



NEXT GENERATION CALORIMETERS

CAL3K-AP INSTALLATION GUIDE

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MANUFACTURED BY: DIGITAL DATA SYSTEMS



DDS CALORIMETERS

Scientific Analytical Calorimeter Solutions



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1 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 combustion calorimeter systems available today. The system is used to measure the calorific value of both solids and liquids. **dds** has a wide range of systems to suit different applications and sample requirements. Please visit our website: www.ddscalorimeters.com to find out more.

You have chosen the **CAL3K-AP** Bomb Combustion Calorimeter System, which is best suited for fast and accurate calorimetry operations with automated oxygen filling.

1.1 PURPOSE OF THIS MANUAL

It serves as a short introduction to the CAL3K-AP system and the various components. Special attention is given to SAFETY and good installation practice. The basic and advanced operation of the CAL3K-AP is explained in the operators manual.

We have strived to make all setup parameters accessible from the keyboard. But, there are some very advanced items for which you need a PC or laptop to change or display them. This is not explained here but in an ON-LINE version.

1.2 HOW TO USE THIS MANUAL

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

1.2.1 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.

1.2.2 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.

2 USER INFORMATION AND HELP AIDS

Included in your shipment is this printed Installation Guide.

The on-line Help Guide for basic system operations, trouble-shooting and solutions, application notes as well as how everything functions is available on-line and can be found at www.ddscalorimeters.com .

Please note the CAL3K-AP Windows Software can be downloaded from the following link:

<https://www.ddscalorimeters.com/software/cal3k/>



3 SYSTEM COMPONENTS

3.1 THE CAL3K-AP SYSTEM CHECK LIST

The system consists of the following:

3K-AP	CAL3K-AP Calorimeter with Manual Oxygen Filling	1	Received
3K-AP-KT	CAL3K-AP Calorimeter Installation Kit	1	
<i>Included in Kit:</i>			
3K-1-062	<i>Power Supply 12V</i>	<i>1</i>	
3K-1-122	<i>Mains Cable 15A</i>	<i>1</i>	
3K-1-117	<i>Balance Cable</i>	<i>1</i>	
3K-1-084	<i>PC Cable (USB)</i>	<i>1</i>	
3K-1-061	<i>PC Keyboard (PS2)</i>	<i>1</i>	
3K-4-049	<i>Preparation Stand</i>	<i>1</i>	
3K-1-098	<i>Printer Cable</i>	<i>1</i>	
3K-1-081	<i>Stainless Steel Tweezers</i>	<i>1</i>	
3K-4-084	<i>Certified Benzoic Acid Tablets (150 x 0.5g Tablets per Bottle)</i>	<i>1</i>	
PIPE-4MM-CLEAR	<i>High Pressure Oxygen Pipe (3.75m) (Clear)</i>	<i>3.75M</i>	
3K-6-012	<i>Exhaust Pipe 6.4mm (4m) (Clear)</i>	<i>4M</i>	
3K-3-21	<i>Oxygen Regulator Connection Quickfit</i>	<i>1</i>	
3K-6-031	<i>3K-AP Exhaust O-ring</i>	<i>1</i>	
3K-1-080	<i>3K-AP Nozzle O-ring (Black)</i>	<i>1</i>	
3K-4-107	<i>3K-AP Nozzle O-ring (Green)</i>	<i>1</i>	
3K-6-005	<i>3K-AP Exhaust filter O-ring</i>	<i>1</i>	
3K-6-018	<i>AP Fill Nut</i>	<i>1</i>	
3K-4-039	<i>Inflation Nipple</i>	<i>1</i>	
3K-6-025	<i>AP Fill Heat O-ring</i>	<i>1</i>	
3K-6-033	<i>4MM Compression Pipe fitting with double ferrule</i>	<i>1</i>	
3K-1-115	<i>3K-AP Pressure Leak Test Jig</i>	<i>1</i>	
3K-1-086	<i>Grease Tube</i>	<i>1</i>	
3K-1-043	<i>USB Memory Flash Drive with manuals, software etc.</i>	<i>1</i>	
INSTALLATION_MANUAL	<i>Printed Installation Guide for 3K-AP</i>	<i>1</i>	
3K-2	CAL3K Air Cooler	1	
3K-2-KT	CAL3K Air Cooler Installation Kit	1	
<i>Included in Kit:</i>			
3K-1-055	<i>Power Supply 12V</i>	<i>1</i>	
3K-4	CAL3K-AP Bayonet Vessel	2	
3K-4-KT	CAL3K-AP Bayonet Vessel Installation Kit	2	
<i>Included in Kit:</i>			
3K-4-036	<i>Centre Electrode Bottom Only M3</i>	<i>2</i>	
3K-4-046	<i>Centre Electrode Top Only M3</i>	<i>1</i>	
3K-4-029	<i>Nozzle O-ring used in defiller cap & Filling station</i>	<i>2</i>	
3K-4-037	<i>Outside Electrode M3</i>	<i>2</i>	
3K-4-047	<i>Crucible</i>	<i>2</i>	
3K-4-005	<i>Deflector Plate</i>	<i>2</i>	
3K-4-032	<i>Firing Wire (1 packet of 5)</i>	<i>1</i>	
3K-4-065	<i>Firing Cotton Packet (1 packet of 100)</i>	<i>2</i>	
3K-4-16	<i>Lid O-Rings</i>	<i>5</i>	



