Series 6000 Oxygen Bomb Calorimeters

Designing and Building High Precision Bomb Calorimeters for Over 100 Years

6000

Bulletin:
6000 Calorimeters

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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Welcome.

We are pleased to have this opportunity to tell you about our Series 6000 Oxygen Bomb Calorimeters. Over 100 years ago Prof. S.W. Parr introduced his first calorimeter intended for routine fuel testing. We believe we are continuing his tradition of applying the latest in technology to meet the real needs of today's research and fuel testing laboratories.

In these Calorimeters we have combined our understanding of the basic fundamentals of calorimetry with our best mechanical designs and the latest in microprocessor based controls and communications.

Our objective has been to produce a family of calorimeters from which our customer can select an instrument well matched to their requirements for precision, testing load, automation, laboratory environment, sample size, existing equipment and operating preferences. By using this family approach we believe we can offer this wide selection at very attractive prices. We hope you will agree that this line of Calorimeters fulfills this design objective.

Mike Steffenson
President

Quality Assurance

Parr Instrument Company operates under a Quality Assurance Program. This program ensures that all aspects of the design, materials selection and procurement, manufacture, testing and certification of its calorimeters and combustion bombs are performed in accordance with accepted codes and practices. This Quality Assurance Program has been certified to be in compliance with the following codes and quality systems:

ISO 9001-2000 Certification

Parr Instrument Company's overall Quality Assurance System has been certified to be in compliance with ISO 9001-2000 by TÜV. ISO 9001-2000 covers the overall quality assurance and management compliance aspects of Parr's activities as opposed to the certification of an individual product.

CSA Certification

Where appropriate, Parr calorimeters are manufactured and certified to the electrical code established by the Canadian Standards Association. The CSA logo is shown on the nameplate of each CSA certified unit.

CE Certification

Where appropriate, Parr Calorimeters will carry the CE mark certifying compliance with the E.C. Directive 89/3361/EEC for EMC compliance and E.C. Directive 73/23/EEC for low voltage electrical safety.

European Community – Pressure Equipment Directive (PED)

The Parr Instrument Company has been approved to design and manufacture pressure vessels in compliance with the European Council's Pressure Equipment Directive 97/23/EC. While oxygen bombs are different from general pressure vessels, the same criteria are used in all Parr designs.

ASTM E144-94(2001)

Parr Instrument Company certifies that all vessels have been tested in accordance with ASTM E144-94(2001), as required.

Chinese and Russian Pattern Approvals

Parr calorimeters also maintain both Chinese and Russian Pattern Approvals.

Compliance with Standard Test Methods

The unique design features which provide the high degree of automation in the 6400 and 6300 Calorimeters cause them to differ in certain physical details from the basic calorimeter designs prescribed in older standard methods. However, the basic requirements of these test methods have been reviewed and testing has confirmed that the results obtainable with these calorimeters will meet or exceed the repeatability and reproducibility limits specified in these test methods. The technical staff at Parr Instrument Company would be happy to review additional methods to help determine compliance.

Standard ASTM Test Methods

- ASTM D240, "Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter"
- ASTM D4809, "Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)"
- ASTM D5468, "Standard Test Method for Gross Calorific and Ash Value of Waste Materials"
- ASTM D5865, "Standard Test Method for Gross Calorific Value of Coal and Coke"
- ASTM E711, "Standard Test Method for Gross Calorific Value of Refuse-Derived Fuel by the Bomb Calorimeter"

International Standard Test Method

- ISO 1928, "Solid mineral fuels -Determination of gross calorific value by the bomb calorimetric method, and calculation of net calorific value"

Australian Standard Test Method

- AS1038.5, "Coal and coke — Analysis and testing — Gross calorific value"

British Standard Test Method

- BS1016, "Methods for analysis and testing of coal and coke. Total moisture of coal"

German Standard Test Method

- Din 51 900, "Determination of Gross Calorific Value of Solid and Liquid Fuels by the Bomb Calorimeter and Calculation of Net Calorific Value"

Japanese Industrial Standard Method

- JIS M 8814 "Determination of Calorific Value of Coal & Coke"

Bomb Calorimetry

Bomb calorimetry is a fundamental test of great significance to anyone interested in calorific measurements. The following list includes possible applications:

