without having to prepare a new measurement.

**water line:**

 **Working with the water supply line is only permitted if the pressure control valve C 25 is used. The water temperature at the inlet must not fall below 12 °C.**

**FUT -screen visible:** If selected the FUT screen will be shown at startup.

Select the menu option to connect the C 3000 to the water supply line. Do not exceed the maximum inlet pressure specified.



**"Ignition aids" tab**

 **These predefined ignition aids cannot be changed.**

You can use an ignition aid to ensure that samples are correctly and reliably ignited. The external energy contributed by the aid must be included when calculating the calorific value.

**Add new ignition aid**



**Ignition aids:**

Select an ignition aid from the list: An energy value is defined for each ignition aid; this value is included automatically in the calculation of the calorific values. If you select "user-defined" this energy value can also be changed at the preparation of each individual measurement. The default setting is "IKA ignition thread"

You can modify the list or add new ignition aids to it. Select an ignition aid and click on the "Edit" button to activate the input fields for this.

You must change the name and the energy values. Click on "Apply" to modify the selected ignition aid. Click on "Add" to add a new ignition aid to the list with the data that were input. Click on "Cancel" to make no changes.



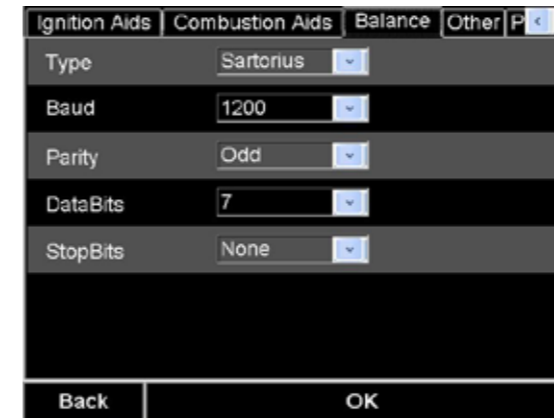
**"Combustion aids" tab**

There are two different combustion aids available for use in order to achieve correct combustion of samples. The external energies contributed by the aids are input or calculated at preparation of the sample and are included automatically in the calculation of the calorific values.

A list is provided for the most commonly used combustion aids, showing their calorific values. If one of these combustion aids is used during preparation of the sample you need only input its weight or load it from the balance.



You can modify the list or add new combustion aids to it. Select a combustion aid from the list and click on the "Edit" button to activate the input fields for it. You can change the name and the calorific value. Click on "Apply" to modify the selected combustion aid. Click on "Add" to add a new combustion aid to the list with the data that were input. Click on "Cancel" to make no changes.



**"Balance" tab**

You can select the balance from a list.

The default values for the serial interface are set for each selected type of balance. If necessary you can change the values for Baud rate, parity, data bits and stop bits.

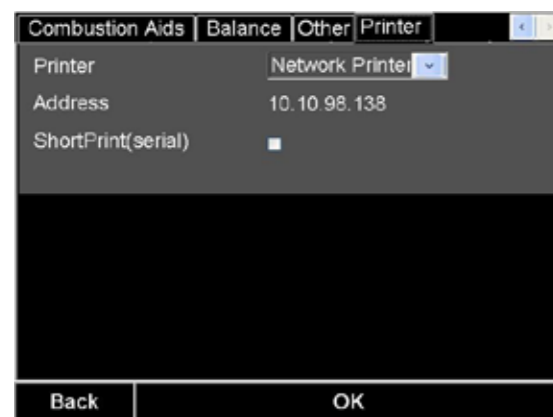
Click on "OK" to use all the changed settings for the subsequent calorimetric procedures.

Click on "Cancel" to leave all the settings unchanged.





## Printer



### "Printer" tab

Select a suitable printer from the list.

#### USB PCL printer

You can connect many type of USB printers which the use the PCL printer language to the C 3000. We recommend the HP Business Inkjet 1200 or its successor models.

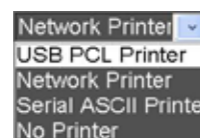
**Note:** PCL languages PCL 3 to PCL 5 are supported. PCL 6 may not work.

