



**NEXT GENERATION CALORIMETERS**

# **3K-S INSTALLATION GUIDE**

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**MANUFACTURED BY:**



**DDS CALORIMETERS**

Scientific Analytical Calorimeter Solutions



**Table of Contents:**

<b>1</b>	<b>SAFETY OF BOMB CALORIMETERS</b> .....	<b>1</b>
1.1	SAFETY RULES .....	1
<b>2</b>	<b>INTRODUCTION</b> .....	<b>1</b>
2.1	PURPOSE OF THIS MANUAL .....	2
2.2	HOW TO USE THIS MANUAL .....	2
2.2.1	WARNING SYMBOL .....	2
2.2.2	INFORMATION (NOTE) SYMBOL .....	2
<b>3</b>	<b>USER INFORMATION AND HELP</b> .....	<b>2</b>
<b>4</b>	<b>SYSTEM COMPONENTS</b> .....	<b>3</b>
4.1	THE CAL3K-S SYSTEM CHECK LIST .....	3
<b>5</b>	<b>INSTALLATION</b> .....	<b>4</b>
5.1	UNPACKING AND INSPECTION .....	4
5.2	SETTING UP .....	5
5.2.1	PREREQUISITES .....	5
5.2.2	SITE SELECTION .....	5
<b>6</b>	<b>TESTING</b> .....	<b>6</b>
6.1	TEST CAL3K HARDWARE .....	6
6.2	TEST VESSEL HARDWARE .....	6
<b>7</b>	<b>SAFETY PRECAUTIONS</b> .....	<b>6</b>
7.1	CALORIMETER (3K-S) .....	6
7.2	FILLING STATION (3K-3) .....	6
7.2.1	HIGH PRESSURE OXYGEN .....	7
7.3	VESSEL (4K-4) .....	7
<b>8</b>	<b>DAILY SAFETY STEPS</b> .....	<b>9</b>
<b>9</b>	<b>HARDWARE TEST</b> .....	<b>9</b>
<b>10</b>	<b>WARRANTY – FOR NEW PRODUCTS</b> .....	<b>10</b>
10.1	PURPOSE OF PRODUCT WARRANTY .....	10
10.2	OWNER’S WARRANTY .....	10
10.3	EXCLUDED (NON-WARRANTY) PARTS .....	10
10.4	WARRANTY – REPAIRED PRODUCTS .....	11
10.5	GENERAL – WARRANTY VOID .....	11
<b>11</b>	<b>RETURNS / REPLACEMENTS POLICY</b> .....	<b>11</b>
<b>12</b>	<b>INDEMINTY AND HOLD HARMLESS</b> .....	<b>12</b>
<b>13</b>	<b>WARRANTY REGISTRATION FORM</b> .....	<b>13</b>



## READ THIS SECTION BEFORE OPERATING THE CAL3K BOMB CALORIMETER

- Always seek advice from a qualified high-pressure oxygen installer to ensure that your oxygen and/or nitrogen gas installations are carried out safely and professionally.



### 1 SAFETY OF BOMB CALORIMETERS



A 'BOMB CALORIMETER' uses a vessel which is filled with oxygen and the sample material, and then the sample is ignited. The sample burns and the resultant temperature increase of the vessel is measured and converted to a calorific value.

During the burning the gas temperature rises and the pressure increases. The pressure increase depends on the speed of the burning process and to a lesser extent on the sample volume. The safety is therefore mainly concerned with the burning process.