- Coal and coke, all varieties and types
- Fuel oil, both heavy and light varieties
- Gasoline, all motor fuel and aviation types jet fuels, all varieties
- Combustible wastes and refuse disposal
- Foodstuffs and supplements for human nutrition
- Forage crops and supplements for animal nutrition
- Building materials
- Explosives and heat powders
- Rocket fuels and related propellants
- Thermodynamic studies of combustible materials
- Energy balance studies in ecology
- Instruction in basic thermodynamic methods

Heats of combustion, as determined in an oxygen bomb calorimeter, are measured by a substitution procedure in which the heat obtained from the sample is compared with the heat obtained from a standardizing material. In this test, a representative sample is burned in a high-pressure oxygen atmosphere within a metal pressure vessel or "bomb". The energy released by the combustion is absorbed within the calorimeter and the resulting temperature change is recorded.

Four essential parts are required in any bomb calorimeter: (1) an insulating jacket to protect the bucket from transient thermal stresses during the combustion process, (2) a bucket for holding the bomb in a measured quantity of water, together with a stirring mechanism, (3) a bomb in which the combustible charges can be burned and (4) a thermometer or other sensor for measuring temperature changes within the bucket. Different model calorimeters will incorporate these parts with varying degrees of technology.

Calorimeter Selection

There are a number of factors which should influence a user in the selection of a calorimeter. In general, these four areas will help define the correct calorimeter choice:

1. Anticipated Workload
2. Required Precision
3. Appropriate Standard Methods
4. Available Budget

For those laboratories testing a large volume of samples, either the 6400 Automatic Isoperibol Calorimeter or the 6300 Automatic Isoperibol Calorimeter is an appropriate choice. Loading of the sample involves a simple 1/8th turn of the bomb head in the unit. The calorimeter then automatically fills the bomb and bucket, ignites the sample, monitors the temperature rise and flushes the system once the reaction is complete. Users will find that they can operate multiple calorimeters with ease. The operator time per test is estimated to be 1 minute and therefore it is possible for one operator to manage multiple units simultaneously.

The 6200 Isoperibol Calorimeter and the 6100 Compensated Jacket Calorimeter can analyze just as many samples per instrument as an individual automatic calorimeter; however, there is additional operator time per test and therefore fewer instruments can be operated at the same time. The user will need to fill and rinse the bomb as well as fill and drain the bucket. The operator time per test is estimated to be 6 minutes.

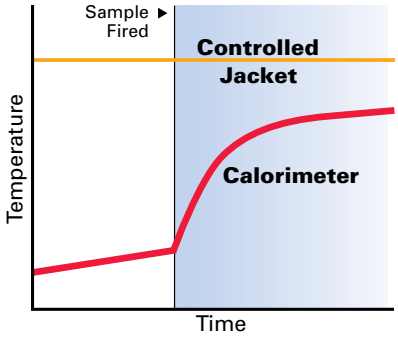
The 1341 Plain Jacket Calorimeter requires significant user time. Along with filling and rinsing the bomb and filling and draining the bucket with water, the user must record the temperatures during the course of the reaction. The estimated time that the user will spend with this instrument is 25 minutes per test. This process can be simplified for the user by adding the 6772 Calorimetric Thermometer. ***See page 8 for Selection Guide.***

100 Years of Leadership and Innovation

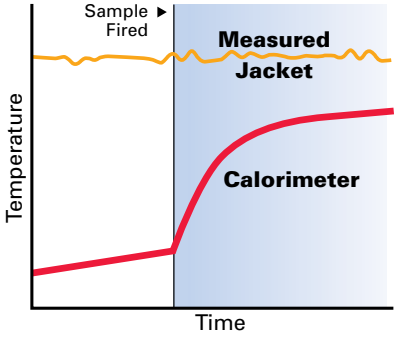
1899 Professor S.W. Parr developed a simplified calorimeter for measuring the heating value of coal.	**1911** Parr introduced an oxygen bomb calorimeter of a new design with a bomb made of an acid-resistant alloy.	**1916** Parr introduced its first water-jacketed, adiabatic calorimeter using hot water injection for temperature control.	**1933** Parr introduced the first self-sealing oxygen combustion bomb.	**1962** Parr introduced the first automatic jacket temperature control system for an adiabatic calorimeter.	**1979** Parr introduced the first microprocessor-based controller for handling all steps in a calorimetric test.	**1980** Parr introduced dynamic operating mode and isoperibol calorimetry to dramatically shorten calorimetric tests.	**1982** Parr introduces "Smart Link" local area network for linking coal testing instruments and computers.