#### Network printer

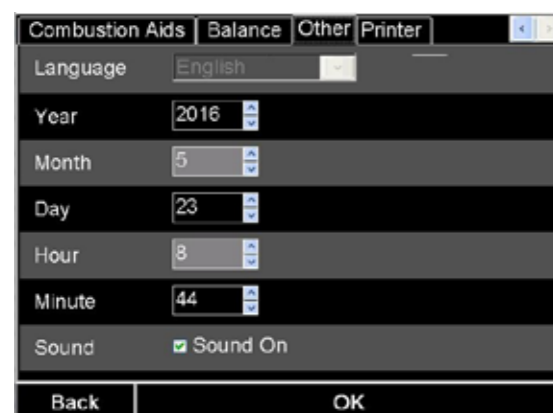
When you have selected a network printer you must then input the network address of the printer. In addition the C 3000 must be connected to the company's network.

#### Serial printer

A serial printer can be connected to PC port of the C 3000. This printer allows printing of the sequential record of the measurements. No other printing operations can be performed with this printer. We recommend the IKA C 1.50 printer with the serial settings 9600-8-N-1.



## Other



### "Other" tab

#### Language:

You can select the language from a list. The next start of the device makes the change of language effective

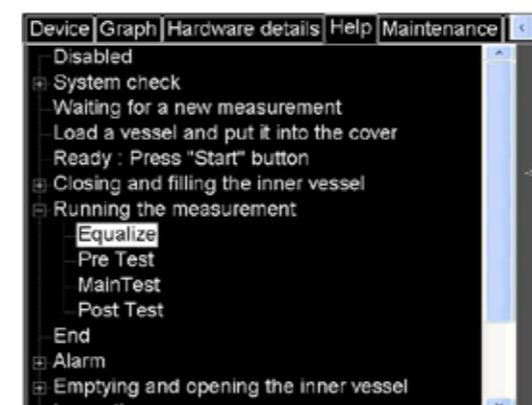
#### Year, month, day, hour, minute:

These settings become effective when you click on the "OK" button. The input field for the hour uses the 24-hour format.

#### Sound:

Activation of the speakers.

## Help and servicing system

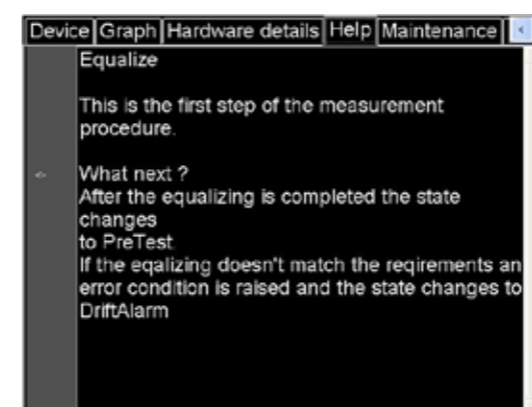


### Help

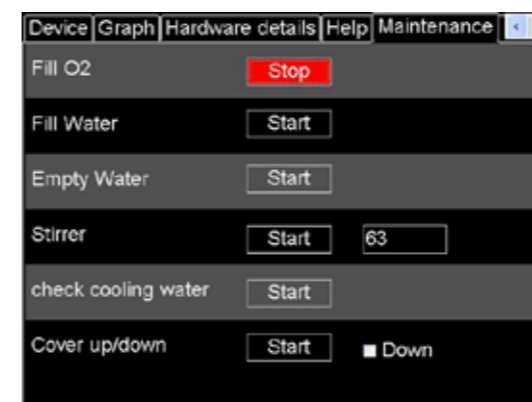
You can activate and display the "Help" tab at any time to obtain detailed information on the current status and available actions for the calorimeter. Click on either the "Help" button in the information field or on the "Help" menu item and switch to the "Help" tab. The "Hardware details" and "Servicing" tabs are also displayed as well as the "Help" tab.