3.2 THE 3K-AP CALORIMETER WITH INTERNAL OXYGEN FILLING

The CAL3K-AP uses the Dynamic method (Isothermal) of determination as default while still using the DRY method. The prepared vessel is placed in the calorimeter and the lid is closed. The rest is automatic. The oxygen filling pressure is monitored and adjustable. Two other operating modes can be set. Consult the CAL3K-AP Operations Manual for details. This is by far the most versatile, complex and adjustable calorimeter.

Width	-	270mm
Height	-	200mm
Depth	-	380mm
Weight	-	8kg
Power	-	220-240V / 12W

3.3 THE 3K-2 AIR COOLER

The air cooler requires no water, piping or other resource. It is powered by an external 12V power supply.

The cooler will cool the vessel in approximately 6-8 minutes to the specified setting. The operation of the cooler is controlled from the CAL3K-AP. Simple! Effective!

Width	-	155mm
Height	-	235mm
Depth	-	285mm
Weight	-	3 to 4kg
Power	-	12VDC





3.4 THE 3K-4 BAYONET VESSEL

The ignition and burning process is contained within a chamber so that the energy released can be measured in the form of heat. The Vessel has temperature sensors built into it, so that the temperature rise can be measured.

Because of the high pressure of oxygen required for combustion, the Vessel is classified as a “Pressure Vessel” and is batch tested by an inspection authority to 10 times its normal pressure.

- Diameter-** ~76mm
- Height -** ~150mm
- Weight -** ~2kg



4 INSTALLATION

4.1 UNPACKING AND INSPECTION

There are no special precautions to be taken when unpacking your system. The following check list is for your convenience:

1. Locate and tick-off the various system components as indicated on the CAL3K-AP Check List as per above.
2. Unpack and inspect all the system components such as the 3K-AP Calorimeter, 3K-2 Air Cooler, 3K-3 Filling Station and the 3K-4 Bayonet Vessels according to the instructions in the relevant sections in this document.
3. Locate the LID LOCK LOOP and two screws inside the calorimeter well and remove it.
4. Inspect everything for any physical damage during transit. If damaged, consult your Agent immediately.
5. The Calorimeter has a GROUND (SAFETY EARTH) lug at the rear panel. This lug **MUST** be connected to the EARTH supply to ensure operating personal safety in case the power supply fails.
6. Verify the earth connection of the mains outlet, which you intend to use. Ask a qualified electrician to check it.
7. Connect the power supply to the mains power and to the Calorimeter. Use the supplied power supply only.
8. Do the same for the COOLER. The Cooler does not require ground lug.
9. Plug in the external keyboard into the rear of the Cal3K-AP Calorimeter.
10. Observe that the Display on the Calorimeter comes ON. If not, check the mains connections or consult your Agent immediately. Press the "ESC" key on the keyboard to open the lid of the calorimeter.
11. Observe that the Display on the COOLER comes ON. If not, check the mains connection or contact your agent.
12. The Lid lock mechanism has been dismantled for shipping and customs inspection. Install the loop with the two counter sunk screws but do NOT close the lid. It can only be opened with power and a keyboard.