Jacket Designs

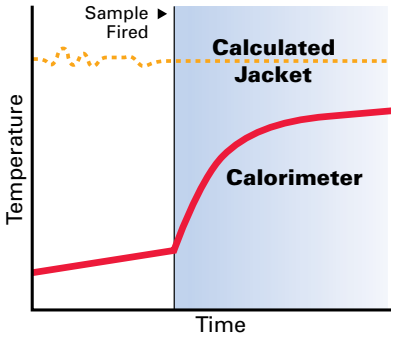
Parr introduces the Series 6000 line of Oxygen Bomb Calorimeters described in this brochure featuring a high degree of automation with touch screen operation, Linux operating system and fifth generation microprocessor control.



Isoperibol Calorimetry
An isoperibol calorimeter is one where the surrounding jacket is maintained at a constant temperature while the temperature of the bomb and bucket rise as heat is released by the combustion. The Model 6400, 6300 and 6200 Calorimeters are true isoperibol calorimeters. In these implementations, a controlled temperature jacket, completely surrounds the combustion bomb and its "bucket". A microprocessor-based controller monitors both the temperature of the bucket and the jacket and performs the necessary heat leak corrections that result from differences in these two temperatures. These corrections are applied continuously in real-time throughout the test rather than as a final correction based on pre and post test measurements.



Continuously Compensated Calorimetry
The Parr 6100 Calorimeter takes advantage of the real time, continuously corrected method developed by Parr. No attempt is made in the Model 6100 Calorimeter to establish the constant jacket temperature required for isoperibol calorimetry. Instead, the temperature of the jacket is continuously monitored and real time heat leak corrections are applied based upon the temperature difference between the bucket and the actual temperature of the jacket. While this method is not truly an isoperibol method, its real time correction procedure achieves the same purpose with nearly equal results. What it can not do is match the temperature uniformity of a circulating water jacket.



Compensated Calorimetry
The Parr 6772 Precision Thermometer, serving as a controller for the 1341, 6725 and 6755 Calorimeters, uses yet another approach to emulate the isoperibol calorimetric method. In these calorimeter systems, the heat leak is precisely measured during the calorimetric pre-period. This evaluation results in an estimate of the effective, average temperature of the calorimeter surroundings. This temperature value is then used throughout the test interval to provide the calorimeter heat leak correction. While not as robust as either of the other two methods outlined above, it harnesses the computing power of the controller, with no additional hardware costs, to provide heat leak correction capability that is almost identical to the approach used when non-electronic thermometry and manual calorimetric techniques are employed.

1992-94
Parr introduced two completely new, automatic, fixed bomb, isoperibol calorimeters (1271 & 1281) with fully automatic bomb and water handling capabilities.

1999
Parr introduces the 1266 Isoperibol Calorimeter and the 1356 Continuously Corrected Calorimeter.

2004
Parr introduces the Series 6000 line of Oxygen Bomb Calorimeters described in this brochure featuring a high degree of automation with touch screen operation, Linux operating system and fifth generation microprocessor control.

Parr Removable Bomb & Bucket Technology

Removable bomb calorimeters are the more traditional design most users will recognize. In this design the oxygen bomb and bucket are removed from the calorimeter for loading the sample and filling the bucket with the carefully measured amount of water which absorbs the energy released in the combustion.

The choice of bomb style may affect the calorimeter chosen. Bomb choice is dictated by sample size and alloy of construction. These bombs range in sample size from 500 to 12,000 calories per charge, and are offered in different alloys and designs for a variety of applications.

Alloy Selection

Parr oxygen combustion bombs are made of Alloy 20 which is richer in chromium and contains three times as much nickel as series 300 Stainless Steels. Alternatively, Alloy G-30 is offered for chloride service as the metal contains cobalt and molybdenum to resist the corrosive effect of the chloride ion. The fixed bombs of the 6400 and 6300 Calorimeters are available in either alloy.