The left hand selection field displays an extendable list of all statuses, views and fault options. The current status or fault is selected automatically and the explanation for it shown in the upper right selection field. If this information is insufficient you can navigate the left hand selection field further to obtain more information.

Click on the desired topic then click on the right hand field with the arrow symbol.



Here you can obtain detailed information on the topic. Click on the left hand field with the arrow symbol, to revert to the overview of topics and if necessary select a different topic.



### Maintenance


Depending on the current status and the information obtained you can perform various actions using the buttons in the "Servicing" tab.

#### Fill O<sub>2</sub>:

The decomposition vessel can be filled with oxygen manually.

#### Fill water:

The inner vessel can be filled manually.

 **The safety functions are deactivated for filling.**

#### Empty Water:

The inner vessel can be emptied manually.

#### Stirrer:

Here the operation of the stirrer can be tested. After the start the stirrer speed is displayed.

#### check cooling water:

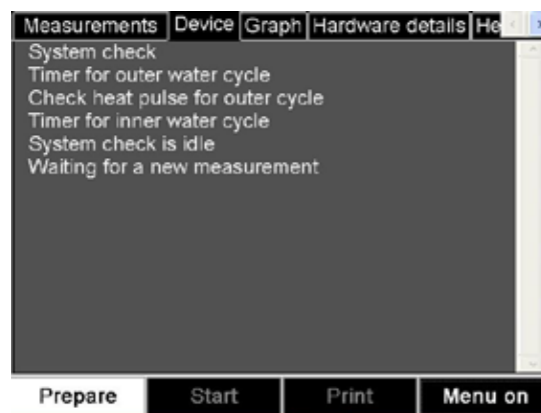
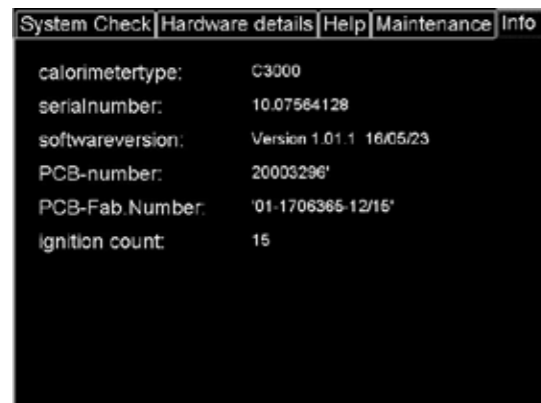
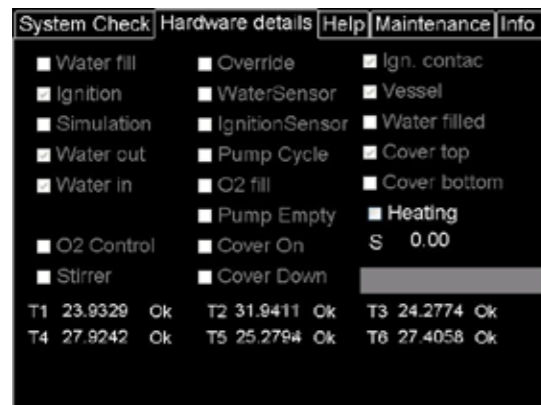
After the start the current cooling water temperature at the entry into the calorimeter is displayed.

#### Cover up/down:

The cover can be opened and closed manually.

Click on "Stop" to stop the function test.





## Hardware details

In addition you can switch to the “Hardware details” tab. This tab shows you all the information about the digital inputs and outputs, the temperature values on all the measurement channels, various counters and statuses of accessories. You cannot make any changes here. The information displayed can be forwarded to Service Engineers who have access to various settings.

## Info

Here you can call up important information for servicing purposes:

- Serial number of the calorimeter
- Software version
- PCB\* number
- PCB\* works number
- Number of ignitions

\*PCB = printed circuit board

## Logging data to SD-CARD or USB-Stick

The complete measurement and calibration folder can be copied via the “Log To Disk” button.

This button can be accessed by switching to the “DEVICE” Tab and then pressing the button „MENU ON”.

The following screen appears.

