



# 6700 Series Solution & Semimicro Calorimeters

**Designing  
and Building  
High Precision  
Calorimeters  
for Over  
100 Years**



# 6700

Founded more than  
100 years ago by  
University of Illinois  
Professor S.W. Parr,  
Parr Instrument  
Company has  
consistently strived  
to provide for its  
customers the very  
best in product,  
service and support.



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**Parr Instrument** is pleased to introduce its new Series 6700 line of Calorimetric Thermometers, Solution and Semimicro Oxygen Bomb Calorimeters. These new instruments bring the latest in microprocessor based technology to these specialized applications. These new instruments incorporate the advances in control, display and data handling developed for the Parr Series 6000 line of Oxygen Bomb Calorimetry.

**The Model 6772 Calorimetric Thermometer** features a calorimetric thermometer with temperature resolution of 0.0001 °C over a range of 10 – 50 °C. In addition it includes all of the operating controls, heat leak and thermochemical calculations required for automating the Parr 1341 calorimeter as well as these two new calorimeters described below. Modern digital communications (Ethernet and Serial) are provided for data transfer to and from the thermometer. See page 3.



**The Model 6755 Solution Calorimeter** incorporates the 6772 Thermometer and provides a convenient and easy to operate instrument for measuring heats of reaction, mixing, solution, dilution, wetting and similar endothermic or exothermic reactions at ambient temperatures and pressures. The 6772 thermometer includes the capabilities of determining initial and final equilibria and determining heat leak corrections by any one of three methods. See page 4.



**The Model 6725 Semimicro Calorimeter** incorporates the 6772 thermometer and offers a high degree of automation and data handling for users who prefer or must work with samples in the 20 to 200 milligram range. This calorimeter features the new Model 1109 Self Sealing, Semimicro Oxygen Bomb. See page 8.



**The Model 6765 Combined Solution and Semimicro Calorimeter** (not shown) provides all of the equipment for running both solution calorimetry and semimicro oxygen bomb calorimetric tests. This is a valuable multi experiment system for physical chemistry instruction. Conversion sets are also available to add the second operating mode to either of the calorimeters. See page 11.

# 6772 Calorimetric Thermometer

For precise temperature rise measurements and calorimetric determinations control.



6772 Calorimetric Thermometer Displaying Main Menu Screen.

This two-channel precision calorimetric thermometer is included with the 6725 Semi-micro Oxygen Bomb Calorimeter and the 6755 Solution Calorimeter. It is also used with the Parr 1341 Oxygen Bomb Calorimeter or for other laboratory applications requiring high precision, differential temperature measurements.

The 6772 Calorimetric Thermometer features Parr's new fourth generation micro-processor control and provides:

- A bright, color, touch screen display and data input system with an intuitive graphical user interface for instrument setup and operation.
- A modern operating system (Linux) with communication and file management systems comparable to a PC.

- Special communications parts for reporting to a printer, receiving sample weights from an analytical balance and bi-directional communications with a laboratory computer via an Ethernet connection.
- A built-in ignition circuit for manually or automatically firing an oxygen bomb.

The Operating Program provides the user with many options and provisions for: Calorimeter Operation

- Oxygen bombs
- Solution Thermal Corrections
- Calculated
- Fixed
- Measured – using a second probe

Temperature Graphing

- On screen

- Remote

Thermochemical Corrections (Combustion)

- Fuse
- Nitric Acid
- Sulfur

Data Entry

- Manual
- Automatic

Reporting Controls

Communications Controls

- Diagnostic
- Help menus

## Ordering Guide

Model No.	Description (Voltage)	
6772EB	Calorimeter Thermometer with 1168E Thermistor Probe	115V
6772EE	Calorimetric Thermometer with 1168E Thermistor Probe	230V

## SPECIFICATIONS

Model Number:  
6772 Calorimetric Thermometer

Probe Type:  
Thermistor

Number of Probes:  
Standard - One / Optional - Two

Range:  
10–50 °C

Resolution:  
0.0001 °C

Absolute Accuracy:  
+/- 0.1 °C (w/out Calibration)  
+/- 0.05 °C (with Calibration)

Repeatability:  
+/- 0.002 °C (Single Point)

Linearity:  
+/- 0.002 °C (10 °C Span)

Communications:  
Balance Port: RS232C  
Printer Port: RS232C  
Computer Port: Ethernet