4.2 SETTING UP

4.2.1 PREREQUISITES

Prior to installation of the CAL3K-AP System, the User must provide the following:

1. A mains outlet for the 3K-AP Calorimeter power supply and a mains outlet for the 3K-2 Air Cooler power supplies.
2. **A supply of oxygen, regulated at a pressure of 3.0Mpa (30bars) (3000Kpa)** within 4 meters of the 3K-AP Calorimeter. If bottled oxygen is used, a suitable high-pressure oxygen regulator must be supplied. Digital Data Systems can supply a single stage or dual stage high-pressure oxygen regulator; contact your agent for more information.
3. If a balance is supplied, ensure that a sturdy, stable weighing surface is available. A mains outlet and Balance connecting cable will also be required (balance cable supplied as part of kit 3K-1-117).

4.2.2 SITE SELECTION

The 3K-AP Calorimeter is a desktop unit, which can be installed wherever the laboratory space permits, with the following restrictions:



1. The CAL3K-AP system, consisting of 3K-AP Calorimeter, 3K-2 Air Cooler, 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.
2. The side should be free of drafts and not in direct vicinity of an air-condition outlet.
3. Neither should it receive direct sun light.
4. Install the CAL3K away from any heat source such as an oven.

Please see above for the dimensions, weights and power requirements per unit. The BALANCE data would be dependent on the make and model that you will be using.



4.2.3 ASSEMBLING THE CAL3K_AP

The unit is shipped with a set of spares and some items required for operation. The operational items need to be assembled before the unit is operational.

1. Locate the Lid locking 'loop' and the two screws and screw the loop in to the lid. The loop was removed to enable customs inspection. Do not close the lid! It opens only with power.
2. Locate the exhaust pipe assembly: 4 metres black plastic pipe, O-ring and plastic screw. Screw it in to the exhaust port by hand.
3. Locate the filter housing. It is a Stainless-Steel cylinder, a Stainless Steel filter and an O-ring. It was removed for shipping purpose to avoid damage. Screw the filter in to the base (on the lid) by hand. Then put the O-ring in to the filter housing. Use a pencil to squeeze the O-ring in to the recess, then, screw the housing on to the base by hand.

5 SAFETY PRECAUTIONS

5.1 CALORIMETER (3K-AP)

- Connect the safety earth to the EARTH STUD on the back of the instrument. This is required when the external power supply fails.
- Do not open the CAL3K for any reason whatsoever! There are no serviceable parts inside the unit.



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

- **DO NOT USE ANY OTHER PIPE OTHER THAN THE HIGH PRESSURE PIPE SUPPLIED FOR OXYGEN FILLING.**
 - **DO NOT USE THE HIGH-PRESSURE PIPE IF IT HAS A SHARP BEND OR KINK, DISCARD IMMEDIATELY**



- **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.



5.1.1 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.
- Should the Oxygen supply be in another room, make sure there is a high pressure shut off valve near the 3K-AP calorimeter.

5.2 OXYGEN CONNECTIONS

Install the high-pressure oxygen pipe without any sharp bends. A 4mm pipe connection is provided on the CAL3K. The oxygen source connection depends on the installation (oxygen regulator or piped in oxygen). It is important that the oxygen connection is secure.

5.3 EXHAUST CONNECTION

It is advisable to route the exhaust gases to the outside or through a water trap. If no exhaust pipe is installed then the exhaust noise is startling to say the least.

The unit is supplied with a 4-metre length of black plastic pipe and an O-ring (3K-6-031). Unscrew the plastic exhaust nut (no tools!), insert the exhaust pipe, put the O-ring over the pipe, and screw the nut in to the exhaust housing. Tighten by hand!

Note: There is no pressure in this pipe!

5.4 COOLER (3K-2)

- There are no user serviceable parts inside.

5.5 VESSEL (3K-4)

- Handle the vessel over a table or solid surface.
- Do not drop a vessel.
- Do not overfill a vessel with oxygen: The maximum oxygen filling pressure is 30bar / 3000kPA, which is the standard for bomb calorimetry.
- Do not use any oil or grease on any of the oxygen fittings or the O-rings. A very small amount of high-pressure (vacuum) grease is allowed on the O-ring to make them pliable. Wipe them clean afterwards.
- Store the vessel with the lid open. Never store a vessel under pressure, always deflate using the defiller cap.
- Clean the inside of the vessel with paper towel after every use.
- Weigh the crucible every week and discard it when it has lost 10% of its original mass.
- Discard the crucible when the bottom is distorted and extremely discoloured.
- Remove the deflector plate every week and clean the top surface. It does accumulate residue and must be clean regularly.
- Make sure to use the pipe-clamping device on the right side of the filling station for safe use.