#### 1.1 SAFETY RULES

1. **Do not** burn powdery substances by themselves. They can explode. Use a gelatin capsule or press the sample material into a tablet or pellet.
2. Choose a sample volume according to the following guidelines:

Low calorific value (sugar):	~0.75g
Medium calorific value (Benzoic Acid):	~0.5g
High calorific value (Oil, Fat)	~0.3g
3. Examine the vessel inner wall after a sample burn for any sample residue. If found, then the sample has exploded.
4. **Do not** use oil on any part of the calorimeter. It will ignite under pressure and elevated temperature and may cause destruction of the apparatus.
5. Reduce the oxygen pressure down to 20bar if the sample explodes. This slows the burning process and can prevent explosions.
6. **Do not** store a vessel with pressure. Deflate it and leave the lid open.
7. Clean the vessel with a paper towel after each use
8. Check O-Rings regular for wear, leakage and aging.
9. Check O-Ring seats for sample deposits. Clean the seats regular.

### 2 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](http://www.ddscalorimeters.com) to find out more. You have chosen the **CAL3K-S** Bomb Combustion Calorimeter System, which is best suited for fast and accurate calorimetry operations.



## 2.1 PURPOSE OF THIS MANUAL

It serves as a short introduction to the CAL3K-S system and the various components. It explains the very basics of operation and guides you to perform hardware tests. It relies on the DEFAULT setting and the factory calibration.

But there is more: Information and capability! This is not explained here but in the operations manual. All functions can be exercised from the keyboard and a PC is not needed. However, a PC can show more data and it can capture results.

## 2.2 HOW TO USE THIS MANUAL

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

### 2.2.1 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.

### 2.2.2 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.

## 3 USER INFORMATION AND HELP

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](http://www.ddscalorimeters.com).

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

<https://ddscalorimeters.com/dds-software/cal3k/>



## 4 SYSTEM COMPONENTS

### 4.1 THE CAL3K-S SYSTEM CHECK LIST

The system consists of the following:

<b>3K-S</b>	<b>CAL3K-S Calorimeter</b>	<b>1</b>	<b>Received</b>
<b>3K-S-KT</b>	<b>CAL3K-S Calorimeter Installation Kit</b>	<b>1</b>	
<i>Included in Kit:</i>			
<b>3K-1-055</b>	<i>Power Supply (12V)</i>	<i>1</i>	
<b>3K-1-061</b>	<i>PC Keyboard (PS2)</i>	<i>1</i>	
<b>3K-4-049</b>	<i>Preparation Stand</i>	<i>1</i>	
<b>3K-1-081</b>	<i>Stainless Steel Tweezers</i>	<i>1</i>	
<b>3K-4-084</b>	<i>Certified Benzoic Acid Tablets (150 x 0.5g Tablets per Bottle)</i>	<i>1</i>	
<b>3K-4-106</b>	<i>Wire Brush</i>	<i>1</i>	
<b>3K-3-18</b>	<i>Emergency Deflate Cap</i>	<i>1</i>	
<b>3K-1-131</b>	<i>RS232 PC Cable</i>	<i>1</i>	
<b>3K-1-043</b>	<i>USB with manuals, software etc</i>	<i>1</i>	
<b>INSTALLATION-MANUAL</b>	<i>CAL3K-S Installation Guide Printed</i>	<i>1</i>	
<b>3K-3</b>	<b>CAL3K Filling Station</b>	<b>1</b>	
<b>3K-3-KT</b>	<b>CAL3K Filling Station Installation Kit</b>	<b>1</b>	
<i>Included in Kit:</i>			
<b>3K-3-29</b>	<i>Nozzle O-rings</i>	<i>5</i>	
<b>3K-3-21</b>	<i>Oxygen Regulator Connection - Quick Fit</i>	<i>1</i>	
<b>3K-3-27</b>	<i>High Pressure Oxygen Pipe 4mm (3.75m) (Clear)</i>	<i>3.75M</i>	
<b>3K-3-22</b>	<i>De-filler Cap</i>	<i>1</i>	
<b>3K-1-080</b>	<i>Nozzle O-rings</i>	<i>2</i>	
<b>3K-3-32</b>	<i>Allen Key</i>	<i>1</i>	
<b>3K-1-106</b>	<i>O-Ring Lubrication Grease tube</i>	<i>1</i>	
<b>4K-4</b>	<b>CAL3K-F Thread Vessel</b>	<b>1</b>	
<b>3K-4-KT</b>	<b>CAL3K-F Thread Vessel Installation Kit</b>	<b>1</b>	
<i>Included in Kit:</i>			
<b>3K-4-122</b>	<i>Centre Electrode Complete</i>	<i>2</i>	
<b>3K-4-124</b>	<i>Outside Electrode</i>	<i>2</i>	
<b>3K-4-047</b>	<i>Crucibles</i>	<i>2</i>	
<b>3K-4-092</b>	<i>Deflector Plate</i>	<i>2</i>	
<b>3K-4-093</b>	<i>Firing Wire (1 packet of 5)</i>	<i>1</i>	
<b>3K-4-065</b>	<i>Firing Cotton Packet (1 packet of 100)</i>	<i>2</i>	
<b>3K-4-094</b>	<i>Lid O-Rings</i>	<i>5</i>	
<b>3K-4-022</b>	<i>Top &amp; Bottom O-ring</i>	<i>10</i>	