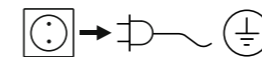
After pressing the button “Log To Disk” all measurement data will be copied automatically to the SD-Card (if inserted).

## Cleaning

### Cleaning the system



**Refer also to the operating instructions for the C 6010/ 6012 decomposition vessel**



For cleaning, disconnect the main plug!

After the result has been recorded, you can take out the decomposition vessel, open it and clean it.

If you suspect that the combustion sample, the combustion gases produced or the combustion residue could be harmful to health, wear personal protective equipment (e.g. protective gloves, breathing masks) when handling these materials. Harmful or polluting combustion residue must be disposed of as hazardous waste. Express reference is made to the applicable regulations.

In order to obtain accurate measurements it is essential that the decomposition vessel is clean and dry. Impurities alter the heat capacity of the decomposition vessel and thus cause inaccurate measuring results. It is important to thoroughly clean the inner walls of the vessel, the internal fittings (brackets, electrodes etc.) and the combustion crucible (inside and out!) after each combustion test.

In most cases all that is necessary is to remove condensate from the inner walls of the vessel and the internal fittings. It is sufficient to thoroughly wipe the parts with an absorbent, non-fibrous cloth. If the decomposition vessel cannot be cleaned in the above way (e.g. due to baking, pitting, corrosion etc.), please contact Technical Service.

The combustion residue in the crucible, e.g. soot or ashes, should also be wiped away with an absorbent non-fibrous cloth.

#### Repairs:

**Please only send devices in for repair that have been cleaned and are free of materials which might present health hazards.**

For this, use the “certificate of compliance” form which you can obtain from **IKA** or can download a version for printing from the **IKA** website at **www.ika.com**.

If your appliance requires repair, return it in its original packaging. Storage packaging is not sufficient when sending the device - also use appropriate transport packaging.

### Servicing and cleaning the filter

#### Servicing

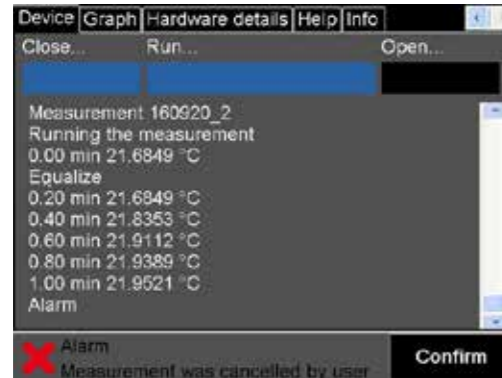
Check the filter every week or according to experience. Over time the filter becomes clogged with sludge thereby causing a reduction in the cooling water flow rate.

**Do not use distilled or demineralized water (increased risk of corrosion)!** Fill the cooler according to the cooler operating instructions. is recommended in drinking tap water quality. Mix in (max. 1 ml for 4-5 l of water) of the supplied water additive. Thus, the durability of the water is improved.

#### Cleaning

- Switch the device off.
- Switch the cooling water supply off (switch off the condenser, clock the water shut-off valve).
- Disconnect the hoses from the device.
- Have an absorbent cloth ready to hand.
- Turn the filter casing anticlockwise, some water will escape. wipe up the water with the cloth.
- Pull out the sieve.
- Use a suitable brush to clean the sieve inside and out.
- Place the sieve back in the filter.
- Screw the filter casing on again finger-tight.
- Reconnect the hoses to the device (see also the section “Commissioning”).
- Switch the cooling water supply on again.
- Switch the device on again.

## Troubleshooting



In the event of a fault you will see an error message in the information field. This appears automatically.

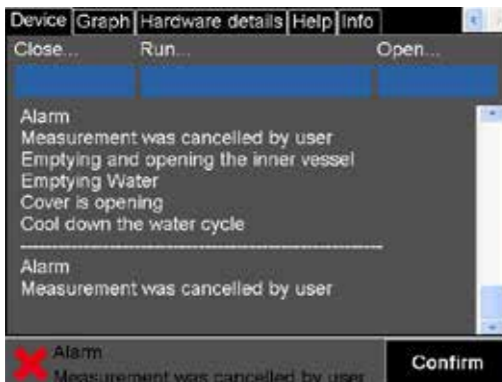
You can click on the "Help" button to obtain detailed information on the fault.