- **NEVER OPERATE ANY UNSAFE VESSEL.**

- **NEVER IMMERSE THE VESSEL INTO COLD WATER WHEN COOLING. USE THE 3K-2 AIR COOLER OR ALLOW THE VESSEL TO COOL DOWN NATURALLY.**



- **A SUITABLE INSPECTION WARNING PERIOD OF 2000 FIRINGS, AND A STOP OPERATING LIMIT OF 2500 FIRINGS ARE PRE-PROGRAMMED FROM THE FACTORY**

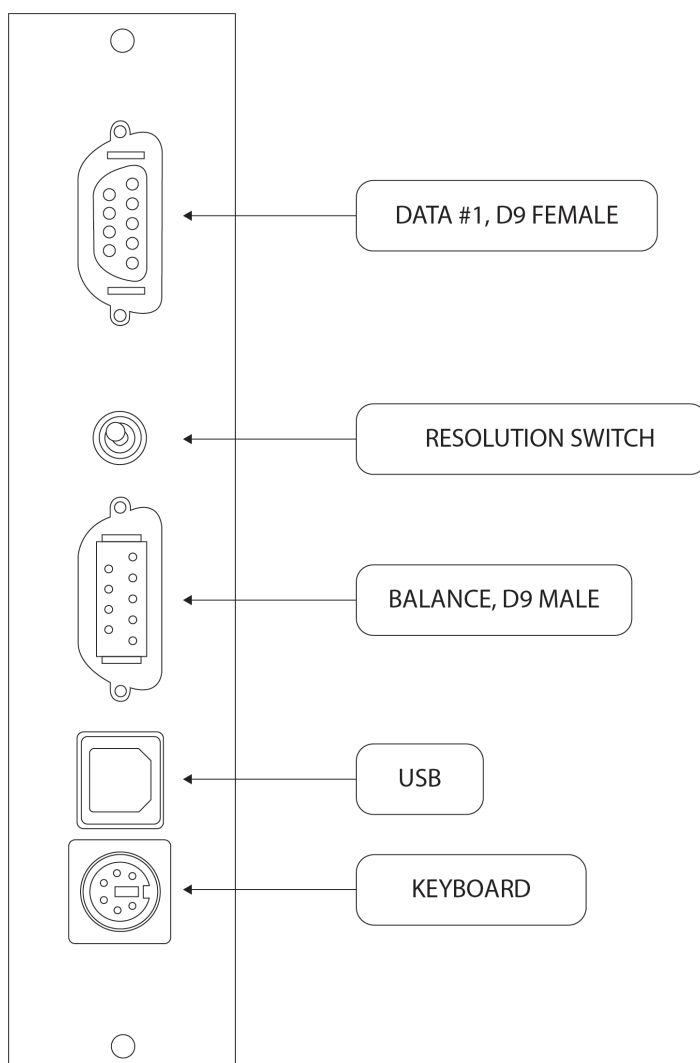
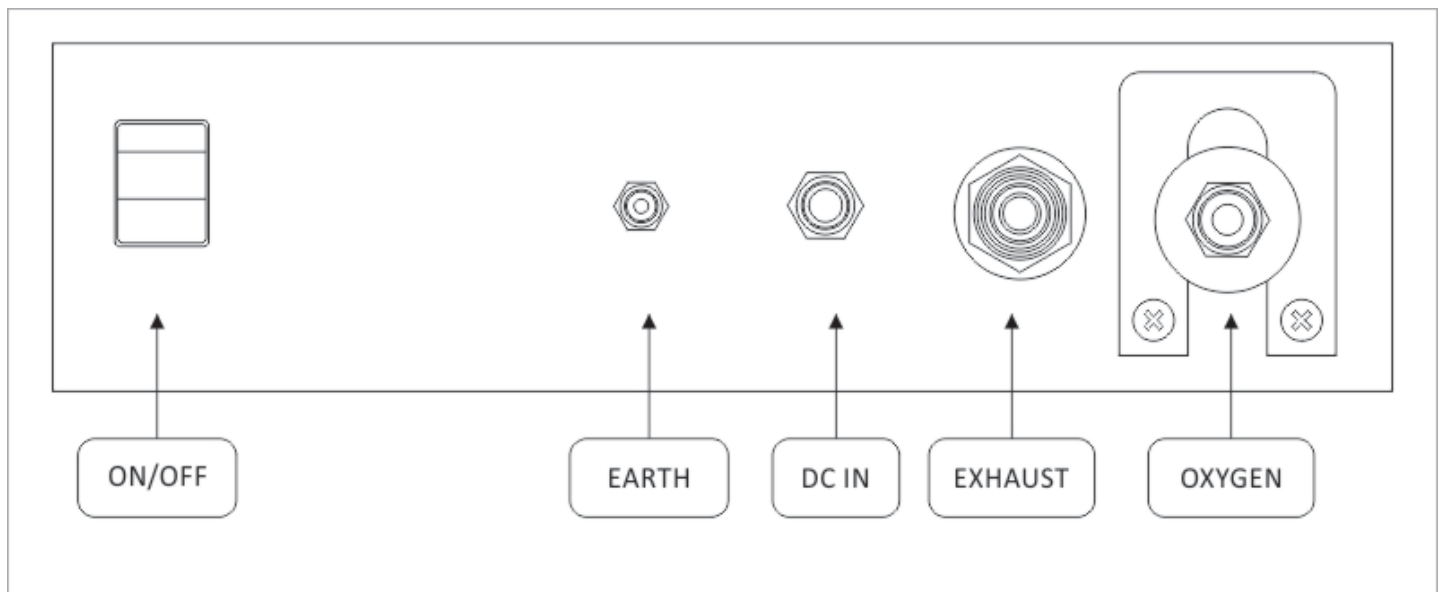
THE VESSEL MUST BE INSPECTED AT REGULAR INTERVALS DEPENDING ON THE USE. A SUITABLE INSPECTION PERIOD CAN BE SET (By your agent!) AND THE UNIT WILL ISSUE AN INSPECTION WARNING AND SOON AFTER THIS IT WILL SHUT-DOWN THE OPERATION.