Memory:  
Test Results: 1,000 Tests  
Data logging: 10,000 Points

# 6755 Solution Calorimeter

For measuring enthalpy changes produced by chemical reactions in solution

## SPECIFICATIONS

Model Number:  
6755

Working Temperature Range:  
10 to 50 °C

Temperature Sensitivity:  
0.0001 °C

Energy Measurement Range:  
2-1000 Calories

Detection Limit:  
0.1 Calorie

Energy Equivalent:  
100-145 Calories / °C

Maximum Volume, Solute:  
20 mL

Required Volume, Solvent:  
90-120 mL



6755 Solution Calorimeter

### A Multi-purpose Calorimeter

Utilizing a unique rotating sample cell and a precise microprocessor-based thermometer, the Parr 6755 Solution Calorimeter provides a moderately priced and easily operated instrument for measuring:

- Heats of Reactions
- Heats of Mixing
- Heats of Solution
- Heats of Dilution
- Heats of Wetting

Measurements are made at ambient temperature and at atmospheric pressure in either liquid-liquid or liquid-solid systems covering energy changes ranging from 2 to 1000 calories. All operations are straightforward and simple, using a built-in, microprocessor-based thermometer for precise

temperature measurements. The calorimeter is controlled from a touch screen LCD panel on the 6772 Calorimetric Thermometer. Communication ports are provided for optional printers, computers and/or laboratory data networks.

### Many Uses

- There are many uses for this convenient, bench-top calorimeter:
- As a research instrument it offers a convenient and rapid means for obtaining basic chemical data with a precision that will be adequate for most preliminary research and exploratory applications.
  - As an analytical tool it has many applications in industrial laboratories for product evaluation and quality control.

Such applications may extend beyond the range of pure calorimetry to include tests in which there is a direct relationship between the heat of reaction and a chemical or physical property of one of the reactants in a system.

- As a teaching instrument it has an important place in college and university laboratories for demonstrating and teaching the fundamentals of thermochemistry in a student laboratory.

### Many Different Reactions

Any liquid-liquid or liquid-solid chemical reaction in which heat is evolved or absorbed within a temperature range from 10 to 50 °C can be studied in the 6755 Calorimeter.

Heats of Reaction, either endothermic or exothermic, can be determined in many different systems, ranging from simple acid-based reactions to more complicated redox, chelation, hydrolysis, protonation and other reactions. The calorimeter is particularly effective for assays of weak acid and weak bases which do not respond readily to other detection methods. It can also be used for rapid specific ion determinations by thermochemical methods as best illustrated by determination of sulfur using barium chloride to precipitate barium sulfate from a sulfate solution.

The heat of solution produced when a solid dissolves

in a liquid can be measured easily. Similarly, the calorimeter can be used to measure the heat of dilution produced by diluting a solution with solvent or with a solution of a lower concentration. It will also measure the heat of mixing, produced when two liquids are combined.

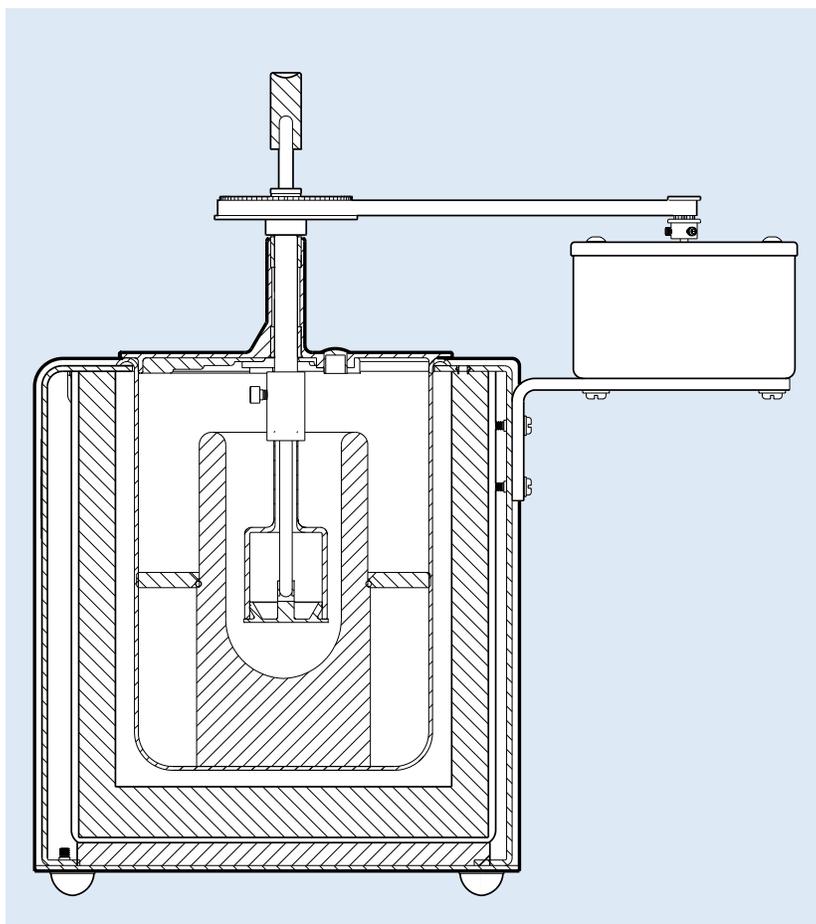
The heat of wetting as measured with this calorimeter serves not only as a thermochemical measurement, but also as a rapid method for determining the surface area of a powdered solid, since the heat released when a powder is treated with a wetting agent will be proportional to the exposed surface area.