## 5 INSTALLATION

### 5.1 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-S Check List as per above.
2. Unpack and inspect all the system components such as the 3K-S Calorimeter, 3K-3 Filling Station and the 3K-5S Standard Vessels according to the instructions in the relevant sections in this document.
3. Inspect everything for any physical damage during transit. If damaged, consult your Agent immediately.
4. 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.
5. Connect the power supply to the mains power and to the Calorimeter. Any power supply with 12V output, 1000mA capacity, centre pin POS, can be used.
6. Observe that the Display on the Calorimeter comes ON. If not, check the mains connections or consult your Agent immediately.



## 5.2 SETTING UP

### 5.2.1 PREREQUISITES

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

1. A mains outlet for the 3K-S Calorimeter and a mains outlet power supply.
2. **A supply of oxygen at a pressure of 3.0Mpa (30bars) (3000Kpa)** within 4 meters of the 3K-S Calorimeter. If bottled oxygen is used, a suitable high-pressure oxygen regulator must be supplied. Digital Data Systems can supply a single 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).

### 5.2.2 SITE SELECTION

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

1. The CAL3K-S system, consisting of 3K-S Calorimeter, 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 unit should be in a place with a stable temperature, not in direct sunlight or in the outlet path of an air conditioner.



**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.**



## 6 TESTING

It is recommended to run a calorimeter hardware test and a vessel hardware test after installation and before operation of the system.

### 6.1 TEST CAL3K HARDWARE

The test is activated by F9 or by:

**13 CAL3K-TEST: 0**

This command tests the CAL3K hardware. Once started the unit will cycle through all tests and will 'hang' on any fault. Individual test can be executed (without cycling through all preceding test) by replacing the 'YES' entry by the test number.

This test should be repeated once a day. The vessel must not be in the well.

### 6.2 TEST VESSEL HARDWARE

This test is activated by F7 or:

**14 VESSEL-TEST: 0**

The vessel must be in the well.

## 7 SAFETY PRECAUTIONS

### 7.1 CALORIMETER (3K-S)

- 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.**

### 7.2 FILLING STATION (3K-3)

- Install the flexible high-pressure pipe supplied without any sharp bends.
- Check the nylon high-pressure pipe supplied for any mechanical damage before putting it under pressure.
- Secure the pipe into the ferrule connector and screw the connector to the pressure regulator side. 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 perhaps 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 3K-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 3K-3 Filling Station.
  - The oxygen bottle should be secured according to regulations.
  - Secure the pipe to the side of the filling through the supplied device.
  - 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.
- **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.**

### 7.2.1 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-3 Filling Station installation.
- **Always seek advice from a qualified high-pressure oxygen installer to ensure that your oxygen and/or nitrogen gas installations are carried out safely and professionally.**



### 7.3 VESSEL (4K-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.



- Use the provided De-filler cap only, part number: 3K-3-22.
- 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 filing station for safe use.



