E2K HANDBOOK

e2k
Combustion Calorimeter

VERSION 3.2

MANUFACTURED BY DIGITAL DATA SYSTEMS (PTY) LTD.

AND PART OF THE DDS CALORIMETERS BRAND

TÜV Rheinland Quality Services

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INTRODUCTION

Digital Data Systems (Pty) Ltd (**dds**) specializes in the design and manufacture of scientific Bomb Calorimeter systems for various types of industries and applications from the coal mining industry to educational institutes. **dds** Bomb Calorimeter systems are the most advanced bomb calorimeter systems available today. The system is used to measure the calorific value of both solids and liquids. **dds** has three different Bomb Calorimeter models in their Scientific CAL2k range:

CAL2K	ECO	E2K
The CAL2k Calorimeter is aimed at the higher volume market; which requires higher quantities of CV samples per day. A determination will take approximately 7 minutes to run and depending on the number of Vessels used, 10 samples can be carried out every hour.	The ECO Calorimeter is inexpensive and aimed at the lower volume market; which requires very small quantities of CV samples per day. A determination will take approximately 40 minutes to run, and 1 (One) sample can be carried out every hour.	The e2k Calorimeter is a middle of the range product, suited to both the lower and higher volume markets. It also comes with a fantastic language compatible feature. A determination can take approximately 10 minutes using the CAL2K-2 Cooler and one Vessel.

You have chosen the **CAL2K-ECO** Bomb Calorimeter System, which is best suited for your calorimetry requirements.

HISTORY OF DDS BOMB CALORIMETERS

In 1972, **dds** manufactured its first Calorimeter product the AMPC (Automatic Micro Processor Calorimeter). It was a dual water isothermal unit controlled by a microprocessor. In 1980 a new revolutionary design of Vessel, namely the DRY Vessel or CP510 was produced as it had no surrounding water jacket. The determination time was significantly reduced, thus increasing the product's efficiency by 4 times.

With the processing power of the microprocessors available at the time, the CP500 Calorimeter was born with its striking "buttercup yellow" colour. The CP500 proved to be a very fast and reliable system and was exported to the USA, Europe, Scandinavia, Australasia, Africa and India.

In early 2002 work began on the new CAL2k model. The tried and tested DRY system was retained and only the very latest electronic technology was used, including surface mount devices. The CAL2k is now in full production and is sure to be an even bigger success than its predecessor, the CP500. In 2005, **dds** realized the need for a smaller, low sample volume, and inexpensive calorimeter system with the same accuracy and reliability of the CAL2k. Based on these requirements, the ECO was then created as an alternative system to the CAL2k. By 2007, due to customer demands work began on the e2k model. The e2k was designed to be able to have two language options – one being English and the other an alternative language for example French. The e2k was also designed to work faster than the ECO but not as fast as the CAL2k with less features as the CAL2k to keep it cost-effective.

HOW TO USE THIS MANUAL

This Manual makes use of some informative symbols or icons, in order to bring your attention to the text.

WARNING SYMBOL

This yellow triangle with an exclamation mark inside it, indicates a WARNING message or a message that is instructing you NOT to do something. Please take note of this message, because if you ignore it you could damage the Calorimeter equipment.

INFORMATION (NOTE) SYMBOL

This white hand with a finger pointing, indicates a NOTE or INFORMATIVE message. It indicates something that you need to pay attention to. Please take note of this message, as it provides special or detailed information about a particular item.

USER INFORMATION AND HELP AIDS

Included in your shipment is this printed Handbook as well as a CD. The CD includes Application Notes, the Operating Manual, Maintenance Manual and the e2k Windows PC Software.

Below is a detailed description for each of the Help Aids provided:

E2K HANDBOOK

The Handbook is printed and included in your shipment. The Handbook contains useful information for getting started, including:

- System components – what is included
- What each component is used for
- Unpacking instructions of the system
- Setting up the system
- Safety precautions
- Warranty details and registration

E2K OPERATING MANUAL

The Operating Manual is supplied on the CD. The manual contains information on the system operation, including:

- Safety precautions
- Getting started
- System connections
- e2k firing voltages
- General operation
- Operating cycles
- Running a sample using the e2k demo kit
- Quick guide – quick reference guide to operating instructions
- Software Operating instructions

- Maintenance
- Hits and Tips
- Trouble shooting and solutions
- Technical specs
- Spare parts and installation kits
- etc.