Recommended Applications

While these bombs do not feature the automatic handling features of the fixed bomb and bucket design calorimeters, the removable bomb calorimeter will remain the calorimeter of choice for users with one or more of the following applications or preferences:

- Low to medium testing loads which will not justify the higher cost of more automated systems.
- Applications requiring a greater level of control over the test process.
- Applications which require one of the special purpose oxygen bombs such as the 1104 High-Strength Bomb or the 1109 Semi-micro Bomb.
- Combustions which produce unusual amounts of ash or other corrosive residues that would damage the automatic discharge system.
- Users who chose not to perform the additional maintenance that the fully automatic instruments require.
- Users who presently have a number of 1108 Oxygen Bombs and other accessories in their laboratories.
- Student instruction applications with an emphasis on the basic principals of calorimetry.

1108(P) Oxygen Bomb

More than 20,000 of these reliable oxygen combustion bombs have been placed in service on a world wide basis. The 1108 Bomb is the standard, 350 mL, general purpose bomb used in all Parr 6200, 6100, and 1341 Calorimeters, and in the 1901 Bomb Combustion Apparatus. It will safely burn samples liberating up to a maximum of 8000 calories per charge, using oxygen charging pressures up to 40 atm. This bomb features an automatic inlet check valve and an adjustable needle valve for controlled release of residual gasses following combustion. They are intended for samples ranging from 0.6 to 1.2 grams with a maximum energy release of 8000 calories per charge. The 1108P bomb features a semi-permanent heating wire and cotton thread. When contact is made through the heating wire, the thread will burn, drop into the sample cup and ignite the sample. Both are available in Alloy 20 and Alloy G30.

1109A Semi-micro Bomb

The Parr 1109A Semi-micro Oxygen Bomb is designed for small samples such as marine biology or ecological studies. It may also be used when sample size is limited. This 22 mL bomb will handle samples that range from 25 to 200 milligrams, liberating 52 to 1200 calories when burned in oxygen, using initial pressures up to 35 atmospheres. Outputs of 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.

1104(B) High Strength Bomb

This is a 240 mL, extra heavy bomb for combustion tests with samples that burn with extreme violence. It will handle samples that liberate up to 12,000 calories per charge, using oxygen charging pressures up to 45 atm. This bomb should be used in place of the standard bomb when testing explosives, gun powders and fast-burning propellants, or when working with materials whose combustion characteristics are unknown or unpredictable. Samples to be burned in the 1104 Oxygen Bomb are held in a thick-walled capsule within a heavy combustion cage which serves to muffle the shock forces produced by high-energy samples. The combustion cage may not be necessary when testing samples which do not burn violently. In some cases it may be easier to secure complete combustion by substituting a lighter capsule and omitting the combustion cage. Part number 1104B is the High Strength Bomb with the loop terminal only.

Parr Fixed Bomb & Bucket Technology

In the fixed bomb and bucket design used in the 6400 Automatic Isoperibol Calorimeter and the 6300 Automatic Isoperibol Calorimeter, the bomb and bucket are not removed from the calorimeter during routine operations. This design concept has made it possible to offer unique levels of automation for the entire calorimetric determination not just the data collection and reporting steps. The result of this automation will save approximately five minutes of operator time per test when compared to any removable bomb calorimeter.

Oxygen Charging and Release

The fixed bomb and bucket design allow the oxygen supply to be directed into the head of the bomb at the beginning of each test. The head of these bombs incorporate a check valve which dynamically seals when the bomb is pressurized. At the end of the test, the gases in the bomb are automatically released while the calorimeter is being returned to its starting temperature.

Fixed Bucket

The bucket in these calorimeters has been designed to provide smooth circulation over the surface of the vessel. The design also repeatedly fills the bucket volumetrically.

The bomb head closure seals the bucket at the same time the bomb is closed. This unique design minimizes the amount of water required for the test as well as permitting rapid, automatic and repeatable filling for each test. The water heated by the combustion is automatically drained from the bucket at the conclusion of the test and replaced with cooling water to bring the bomb and bucket rapidly back down to the starting temperature for the next test.

Fixed Bomb

The 6300 and 6400 Calorimeters feature the patented closure design of the Parr Fixed bombs. This design allows the user to seal and lock the head into the cylinder with simple 1/8th turn. The main bomb seal is an o-ring optimized to minimize frictional wear, improving the lifetime of this seal.