- **NEVER OPERATE ANY UNSAFE VESSEL.**



- **NEVER IMMERSE THE VESSEL INTO COLD WATER WHEN COOLING. ALLOW THE VESSEL TO COOL DOWN NATURALLY.**

- **A SUITABLE INSPECTION WARNING PERIOD OF 5000 FIRINGS, AND A STOP OPERATING LIMIT OF 5000 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-S SYSTEM REGULARLY.**



## 8 DAILY SAFETY STEPS

The 4K-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.
- Use the provided De-filler cap only, part number: 3K-3-22.
- 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.

## 9 HARDWARE TEST

The hardware test is activated with the F9 function key. Press **F9, ENTER**

The test needs no further instruction but requires that the LID is closed when instructed to do so. The test can be terminated at any time with the **ESC** key. If a test fails, it can be terminated with the **F8** key.

The vessel can be tested with the **F7** key. The vessel must have a firing wire attached to the electrodes but needs no oxygen. Close the lid and test each vessel.



## 10 WARRANTY – FOR NEW PRODUCTS

### 10.1 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.

### 10.2 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.**

**Note: Please note that goods returned for warranty claims must be returned in original packaging to avoid damage to the goods during transport. Goods returned in packaging other than the original risk the chance of making the warranty Null and Void.**

### 10.3 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, because 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.**

#### **10.4 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.

#### **10.5 GENERAL – WARRANTY VOID**

All serial numbers on any relevant “dds” Scientific product need to always remain on the product, 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.

##### **Important Notice:**

It is required that only **genuine DDS consumables and parts** are used on all DDS Calorimeter systems. Should it be determined that **non-genuine consumables or parts** have been used, the **warranty will be deemed null and void**.

DDS will **not be held responsible for any damage to the equipment** resulting from the use of non-genuine parts or consumables. Furthermore, DDS accepts **no liability for any safety hazards or risks** that may arise due to the use of non-genuine components or consumables.

## **11 RETURNS / REPLACEMENTS POLICY**

When returning any of our bomb calorimeter products, please use either a reputable Courier Company or Air Freight Company. We suggest returning the good using the Door-to-Door Courier Service or Air Freight Shipping Service.

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For returns via a Courier or Air Freight Shipping Company:

Digital Data Systems (Pty) Ltd.  
22 Arbeid Avenue  
Strydom Park  
Randburg  
2196  
Gauteng  
South Africa



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**PLEASE ENSURE THAT YOU INCLUDE A ZERO VALUE INVOICE AND A DESCRIPTION OF THE "RETURN"/"REPAIR" FOR CUSTOMS PURPOSES. A LOW VALUE FOR CUSTOMS PURPOSES MAY BE INCLUDED.**

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All returns must be sent pre-paid (customer account) and no collect shipments will be accepted. Please ensure the parcel for its full value.

Once we receive the returned products, Digital Data Systems will inspect and test the products for manufacturing faults. If we determine that there is a manufacturing fault, we will repair or exchange the product and pay for the shipping costs to send the repaired/replacement product back to the customer.

Replacement of a defective product will only be made within the applicable 12 (twelve) months warranty. Notwithstanding anything in the contrary herein, any labour involved in the repairing or replacing of a defective product will be charged at the "DDS" rates applicable at the time.

Repair or replacement of a defective product will only be done once the product is received and inspected at our DDS factory at the above address.

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***No Refunds will be issued by DDS under any circumstances. Only Replacement products will be offered by DDS.***

## **12 INDEMINTY AND HOLD HARMLESS**

The original purchaser/user accepts full responsibility for any personal injury to itself, its employees, or third parties that arises from misuse of any DDS products or from use that does not follow DDS's specifications and operating instructions and agrees to indemnify and hold DDS harmless from such claims.



**13 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:** \_\_\_\_\_