#### A Well Insulated Reaction Chamber

All reactions in the 6755 Calorimeter are conducted in a fully silvered glass Dewar. The Dewar is supported within a stainless steel air can from which it is easily removed for filling or cleaning. A block of plastic foam surrounds the air can, with the entire assembly mounted in a rugged aluminum case.

#### A Unique, Rotating Sample Cell

A closed glass bell with a detachable bottom holds a solid or liquid sample in the Dewar and also serves as the stirrer for the calorimeter system. The bottom of the cell is closed with a Teflon dish which fits snugly into the bell without requiring a gasket or sealing ring. Solid samples (up to 2 grams) can be weighed directly into this dish before it is attached to the bell. Liquid samples (up to 20 ml) can be added to the closed cell from a pipet inserted through the top stem.



6755 Calorimeter Cross Section



130C Sample Cell with 126C Bottom Dish

To start the reaction, a glass push rod is inserted from the top of the calorimeter through the stirring shaft and into a socket in the sample dish. When this rod is pushed downward, the dish slides out of the cell and remains attached to the rod, held at a fixed distance above the bottom of the reaction vessel. In this position the rod and dish rotate with the cell, slinging the reactants into the solution and serving as an additional impeller in the stirring system.

Heat leak from the cell to the non-wetted parts of the system is held to a minimum by a low conductivity, thin walled glass stem on the sample cell and a plastic coupling which fastens the cell to the stirring shaft. The cell is easy to load, easy to clean and, if broken, it can be replaced at minimum expense since the sample dish and other parts are interchangeable. The dish itself is made of Teflon reinforced with glass fiber for excellent resistance to most chemical agents and good dimensional stability.

#### The Stirrer Drive

The stirring mechanism consists of an externally mounted electric motor with a drive belt which turns the stirring shaft at a constant speed (approx. 450 rpm) with no slippage and very little bearing friction. The hollow drive shaft terminates at the underside of the calorimeter cover where it joins the low conductivity coupling on the end of the sample cell.

#### Easy to Operate

The operation of the 6755 Calorimeter is quite simple. At the start of a test, one liquid is held in the glass Dewar while the other reactant, either solid or liquid, is held in the sealed

rotating cell which is immersed in the first liquid. The system comes to equilibrium quickly with only a slight temperature drift from the heat of stirring and from any heat leak into or out of the calorimeter. After recording the initial drift and without interrupting the rotation of the sample cell, the operator starts the reaction by depressing the push rods which drop the content of the cell into surrounding liquid. The reaction then proceeds to completion under the vigorous stirring action of the rotating cell.

#### Precision Thermometry

Temperatures in the Dewar are measured with a Parr 6772 Calorimetric Thermometer (described in detail on page 3) which is included with the 6755 Calorimeter. Readings are taken with a thermistor sealed in a stainless steel probe. Although the thermometry section has a working range from 10° to 50 °C, best calorimetric results are obtained when working within  $\pm 5$  °C of room temperature, since the system depends on a glass Dewar for controlling the heat leak.