If the fault is non-critical you can click on the "Confirm" button. After that you can rectify the cause of the fault and repeat the action that led to the fault.



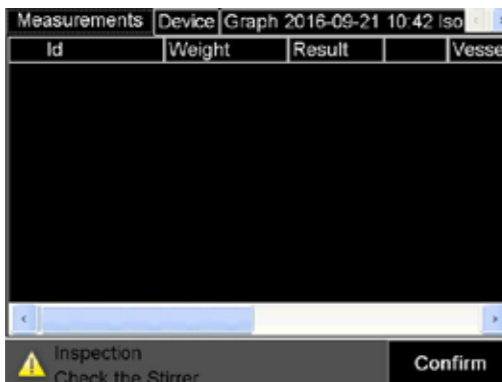
If the fault occurred during a measurement the error message is displayed initially without the "Confirm" button.

After this the calorimeter is opened automatically. Once the calorimeter is open and emptied the error message is displayed once again, this time with the "Confirm" button.



In certain exceptional cases the fault may prevent the calorimeter being available for measurements.

In such cases the calorimeter initiates a system test directly the "Confirm" button is clicked. After you have taken the actions described in the Help or in the operating instructions, click on the "Restart" button to start the system test. On successful completion of the system test the IKA C 3000 isoperibol is again available for measurements.



## Fault rectification

Display	Description	What should be done? What happens next?
No heating pulse in the inner circuit.	No increase in temperature within the inner water circuit.	Acknowledge the alarm. Check the cooling water flow Check the circulating pump. Click on "Restart" to repeat the system test. Click on "Next" to skip the system test.
	No increase in temperature within the outer water circuit.	Acknowledge the alarm. Check the cooling water flow Check the condenser and the water inflow. Click on "Restart" to repeat the system test. Click on "Next" to skip the system test.
The function cannot be performed	The selected function cannot be used because the temperature of the cooling water has not reached the required values.	Acknowledge the alarm. Check the cooling water flow Check the condenser and the water inflow. Check the circulating pump.  Click on "Restart" to repeat the system test. Click on "Next" to skip the system test.
Drift criterion not achieved	This error message is generated during a measurement of the "Equalise" or "Main Test" status if the drift conditions for the current function of the C 3000 cannot be met.	Acknowledge the error message to revert to the "Wait" message. Switch to the "Servicing" tab and press the "Stirrer" button to check that the stirrer is working. Perform a calibration of the C 3000. Establish the specified ambient conditions.
No increase in temperature after ignition.	This error message is generated, if the increase in temperature has not achieved the specified value within the first minute after ignition.	Acknowledge the error message to revert to the "Wait" message. The sample is combusted. The weighted sample of the sample may be insufficient. The calorific value of the sample is too small, use a combustion aid. The oxygen pressure is insufficient The stirrer is not working.  The sample has not been combusted, despite the provision of an ignition thread: The ignition thread was blown away from the sample  Sample and ignition thread were not combusted: Check the ignition system.
Measurement was cancelled by the user.	This error message is triggered in the Close, Run, Open conditions if the user presses the "Cancel" button.	Acknowledge the error message to revert to the "Wait" message.
Cover not closed, or no decomposition vessel is hung in the calorimeter cover.	a. The cover did not reach the lower cover contact. b. The ignition contact did not close.	Acknowledge the error message to revert to the "Wait" message. a. Switch to the "Servicing" tab. Press the "Close" button. b. No decomposition vessel hung in the cover Ignition circuit open circuit.
Water circuit unstable	The stability criterion for the regulation of the water circuits to the working temperature was not achieved within the specified period of time.	Acknowledge the error message to revert to the "Wait" message. Check the water circuit Check the heating We recommend performing a system test to localise more precisely the cause of the problem.
Water not filling OK.	The system could not completely fill the inner vessel with water completely within the specified period of time.	Acknowledge the error message to revert to the "Wait" message. Water level in the condenser too low. Water flow rate insufficient.
Defect at the water sensor.	The water sensor shows completely full within a very short time.	Acknowledge the error message to revert to the "Wait" message. Check whether a drip is hanging from the water sensor. Blow out the recess around the water sensor.