E2K MAINTENANCE MANUAL

The Maintenance Manual is supplied on the CD. The Manual contain information on the maintenance and service of your system:

- Self Testing
- Calorimeter maintenance
- Technical information of the Calorimeter
- Cooler maintenance (for Standard and Elite Systems)
- Filling Station maintenance
- Vessel maintenance

CAL2K APPLICATION NOTES

Application notes supplied on the CD are all the samples **dds** has tested using the CAL2k bomb Calorimeter System. There are different types of applications namely: Fuel Oils, Ammunition, Coal, Food & Nutrition, and Alternative Energy Sources.

SYSTEM COMPONENTS

THE E2K COMBUSTION CALORIMETER SYSTEM

PLEASE NOTE: If you have purchased the Minimum System configuration, the CAL2K-2 Cooler will not be included with your order as it does not form part of that configuration. If you have purchased the Standard or Elite System configurations the CAL2K-2 Cooler is included with your order.

The full e2k Combustion Calorimeter System consists of the following items:

- Calorimeter (CAL2K-E2K)
- Cooler (E2K-2) **Only supplied with Standard and Elite System configurations.**
- Air Cooler (E2K-FAN) **Only supplied with the Minimum System configuration.**
- Filling Station (E2K-3)
- Vessels/Bombs (CAL2K-4)

This system has been specifically designed to ensure accuracy and reliability and is backed by a technical team that are experts in their field.

THE E2K CALORIMETER

The Calorimeter is used to determine the energy content (calorific value) of a solid or liquid sample.

The sample is ignited inside the pressurised Vessel and then the Calorimeter measures the temperature rise of the Vessel. This temperature rise is proportional to the calorific value of the sample. The Vessel's chamber (Well) of the Calorimeter is insulated.

Width - 270mm
Height - 200mm
Depth - 380mm
Weight - 8kg
Power - 0 - 264VAC 50/60Hz 1W

THE E2K-2 COOLER

PLEASE NOTE: The Cooler is ONLY supplied with the Standard and Elite System configurations.

Once the Vessel has been fired, it rises in temperature by approximately 9ºC for a 0.5g sample with a calorific value of approx. 27mJ/kg.

The Cooler is used to return the Vessel back to ambient temperature within a few minutes.

Width - 280mm
Height - 250mm
Depth - 320mm
Weight - 10kg
Power - 85 – 264VAC 50/60Hz 150W

THE E2K-FAN AIR COOLER

PLEASE NOTE: ONLY supplied as part of the Minimum System configuration.

The Air Cooler is used to cool a warm Vessel back to the approximate ambient temperature in approx. 20 to 30 minutes.

Width - 130mm
Height - 180mm
Depth - 170mm
Weight - 2kg
Power - 220 Volts 50 Hz 0,1amps
Fuse - 100mA, Size 5 x 20mm.

THE E2K-3 FILLING STATION

The Filling Station is used to pressurise the Vessel with oxygen to **3MPa (3000Kpa).**

This is required so that the sample will ignite and then burn away completely. The oxygen rich environment allows quick and complete combustion of any solid or liquid sample.

Width - 220mm
Height - 450mm
Depth - 300mm
Weight - 4.5Kg

THE CAL2K-4 VESSEL

The Vessel (traditionally called a Bomb) has a combustion chamber, which contains the burning process and transfers the resulting heat into the Vessel's walls, where it is measured. The Vessel has temperature sensors built into the wall, so that the temperature rise can be measured and converted to an energy value.

Because of the high pressure of oxygen required for combustion, the Vessel is classified as a "Pressure Vessel" and is consequently tested by an inspection authority to 10 times its normal pressure and a certificate is issued for each Vessel , a copy of which is supplied with the Vessel.

Diameter - 82mm
Height - 150mm
Weight - 2.5Kg

INSTALLATION

UNPACKING AND INSPECTION

By the time you read this Manual, you would have unpacked the e2k System. There are no special precautions to be taken. The following check list is for your convenience:

1. Locate and tick-off the various system components as indicated on the Packing List provided.
2. Unpack and inspect all the system components such as the e2k Calorimeter, the E2K-2 Cooler or e2k Air Cooler, the E2K-3 Filling Station, and the CAL2K-4 Vessel according to the instructions in the relevant sections in this Manual.
3. Inspect everything for any physical damage during transit. If damaged, consult your Agent immediately.
4. The Calorimeter has a GROUND (SAFETY EARTH) at the rear panel. This lug MUST be connected to the EARTH supply to insure operating personal safety in case the power supply fails.
5. Verify the earth connection of the mains outlet which you intend to use, by checking the continuity to the nearest water pipe. Ask a qualified electrician to check it.
6. Connect the power supply unit and mains cable to the mains power supply on the Calorimeter. Any power supply with 9V output, 100mA capacity, centre pin POS, can be used.
7. Observe that the Display on the Calorimeter comes ON. If not, check the mains connections or consult your Agent immediately.
8. Connect mains to the E2K-2 Cooler (if purchased).
9. Run the system tests as explained in the Operational Manual. The Operating Manual is supplied on CD.