The thermometer in the calorimeter can also be used for general purpose, high precision temperature measurement in other apparatus, using a thermistor probe in a stainless steel sheath for measurements in the 10 to 50 °C range.

#### Data Collection and Display

The 6755 Calorimeter has digital data outputs, as well as an onboard data logging capability which will store data in the instrument for later transfer to a computer or to a printer.

The software built into the calorimeter can provide temper-

ature rise data which has been corrected for heat leaks and the heat of stirring in the system or, it can provide uncorrected temperature readings for manual, computer or graphical analysis.

A Parr 1757 Printer is offered for users who wish to take full advantage of the onboard calculation capabilities of the calorimeter. This is a compact, 40-column printer which will produce a printed record of all calorimetric data when called up by the user. A standard RS232C port with full configuration software is provided for the printer connection. Users who already have a comparable printer can use it with this connection.

Computers can also be connected to the Ethernet communications port. This option will be attractive to those who wish to use spreadsheets to write their own data collection and reduction programs, or those who wish to plot thermograms for graphical analysis. A fully configurable charting program is provided for the calorimeters LCD display.

#### Precision

The precision obtainable with the 6755 Solution Calorimeter will be a function of the amount of heat liberated by the reactants and the temperature at which the test is conducted. The best precision will be obtained when working with reactions which release between 200 and 600 calories, producing a temperature rise of 1.5° to 5.0 °C at or near room temperature. Under these conditions a standard deviation of less than 0.4% of the determined value can be obtained in repetitive tests. If the total heat release produces a rise of less than 0.5 °C or more than 6.0 °C, or if the test is conducted at

higher working temperatures with significant heat leak, the relative standard deviation may increase to 1.0% of the determined value.

### Standardization

Three different procedures are available for standardizing the calorimeter:

**Chemical Standardization** is readily accomplished using a precise, reproducible exothermic reaction of tris (hydroxymethyl) aminomethane with 0.1 N HCl in an NIST procedure which is described in the instructions furnished with the instrument. A 100-gram bottle of "tris" is furnished with the calorimeter for this purpose. Additional supplies can be obtained from Parr, or the basic reference material may be purchased from the National Institute of Standards and Technology.

**Comparison Standardization** involves the use of known samples supplied by the user. By selecting samples whose enthalpy changes are known and whose thermochemical behavior is similar to the unknown material, the calorimeter can be standardized by simply running duplicate tests with known and unknown materials.

**Electrical Standardization** requires an electric heating probe, a uniform power supply, a high precision voltmeter and a precise interval timer. With the exception of the heating probe (Part No. A274C), this equipment is not sold by Parr, but most of the items can be obtained from commercial sources.

### Standard Parts

Each 6755 Solution Calorimeter consists of a Dewar reaction vessel in an insulated housing with a glass sample cell and sample dish, push rod, thermistor probe, stirrer drive motor and a calorimetric thermometer. One extra sample cell with a dish and one 100g bottle of Parr standard "tris" are furnished with the calorimeter.

### Conversion Parts

A conversion set consisting of all parts needed to convert a 6755 Solution Calorimeter to a 6725 Semimicro Bomb Calorimeter is available as described on page 11.

## Ordering Guide

**Model No.**    **Description** (Select part no. for voltage required.)

6755EA    Solution Calorimeter, 115V 50/60Hz

6755EF    Solution Calorimeter, 230V 50/60 Hz

**Spare parts are available, including:**

A130C    Sample Cell with Coupling, less 126C Bottom Dish.

126C    Bottom Dish, Teflon

A129C    Glass Push Rod

123C    Dewar Flask without Spacer Ring or Cover

3421    Tris (Hydroxymethyl) Aminomethane, Parr Standard, 100g Bottle

1757EA    Printer with Attached Power Supply, 115V 60Hz

1757EF    Printer with Attached Power Supply, 230V 50Hz

334C    Printer Paper Roll

335C    Printer Ribbon

### The 1757 Printer

For users who prefer to have a dedicated printer at the calorimeter, Parr offers the Model 1757 Printer. The 1757 is a compact, dot matrix printer setup for 40-column reports. It is housed in a separate case 5.5 inches wide, 9 inches deep and 7 inches high and operates from its own power supply.