At the conclusion of the test the inside surface of the bomb is washed to remove the products of the combustion from the bomb. The automation of the bomb washing step eliminates one of the most tedious and time consuming manual operations required with removable bomb calorimeters. Besides the elimination of the drudgery of manually washing the bomb, a not so obvious advantage of the fixed bomb design is that the bomb is always washed as soon as the final temperature can be determined. Generally, this is within 4-5 minutes of the time the bomb is fired. This holds to an absolute minimum the time any acids produced by the combustion can attach to the inner surfaces of the bomb. This has improved the service life of these bombs in comparison to removable bombs.

1138 Oxygen Bomb

The 1138 is a 250 mL bomb with a sample range of 5000 - 8000 calories per charge. The straight wall design of this bomb improves bomb rinse recovery, better precision and faster tests times. It also makes available the ability to re-bore the vessel affording a longer service life.

1136 Oxygen Bomb

The 1136 Oxygen Bomb, like the standard 1108 Oxygen Bomb, is 350 mL in internal volume. It will safely handle samples liberating up to a maximum of 8000 calories per charge.

Both the 1136 and the 1138 oxygen bombs use the A1450DD head assembly, therefore service parts in the 6038 kit are interchangeable on these models. Older model 1136 and 1138 bombs with the head assembly model number A895DD will use spare parts kit 6036. The user may update from the A895DD style head to the A1450DD style at no charge.

Please see page 21 for Maintenance Kit Selection Guide.

Parr Calorimeter Selection Guide

Characteristics	*6400 Automatic Isoperibol Calorimeter*	*6300 Automatic Isoperibol Calorimeter*	*6200 Isoperibol Calorimeter*	*6100 Compensated Jacket Calorimeter*	*1341 Plain Jacket Calorimeter*	*6725 Semi-micro Calorimeter*
Calorimeter Type	Isoperibol	Isoperibol	Isoperibol	Compensated	Static	Static
Operator Time per Test	1 Minute	1 Minute	6 Minutes	6 Minutes	25 Minutes	6 Minutes
Precision Classification	0.10%	0.10%	0.10%	0.20%	0.30%	0.40%
Number of Vessels	Up to 4	Up to 4	Up to 4	Up to 4	1	Up to 4
Tests per Hour	6 - 8 as equipped	6 - 8 as equipped	4 - 8 as equipped	4 - 8 as equipped	2	3
Bomb Type & Bucket	Fixed Bomb and Bucket Design	Fixed Bomb and Bucket Design	Removable Bomb & Bucket Design	Removable Bomb & Bucket Design	Removable Bomb & Bucket Design	Removable Bomb Dewar Flask
Bucket Filling	Automatic	Automatic	Manual	Manual	Manual	Manual
Oxygen Filling	Automatic	Automatic	Semi-automatic	Semi-automatic	Manual	Manual
Bomb Washing	Automatic	Automatic	Manual	Manual	Manual	Manual
Memory	1000 Tests	1000 Tests	1000 Tests	1000 Tests	None	1000 Tests
Printer Connection	Ethernet or RS232	Ethernet or RS232	Ethernet or RS232	Ethernet or RS232	None	Ethernet or RS232
Balance Connection	Ethernet, or RS232C	Ethernet, or RS232C	Ethernet, or RS232C	Ethernet, or RS232C	None	Ethernet, or RS232C
Network Connection	Ethernet	Ethernet	Ethernet	Ethernet	None	Ethernet
Temperature Resolution	0.0001 °C	0.0001 °C	0.0001 °C	0.0001 °C	0.002 °C	0.0001 °C
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Model 6400 Calorimeter Designed for laboratories that require high through-put. The unit features a closed loop cooling subsystem in the calorimeter. The patented Quick Twist-Lock vessel closure design allows one operator to run up to four 6400 calorimeters simultaneously.

Model 6300 Calorimeter An alternative to the 6400 Calorimeter. This highly mechanized calorimeter is a cost effective system; both as a capital investment and by limiting operating costs. It is capable of running off of tap water and one operator can run up to four 6300 calorimeters simultaneously.

Model 6200 Calorimeter Featuring a removable bomb and bucket design, the 6200 is our most popular calorimeter. It is a good choice for high precision quality control work and for research and development. Multiple bomb choices are available, expanding its functionality.