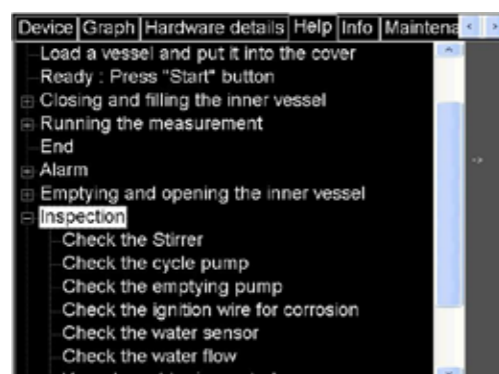
Display	Description	What should be done? What happens next?
Converter alarm	High-precision temperature measurement is one of the core functionalities of the calorimeter. Any error message regarding the temperature recording brings the current measurement to an end and demands a system test. Further work using the calorimeter can be performed only once the system test has been completed successfully.	Acknowledge the error message in order to switch to the "System Check" status. Press the "Restart" button. The temperature converter is reset and the system test starts. On successful completion the status switches to "Wait". If the system test was unsuccessful, switch the C 3000 off and on again. If the system test is unsuccessful again, please contact <b>IKA</b> Customer Service.
Controller alarm	The reliable regulation of the outer vessel is a major precondition for good quality measured values. Any error message from the controller brings the current measurement to an end and demands a system test. Further work using the calorimeter can be performed only once the system test has been completed successfully.	Acknowledge the error message in order to switch to the "System Check" status. Press the "Restart" button. The temperature converter and the controller are reset and the system test starts. On successful completion the status switches to "Wait". If the system test was unsuccessful, switch the C 3000 off and on again. If the system test is unsuccessful again, please contact <b>IKA</b> Customer Service.

## Checks

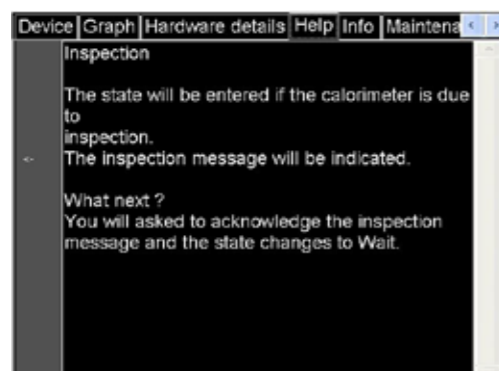


Various major parts of the calorimeter are monitored. Information about when the servicing intervals defined by the manufacturer for these parts fall due is shown in the information field, with the invitation to perform servicing actions. You must then confirm performance of the servicing actions.

Click on "Confirm" to acknowledge performance of the servicing actions. The acknowledgement is saved and can be checked by the Service Engineers.



If you click on the "Help" button you will be given instructions on exactly what to do.



This monitoring is the precondition for a high degree of safety and we ask you to follow the stated instructions precisely.

At the latest after 500 measurements, check the O-ring, filter etc..

## Warranty

In accordance with **IKA** warranty conditions, the warranty period is 12 months. For claims under the warranty please contact your local dealer. You may also send the machine direct to our factory, enclosing the delivery invoice and giving reasons for the claim. You will be liable for freight costs.

The warranty does not cover worn out parts, nor does it apply to faults resulting from improper use, insufficient care or maintenance not carried out in accordance with the instructions in this operating manual.