SETTING UP

PREREQUISITES

Prior to installation of the e2k System, the User must provide the following:

1. A mains outlet for the e2k Calorimeter power supply.
2. A supply of oxygen at a pressure of 3.0-3.5Mpa (30-35 bars) (3000Kpa) within 2 - 10 meters of the e2k System. If bottled oxygen is used, a suitable high pressure oxygen regulator must be supplied (See E2K-3 Filling Station).

3. If the E2K-2 Cooler has been purchased, a supply of water at normal tap pressure within 10 meters of the e2k System (See E2K-2 Cooler) needs to be supplied. A mains outlet is also required.
4. If the e2k Air Cooler is supplied, only a mains outlet is required.
5. If a balance is supplied, ensure that a sturdy, stable weighing surface is available. A mains outlet and a connecting cable are also required.

SITE SELECTION

The e2k Calorimeter is a desktop unit, which can be installed wherever the laboratory space permits, with two restrictions:

1. The measuring chamber (Well) of the e2k Calorimeter should not be exposed to very drastic temperature changes. The Calorimeter's chamber (Well) is double insulated to minimise the effect, however, good installation helps. The inner measuring chamber of the Calorimeter is measured and used as a reference by the E2K-2 Cooler. (If the Cooler has been ordered).
2. The e2k System, consisting of e2k Calorimeter, E2K-2 Cooler, (if supplied) should be connected to a mains circuit without heavy inductive or SCR switched equipment. It is safe to have balances or other small electronic apparatuses on the same circuit. Good installation practice would be to have a separate fused mains circuit with separate earth leakage supply (or an earth current monitor, if applicable) for every system component. Future computers and peripherals installed can be connected to the same circuit.

Please see above for the dimensions, weights and power requirements per unit. The BALANCE data would be dependent on the make and model. Approx. dimensions (in mm): 250W x 450H x 500D.

SAFETY PRECAUTIONS

CALORIMETER (CAL2K-E2K)

- Electrical Shock: There are no user serviceable parts inside.
- Do not open the back panel unless the mains cable has been disconnected.
- Dangerous voltages will be present inside the unit after the mains cable has been disconnected.

DO NOT TAMPER WITH THE EARTHING - CONSULT A QUALIFIED ELECTRICIAN SO THAT THE EARTHING CAN BE CHECKED.

COOLER (E2K-2)

The Cooler is only supplied when the Standard and Elite System configurations have been purchased. If you purchased a Minimum System configuration, you will receive an Air Cooler (E2K-FAN).

- Electrical shock: There are no user serviceable parts inside.
- Do not open with the water hoses connected.
- Disconnect from Mains before opening the Cooler (CAL2K-2).

- Dangerous voltages will be present inside the unit after the mains cable has been disconnected.

DO NOT TAMPER WITH THE EARTHING - CONSULT A QUALIFIED ELECTRICIAN SO THAT THE EARTHING CAN BE CHECKED.

E2K AIR COOLER (E2K-FAN) – ONLY WITH THE MINIMUM SYSTEM

The Air Cooler is only supplied if the Minimum System has been purchased.

- If the fuse needs checking or replacing always disconnect the unit from mains before removing the fuse cover.

DO NOT TAMPER WITH THE EARTHING - CONSULT A QUALIFIED ELECTRICIAN SO THAT THE EARTHING CAN BE CHECKED.

FILLING STATION (E2K-3)

- Secure the Filling Station to the table.
- Install the flexible high pressure pipe supplied without sharp bends.
- Check the nylon high pressure pipe supplied for any mechanical damage before putting it under pressure.
- Secure the pipe nuts to the pressure regulator side, then clamp the ferrule to the high pressure pipe on the gauge block side.
- If the oxygen bottle is not situated close to the Filling Station or if it is in another room or even outside, then a solid, permanent installation of pressure piping should be installed as well as a shut off valve and pressure gauge within easy reach of the E2K-3 Filling Station.
- If bottled oxygen is used, a suitable High Pressure oxygen regulator must be supplied by your Agent, or sourced locally. Ordering this item from the factory ensures that the necessary modifications have been made to fit the E2K-3 Filling Station.
- The oxygen bottle should be secured according to regulations.