Model 6100 Compensated Calorimeter The 6100 takes advantage of the real time, continuously corrected method originally developed by Parr Instrument Company. While not an isoperibol method, its real time correction achieves nearly equal results. This feature, along with a reasonable price, make it attractive for waste and refuse disposal work and student instruction.

Model 1341 Plain Jacket Calorimeter A reliable calorimeter, the 1341 can be used for the same broad range of solid and liquid combustible samples. Its modest cost and simple design make the model suitable for low throughput and minimal precision work such as sample screening and student instruction.

Model 6725 Semimicro Calorimeter A compact, static jacket, calorimeter designed specifically for measuring the heat produced by the combustion of small samples

Model 6755 Solution Calorimeter For laboratories who wish to measure enthalpy changes produced by chemical reactions in solution. (Bulletin 1400).

6400 Automatic Isoperibol Calorimeter

6400 Automatic Isoperibol Calorimeter

The 6400 Automatic Isoperibol Calorimeter represents the next evolutionary step in the Parr automated calorimeters. Inclusive and compact, the instrument incorporates a closed loop cooling subsystem into the calorimeter. This subsystem uses a thermoelectric cooler assembly attached directly to a one liter water tank which supplies cooling water to the calorimeter. An external nitrogen pressurized tank is used to supply rinse water to the calorimeter. This model features the fixed bomb and bucket design allowing for automated bucket and jacket fill as well as automated vessel fill and rinse. The 6400 requires one minute of operator time per test, allowing a technician to operate up to four calorimeters simultaneously.

Quick Twist-Lock Bomb

The 1138 Oxygen Bomb has been redesigned to withstand a higher magnitude of tests. The head is designed with an O-ring groove which is optimized to minimize frictional wear, in turn improving the lifetime of the seal. The bomb head is removable for fast sample loading using the patented Quick Twist-Lock vessel closure design.

Laboratory Requirements

The calorimeter requires a source of 99.5% oxygen, a source of nitrogen or house air at 80 psi, and deionized water.

SPECIFICATIONS

Model Number:
6400

Tests Per Hour:
6 – 8

Operation Time Per Test:
1 Minute

Precision Classification:
0.1% Class

Jacket Type:
Isoperibol, Water Jacket

Oxygen Fill:
Automatic

Bucket Fill:
Automatic

Bomb Wash:
Automatic

Bomb Model Options:
1138, 250mL Alloy 20
1138CL, 250mL Alloy G30

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
42w x 46d x 51h

6400 Automatic Isoperibol Calorimeter, continued

1138 Oxygen Combustion Bomb

6400 Automatic Isoperibol Calorimeter Open

Expanded System

The 6420 Expanded System is a convenient way to order all of the components necessary for a complete system. The system includes the following parts:

- 6400 Calorimeter
- 1576 Rinse Tank
- 1757 Printer
- Extra 1138 Bomb Head Assembly
- 6038 Bomb Maintenance Kit
- 6409B, 1 Year Service Kit

6400 Ordering Guide

6400 Automatic Isoperibol Calorimeter

Model No.	*Voltage*	*Description*
6400EA / EF	115 V / 230 V	6400 Calorimeter with 1138 Oxygen Bomb of Alloy 20
6400CLEA / EF	115 V / 230 V	6400 Calorimeter with 1138 Oxygen Bomb of Alloy G30
6420EA / EF	115 V / 230 V	6420 Expanded System with 1138 Oxygen Bomb of Alloy 20
6420CLEA / EF	115 V / 230 V	6420 Expanded System with 1138 Oxygen Bomb of Alloy G30

6300 Automatic Isoperibol Calorimeter

6300 Automatic Isoperibol Calorimeter

1136 Oxygen Combustion Bomb

SPECIFICATIONS

Model Number:
6300

Tests Per Hour:
6 – 8

Operation Time Per Test:
1 Minute

Precision Classification:
0.1% Class

Jacket Type:
Isoperibol, Water Jacket

Oxygen Fill:
Automatic

Bucket Fill:
Automatic

Bomb Wash:
Automatic

Bomb Model Options:
1138, 250mL Alloy 20
1138CL, 250mL Alloy G30
1136, 350mL Alloy 20
1136CL, 350mL Alloy G30

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
42w x 40d x 43h

The 6300 Automatic Isoperibol Calorimeter is an alternative to the 6400 Calorimeter. This highly automated calorimeter is a cost effective system; both as a capital investment and by limiting operating costs. An important design concept of the 6300 Calorimeter is that this model is capable of running off of tap water provided the water meets the required criteria, freeing the user from purchasing additional accessories.