1757 Printer

## Ordering Guide

**Model No.**    **Description** (Select part no. for voltage required.)

1757    Printer with Power Supply 115/230V

334C    Printer Paper

335C    Ribbon for Printer

A1816E2    Printer Cable

## 6725 Semimicro Bomb Calorimeter

The 6725 Semimicro Bomb Calorimeter for measuring the calorific value of small combustible samples

### SPECIFICATIONS

Model Number:  
6725

Tests Per Hour:  
3

Operator Time:  
10 Minutes

Repeatability (% RSD):  
0.30

Calorimeter Type:  
Compensated

Bomb Type:  
Removable Bomb and Bucket

Bucket Filling:  
Manual

Oxygen Filling:  
Manual

Balance Connection:  
RS232C

Temperature Resolution:  
0.0001 °C



6725 Semimicro Bomb Calorimeter Shown with the 6772 Calorimetric Thermometer

The 6725 Semimicro Calorimeter is a compact and easily operated, static jacket, combustion calorimeter designed specifically for measuring the heat produced by the combustion of small samples when only limited amounts of test material are available. It is equally useful for procedures in which it would be difficult to obtain a measurable temperature rise in a standard calorimeter, or where the nature of the sample makes semimicro operation desirable.

#### Many applications

The ability of the 6725 Calorimeter to produce complete combustion and a measurable temperature rise with small samples in the 25 to 200

milligram range makes this an excellent instrument for use in marine biology and related ecological studies where only limited amounts of sample are available. It also can be used for testing a variety of heat powders and pyrotechnic mixtures, particularly slow burning thermite types which are used to produce heat. Samples which contain their own oxidizers can be burned in an inert atmosphere, while others can be burned in oxygen. There is, however, an important limitation to be observed: the 6725 Calorimeter must not be used for testing self-oxidizing samples if the reaction liberates a considerable amount of gas, due to the dangerous high pressures which might develop within the bomb.

#### A 22ml Oxygen Bomb

The 1109 oxygen bomb used in the 6725 Calorimeter is the smallest of all Parr oxygen bombs. This 22 ml bomb will handle samples ranging from 25 to 200 milligrams, liberating up to 1200 calories when burned in oxygen, using initial oxygen pressures up to 35 atmospheres. Outputs up to 2400 calories can be accommodated if the sample is self-oxidizing, provided it is burned in an inert atmosphere and does not produce gas. Combustion in oxygen must be limited to a maximum output of 1200 calories.

The 1109 Semimicro Oxygen Bomb is a self sealing design with an O-ring main seal. The head is equipped with an

inlet/outlet valve for oxygen filling and release, and insulated and grounded electrodes for the firing circuit.

Samples are held in a shallow nickel alloy dish which is supported on an adjustable Inconel loop attached to the oxygen inlet tube. Electrical connections for the firing circuit are made through a connector which slides into the central terminal stem.

#### The Oxygen Connection

Oxygen is supplied to the 1109 bomb with a Parr 1824 Filling Connection which provides all of the valves and fittings needed to fill the bomb from a commercial oxygen tank, including an automatic relief valve to prevent overcharging.

#### An Effective Thermal Jacket

Effective static insulation is provided in these calorimeters by using a fully silvered glass Dewar as the calorimeter vessel. This vacuum flask holds the 1109 semimicro bomb in 460 grams of water. It is supported within a stainless steel air can which is easily removed for filling or cleaning. The air can is surrounded by a plastic foam block, and the entire

assembly is mounted in a sturdy aluminum case.

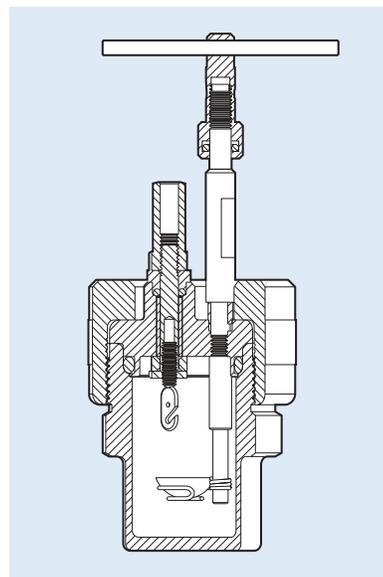
A thermistor probe and stirrer are mounted on the calorimeter cover and remain attached to the cover when the calorimeter is opened. A small motor attached to the side of the case drives the stirring shaft at a constant speed (approx. 450 rpm) through a flat, ribbed drive, belt which is easily removed when opening the calorimeter.