DO NOT USE ANY OTHER PIPE OTHER THAN THE HIGH PRESSURE PIPE SUPPLIED.

ALWAYS FILL THE VESSEL WITH OXYGEN TO A MAXIMUM PRESSURE OF 3000KPA (30 BAR).

NOTE: With some applications you may need to fill the Vessel to less than 3000KPA e.g. 1500KPA (15 bar), however this is only applicable when you have a sample which is highly combustible, for example with wood related samples.

REMEMBER: You may fill the Vessel LESS than 3000KPA but NEVER more than 3000KPA.

HIGH PRESSURE OXYGEN

- The type of Oxygen to be used is the standard Industrial Oxygen used for welding. A purity of 99.5% will be suitable.
- Conform to the industry standard of handling procedures for oxygen bottles.
- Secure the bottle against a wall.

NEVER use oil or grease on any part of the gauge assembly or any part of the Filling Station and Vessel for SAFETY reasons!

DO NOT use a hammer to free a jammed valve.

- Use only the approved pressure reduction valve with a safety blow valve.
- Consult your safety engineer when in doubt.

VESSEL (CAL2K-4)

- The Vessel has been pressure tested (certificate will be provided if required), at 40 MPA according to international standards.
- The Vessel and its Cap's thread are subject to wear and tear, and must be inspected regularly. Check for excessive play.
- A Vessel with "loose" or worn threads is dangerous, and it must be reconditioned by the **dds** Factory.
- A Vessel with worn threads may cause the Cap to blow off during a determination, which is extremely dangerous and may cause injury to the operator. Vessels with worn threads which cannot be reconditioned will be deemed unsafe and a condemnation certificate will be issued.
- Vessels should be returned to **dds** every 6 months for reconditioning, checking and subsequent pressure tests. A Vessel will require reconditioning after 5000 firings; however this quantity could be significantly reduced depending on the type of samples analysed. Therefore it is advisable to have your Vessel(s) checked regularly. Vessels will need to be returned to **dds** for reconditioning, an agent is not authorised to recondition a Vessel and therefore it must be sent to **dds** for this procedure.
- Do not extend any part of your body over the e2k Calorimeter during the initial period.
- Consult your safety engineer or your mechanical engineer for guidelines, when in doubt.

NEVER OPERATE ANY UNSAFE VESSEL.

NEVER IMMERSE THE VESSEL INTO COLD WATER WHEN COOLING. USE THE CAL2K-2 COOLER OR ALLOW THE VESSEL TO COOL DOWN NATURALLY.

NOTE: THE MANUFACTURER (DDS) AND ITS AGENTS CANNOT BE HELD RESPONSIBLE FOR ANY LOSS OR DAMAGE RESULTING FROM NEGLIGENCE OR INCORRECT USE OF THEIR EQUIPMENT. IT IS YOUR DUTY AND RESPONSIBILITY TO CHECK ALL SAFETY ASPECTS OF THE CAL2K SYSTEM REGULARLY.

CERTIFICATIONS

TÜVRheinland®
Precisely Right.

C E R T I F I C A T E

No. TRQS 3043004-F

Licence Holder:	Manufacturer:
Digital Data Systems (Pty) Ltd PO BOX 35872 Northcliff 2115 South Africa	Digital Data Systems 22 Arbeid Avenue Strydom Park Randburg South Africa

Product:	Requirements:
CAL2k-1 Calorimeter	2006/95/EC
CAL2k-e2k Calorimeter	2004/108/EC
CAL2k-ECO Calorimeter	97/23/EEC
CAL2k-2 Cooler	-
CAL2k-3 Filling Station	-
CAL2k-4 Vessel	-
-	-
-	-
-	-

We certify the compliance of the above product with the stated requirements in accordance with the rules and procedures of our Product Certification programme, and license the holder to affix thereto our Test Mark:

TÜV Rheinland Quality Services

J B Peters Pr Eng

TÜV Rheinland Quality Services (Pty) Ltd
PO Box 152
Persequor Park
0020 Pretoria

Original issue:	This Issue	Valid until:
2005-01-07	2014-02-01	2017-01-31

WARRANTY

WARRANTY – FOR NEW PRODUCTS

PURPOSE OF PRODUCT WARRANTY

Any part of a product is subject to ageing and eventual failure. These failures occur during normal use. The purpose of a warranty is to protect the Owner against a part failure caused by manufacturing defects in workmanship, material or design for a specific time.