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 CAL3K-AP SYSTEM REGULARLY.



6 CAL3K-AP REAR PANEL CONNECTIONS





7 DAILY SAFETY STEPS

The 3K-4 vessel is a high-pressure apparatus, and should be treated with care.

- Handle the vessel over a table or solid surface.
- Do not drop a vessel.
- Do not overfill a vessel with oxygen: The maximum oxygen filling pressure is 30bar / 3000kPA, which is the standard for bomb calorimetry.
- Do not use any oil or grease on any of the oxygen fittings or the O-rings. A very small amount of high-pressure (vacuum) grease is allowed on the O-ring to make them pliable. Wipe them clean afterwards.
- Store the vessel with the lid open. Never store a vessel under pressure, always deflate using the de-filler cap.
- Clean the inside of the vessel with paper towel after every use.
- Weigh the crucible every week and discard it when it has lost 10% of its original mass.
- Discard the crucible when the bottom is distorted and extremely discoloured.
- Remove the deflector plate every week and clean the top surface. It does accumulate residue and must be clean regularly.
- Make sure to use the pipe-clamping device on the right side of the filling station for safe use.

[WATCH YOUTUBE VIDEO ON 3K-AP UNPACKING AND INSTALLATION!!](#)



8 WARRANTY – FOR NEW PRODUCTS

8.1 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.

8.2 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 notwithstanding 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**. Notwithstanding 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.

8.3 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.



8.4 WARRANTY – REPAIRED PRODUCTS

Any “dds” scientific product that has been repaired has a warranty period of **30 Days from date of shipment** for the Repair request only. If something else goes wrong that is not part of the original Repair, the warranty does not apply. Each product that is sent to “dds” for Repair is tested and checked and leaves “dds’s” Factory in 100% working order. It is the Owner’s responsibility to inspect any repaired 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, the full cost of repair will be applicable and paid for by the Owner.

8.5 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.



8.6 WARRANTY REGISTRATION FORM

SERIAL NUMBERS (S/N): _____
Calorimeter: _____
Air Cooler: _____
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: _____