#### Precise Temperature Measurements

Temperature measurements in the 6725 Semimicro Calorimeter are taken with a Parr 6772 Calorimetric Thermometer which is described on page 3. In this application, the thermometer module is included with the calorimeter.

#### Good Precision

The precision obtainable with the 6725 Calorimeter will depend primarily upon the amount of energy released by the sample. If the release is less than 100 calories, the deviation from the mean will not exceed 1.0 percent of the measured value. With a 400 calorie release, the deviation will be less than 0.4 percent of the mean value.



Cross Section of 1109 Bomb



1109 Semimicro Oxygen Bomb



The 1109 Semimicro Bomb uses a self-sealing O-ring seal. As a result, no special wrenches or other tools are required to open and close the bomb.

### 6725 Semimicro Calorimeter Standardization

A supply of 0.2 gram standard benzoic acid pellets is provided for standardizing the calorimeter.

### Conversion to a Solution Calorimeter

Since the case, thermometer and motor drive for the 6725 Semimicro Calorimeter are the same as used for the 6755 Solution Calorimeter, the semimicro model can be converted to a solution calorimeter by simply replacing the inner parts with solution calorimeter components. Or, semimicro components can be installed in a solution calorimeter case. Conversion parts for these changes are listed on page 11.

### Standard Accessories

The 6725 Semimicro Calorimeter is furnished with an attached digital calorimetric thermometer and the following standard parts and accessories:

1	1109	Oxygen Bomb
1	1824	Oxygen Filling Connection
2	208AC	Inconel Fuel Capsules
1	45C7	Card of Alloy Fuse Wire
3	45C10	Card of Alloy Fuse Wire
1	3414	Vial of 30, 0.2 g Benzoic Acid Pellets, Plus a Supply of Extra Gaskets and Sealing Rings for the 1109 Bomb

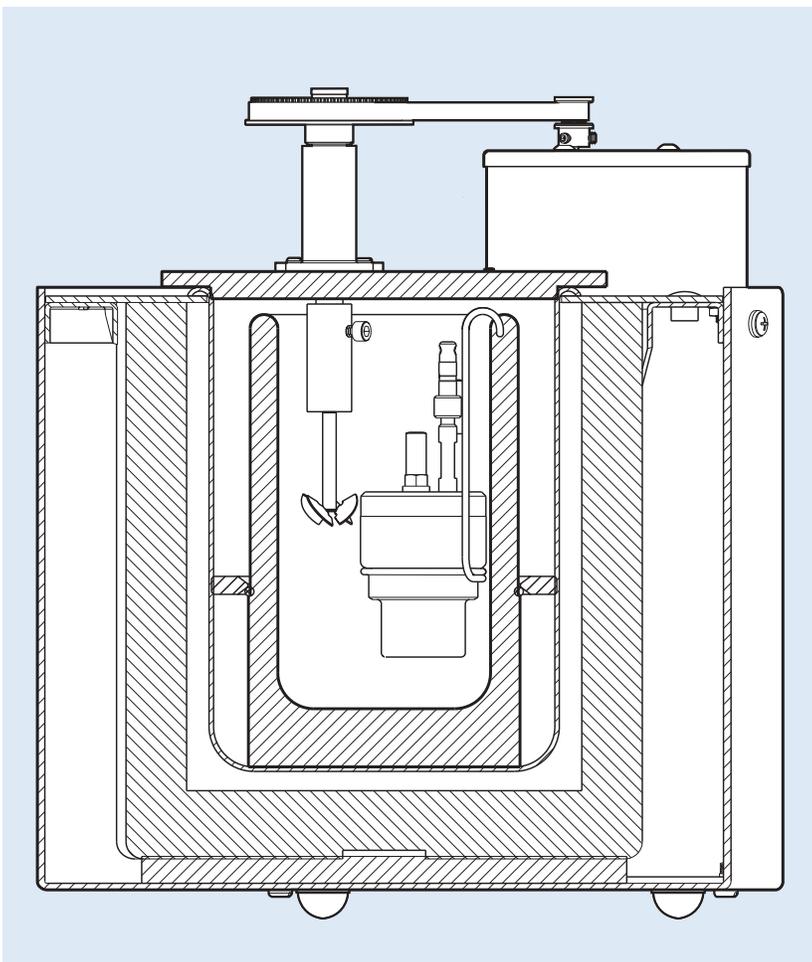
### Optional Accessories

1	A535A	Support Stand
1	1757	Printer

## Ordering Guide

### Model No. Description (Select Part No. for Voltage Required.)

6725EA	Semimicro Calorimeter with Standard Accessories	115V
6725EF	Semimicro Calorimeter with Standard Accessories	230V