OWNER'S WARRANTY

In the event of the Owner contracting directly with Digital Data Systems (Pty) Ltd "**dds**", or in the event of the installation of a unit arising out of a contract between the Owner's Dealer or any other party on his/her behalf and the said "**dds**", the Owner records that not withstanding same, this warranty is the only warranty applicable to "**dds**" units and is expressly in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular purpose. No amendments or additions to this warranty shall be binding on "**dds**", unless recorded in writing and signed by a duly authorised officer of the company**. "dds" agrees to repair and replace with a new or remanufactured part, any part, other than those excluded below, which after inspection, upon its return to the factory in Randburg, Johannesburg by the Owner or the authorised Dealer to which he/she returns the unit, is proven to be defective.**

Replacement of a defective part will be made only within the applicable warranty period of **12 (twelve) months from date of shipment**. Not withstanding anything to the contrary herein, any labour involved in repairing or replacing a defective part will be charged at "**dds**" rates applicable at the time.

If upon inspection it is found that the pressure vessel was submerged in water the warranty will automatically be null and void and the owner will be responsible for the labour and parts charges.

EXCLUDED (NON-WARRANTY) PARTS

"**dds**" shall be entitled to treat this warranty as void unless the relevant warranty form (attached) is sent by registered post to "**dds**" by the Owner within 10 (ten) days from date of original installation.

Regardless of warranty-status, the Owner shall be responsible for labour charges connected with periodic maintenance requirements involving visual and functional inspection of the systems.

This warranty expressly covers the unit(s) "**dds**" supplied only and does not cover any other part, which may, as a consequence of the installation and operation of the unit, become damaged in any way whatsoever.

Special attention should be given to the safe operation of the high-pressure Vessels. The published rules are guidelines only and enclosed in this leaflet for the convenience of the User. The manufacturer is not responsible for any damages, consequential, indirect or direct, or loss whatsoever, resulting out of electrical shock, Vessel explosion, or any other cause.

WARRANTY – FOR RECONDITIONED AND REPAIRED PRODUCTS

Any "**dds**" scientific product that has been repaired or reconditioned has a warranty period of **30 Days from date of shipment** for the Recon or Repair request only. If something else goes wrong that is not part of the original Recon or Repair, the warranty does not apply. Each product that is sent to "**dds**" for Reconditioning or Repair is tested and checked and leaves "**dds**'s" Factory in 100% working order. It is the Owner's responsibility to inspect any repaired or

reconditioned product on receipt thereof and confirm in writing, any faults, errors or problems with the said product. If a fault, error or problem is reported after the 30 Day warranty period, and "**dds**" finds that the product has been damaged and requires another repair/recon, the full cost of repair/recon will be applicable and paid for by the Owner.

GENERAL – WARRANTY VOID

All serial numbers on any relevant "**dds**" Scientific product need to remain on the product at all times, or warranty will be void. Warranty will also be void if any of the branding stickers or decals have been removed and/or the colour of the Scientific product has been changed in any way.

E2K WARRANTY REGISTRATION FORM

SERIAL NUMBERS (S/N):	Calorimeter:
	Cooler/Air Cooler:
	Filling Station:
	Vessel(s):
	Other:

DEALER NAME:	
OWNER'S/CUSTOMER'S COMPANY NAME:	
AUTHORISED BY:	
INSTALLED AT:	
TEL NO:	
FAX NO:	
CONTACT PERSON:	
INSTALLED BY:	
DATE INSTALLED: (REPRESENTATIVE OF DEALER/AGENT)	
CUSTOMER ORDER NUMBER AND DATE:	
INSTALLATION DETAILS (LOCATION, WATER SUPPLY, AIR-CONDITIONING ETC.):	
ACCEPTED IN GOOD CONDITION:	
DATE:	
SIGNATURE:	
NAME (printed):	
WITNESS:	

I have read, understood and accepted the conditions of this warranty, the details of which are printed in this Manual.

CUSTOMER'S SIGNATURE:	
NAME (printed):	
DATE:	