## Accessories and consumables

### Accessories

C 6010	Decomposition vessel	C 6030	Gas washing station
C 6012	Decomposition vessel	C 27	Calorimeter instrument set
C 5010.5	Crucible holder, large	C 5041.10	Connecting cable 9-pin / 3m
C 5010.8	Crucible holder, small	C 6040	Calwin
C 21	Pelleting press	C 1.50	Dot-matrix printer
C 29	Pressure reducer, oxygen	C 60.1020	Organizer

### Consumables

C 723	Benzoic acid blister pack, 50 pieces	AOD 1.12	Control standard for fluorine and bromine
C 723	Benzoic acid big pack	C 1.103	Ignition wire
C 43	Benzoic acid NIST 39i	C 1.123	Ignition wire, platinum
C 710.4	Cotton wool threads cut to length	C 14	Combustible crucible (100 pieces)
C 710.8	Cotton wool threads cut to length, thick	C 5 VA	VA combustion crucible set (25 pieces)
C 16	Parafilm 1000 x 50	C 710.2 VA	VA Combustion crucible large (25 pieces)
C 17	Paraffin liquid 30 ml	C 4	Quartz dish
C 15	Paraffin strips 600 pieces/package	C 6	Quartz dish large
C 9	Gelatine capsules (100 pieces)	C 6000.10	Spare parts kit 1000
C 10	Acetobutyrate capsules (100 pieces)	C 6000.12	Spare parts kit 1000
C 12 A	Combustion bag, 70 x 40 mm (100 pieces)		
C 12	Combustion bag, 40 x 35 mm (100 pieces)		
AOD 1.11	Control standard for sulphur and chlorine		

For further accessories see [www.ika.com](http://www.ika.com).

## Technical data

Measuring range max	<b>J</b>	40000
Measuring mode dynamic 22 °C		yes
Measuring mode isoperibolic 22 °C		yes
Measuring mode dynamic 30 °C		yes
Measuring mode isoperibolic 30 °C		yes
Measuring time* dynamic approx.	<b>min</b>	8
Measuring time* isoperibolic approx	<b>min</b>	16
Reproducibility dynamic (1g benzoic acid NBS39i)	<b>% RSD</b>	0.15
Reproducibility isoperibolic (1g benzoic acid NBS39i)	<b>% RSD</b>	0.05
Touchscreen		yes
Working temperature min.	<b>°C</b>	22
Working temperature max.	<b>°C</b>	30
Temperature measurement resolution	<b>K</b>	0.0001
Cooling medium temperature min.	<b>°C</b>	12
Cooling medium temperature max.	<b>°C</b>	27
Cooling medium permissible operating pressure	<b>bar</b>	1.5

Cooling medium		water quality tap water
Type of cooling		continuous flow
Flow rate min.	<b>l/h</b>	60
Flow rate max.	<b>l/h</b>	70
Recommended flow rate at 18 °C	<b>l/h</b>	60
Oxygen operating pressure max	<b>bar</b>	40
Interface to scales		RS 232
Interface to printer		USB, RS 232 und network
Interface to PC		RS 232
Interface to ext. keyboard		yes
Oxygen filling		yes
Decomposition vessel C 6010		yes
Decomposition vessel C 6012		yes
Evaluation to ASTM D4809		yes
Evaluation to ASTM D5468		yes
Evaluation to ASTM D5865		yes
Evaluation to ISO 1928		yes
Evaluation to GB T213		yes
Width	<b>mm</b>	500
Depth	<b>mm</b>	450
Height	<b>mm</b>	450
Weight	<b>kg</b>	29
Permissible ambient temperature min.	<b>°C</b>	20
Permissible ambient temperature max	<b>°C</b>	30
Perm. humidity rel	<b>%</b>	80
Protection to DIN EN 60529		IP 20
RS 232 interface		yes
USB interface		yes
Rated voltage	<b>V</b>	220 - 240
Rated voltage	<b>V</b>	100 - 120
Frequence	<b>Hz</b>	50/60
Power consumption	<b>W</b>	1700
Fuses (220-240 V)	<b>A</b>	2x 6,25
Fuses (100-120 V)	<b>A</b>	2x 12,5
Perm. on time		continuous operation
Protection class		I
Overvoltage category		II
Contamination level		2
Operation at a terrestrial altitude		max. 2000 above sea level

*Subject to technical changes!*



# IKA

designed for scientists

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Technical specifications may be changed without prior notice.