6725 Calorimeter Cross Section

## 6765 Combined Solution and Semimicro Calorimeter

For laboratories that want to perform both Solution and Semimicro Oxygen Bomb calorimetry tests, Parr offers the 6765 Combined Calorimeter. This includes the 6772 calorimetric thermometer module plus the calorimeter modules from both the 6755 Solution Calorimeter and the 6725 Semimicro Oxygen Bomb Calorimeter. This option has been popular with teaching laboratories that wish to include both types of experiments in their laboratory sessions.

The 6729 and 6759 conversion sets are also available for users who have one of the principle calorimeters and wish to add the second capability to their installation.



6725 Semimicro Calorimeter with Accessories

### Ordering Guide

**Model No.** **Description (Select part no. for voltage required.)**

6729	Conversion Set for Changing a 6755 Solution Calorimeter to a 6725 Semimicro Calorimeter
6759	Conversion Set for Changing a 6725 Semimicro Calorimeter to a 6755 Solution Calorimeter
6765EB	Solution and Semimicro Calorimeter Combined, 115V
6765EE	Solution and Semimicro Calorimeter Combined, 230V

#### To Convert from 6755 to 6725

All of the parts needed to convert a 6755 Solution Calorimeter to a 6725 Semimicro Calorimeter are provided in a 6729 Conversion Set, consisting of:

1	1109	Semimicro Oxygen Bomb with Bomb Hanger and Ignition Cord
1	123C2	Dewar Flask with Locating Ring and O-ring
1	A119C2	Calorimeter Cover Assembly with Bearing Tower and Stirrer
1	1824	Oxygen Filling Connection
2	208AC	Inconel Fuel Capsules
1	45C7	Card of Alloy Fuse Wire
3	45C10	Card of Alloy Fuse Wire
1	3414	Vial of 30, 0.2g, Standard Benzoic Acid Pellets

Plus a supply of extra gaskets and sealing rings for the 1109 bomb and operating instructions for the 6725 Semimicro Calorimeter.

#### To Convert from 6725 to 6755

All of the parts needed to convert a 6725 Semimicro Bomb Calorimeter to a 6755 Semimicro Bomb Calorimeter are provided in a 6759 Conversion Kit consisting of:

1	123C	Dewar Flask with Locating Ring and O-ring
1	A120C	Calorimeter Cover Assembly with Bearing Tower and Pulley
1	A129C	Push Rod
2	A130C	Cell Assembly without Cell Bottom
2	126C	Cell Bottom, Teflon
1	3421	"Tris" Calibration Standard for 6755 Solution Calorimeter, 100g Bottle

## The Parr Warranty

Parr Instrument Company (Parr) combustion bombs, calorimeters, and associated products are designed and manufactured only for use by or under the direct supervision of trained professionals in accordance with specifications and instructions for use supplied with the products. For that reason, Parr sells only to professional users or through distributors to such users. Parr produces precision equipment and associated products which are not intended for general commercial use.

### Exclusive Warranty

To the extent allowed by law, the express and limited warranties herein are the sole warranties. Any implied warranties are expressly excluded, including but not limited to implied warranties of merchantability or fitness for a particular purpose.

### Express Warranties

Subject to the above Conditions, Parr expressly warrants that its products:

Are as described in the applicable Parr sales literature, or as specified in Parr shipping documents.

Will function as described in corresponding Parr sales bulletins, or for specifically engineered assemblies, as stated in the sales proposal and purchase agreement.

Will remain free from defects in materials and workmanship for one year from date of delivery of the product to the original purchaser/user. Note that there is no guarantee of a service life of one year after delivery.

### Limitations on the Parr Warranty

As to the original purchaser/user and to the distributors to such users, Parr limits its liability for claims other than personal injury as follows:

Replacement or repair. With respect to express warranties herein, Parr's only obligation is to replace or repair any parts, assemblies or products not conforming to the warranties provided herein.

Disclaimer of consequential commercial damages, including but not limited to: damages for loss of use, damages for lost profits, and damages for resulting harm to property other than the Parr product and its component parts.



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