Laboratory Requirements

The calorimeter requires a source of 99.5% oxygen, a cooling water source (less than 25 °C) and deionized water for operation. If a closed loop system is chosen, the water handling system must be installed below the calorimeter.

Expanded System

The 6320 Expanded System is a simple way to order a complete system when beginning a laboratory or for improving turn-around time. The system includes the following components:

- 6300 Calorimeter
- 6520A Recirculation System
- 1757 Printer
- Extra Bomb Head Assembly
- 6038 Bomb Maintenance Kit
- 6309B, 1 Year Service Kit

6300 Ordering Guide

6300 Automatic Isoperibol Calorimeter

Model No.	*Voltage*	*Description*
6300EA / EF	115 V / 230 V	6300 Calorimeter with 1138 Oxygen Bomb of Alloy 20
6300CLEA / EF	115 V / 230 V	6300 Calorimeter with 1138 Oxygen Bomb of Alloy G30
6320EA / EF	115 V / 230 V	6320 Expanded System with 1138 Oxygen Bomb of Alloy 20
6320CLEA / EF	115 V / 230 V	6320 Expanded System with 1138 Oxygen Bomb of Alloy G30

6200 Isoperibol Calorimeter

SPECIFICATIONS

Model Number:
6200

Tests Per Hour:
6 – 8

Operation Time Per Test:
6 Minutes

Precision Classification:
0.1% Class

Jacket Type:
Isoperibol, Water Jacket

Oxygen Fill:
Semi-Automatic

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1108, Alloy 20
1108CL, Alloy G30
1108P, Alloy 20, Semi-permanent Wire
1108PCL, Alloy G30, Semi-permanent Wire
1109A, 22mL Semi-micro Bomb
1104(B), High Strength Bomb

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
57w x 40d x 43h

6200 Isoperibol Calorimeter


6220 Expanded System

The 6200 Isoperibol Calorimeter is Parr's most precise model. The traditional removable bomb and bucket design along with the water jacket of this calorimeter afford the user with complete control over the combustion process. This makes the 6200 the ultimate choice for precise research and development and quality control work.

Isoperibol Jacket System

Outstanding thermal jacketing is provided by a circulating water system driven by a built-in, high capacity pump which maintains a continuous forced flow around the sides and bottom of the bucket chamber and through the cover as well. A sealed immersion heater and a built-in heat exchanger, both operated by the calorimeter controller, provide precise jacket temperature control.

Semi-Automatic Oxygen Fill

To speed and simplify the bomb filling operation, the 6200 Calorimeter has a semi-automatic system for charging the bomb with oxygen. Oxygen is connected to a microprocessor controlled solenoid installed in the calorimeter. To fill the bomb, the operator simply slips the filling hose connector onto the bomb inlet valve and pushes the touch screen to start the filling sequence.

Laboratory Requirements

The calorimeter requires a source of 99.5% oxygen and deionized water for operation. If a closed loop system is chosen, the water handling system must be installed to the left of the calorimeter.

Expanded System

The 6220 Expanded System includes the following components:

- 6200 Calorimeter
- 6510 Water Handling System
- 1757 Printer
- Extra Bomb and Bucket
- 6008 Bomb Maintenance Kit
- 6209B, 1 Year Service Kit

6200 Ordering Guide

6200 Semi-Automatic Isoperibol Calorimeter

Model No.	*Voltage*	*Description*
6200EA / EF	115 V / 230 V	6200 Calorimeter with 1108 Oxygen Bomb of Alloy 20
6200CLEA / EF	115 V / 230 V	6200 Calorimeter with 1108 Oxygen Bomb of Alloy G30
6220EA / EF	115 V / 230 V	6220 Expanded System with two 1108 Oxygen Bombs of Alloy 20 and Principal Components
6220CLEA / EF	115 V / 230 V	6220 Expanded System with two 1108 Oxygen Bombs of Alloy G30 and Principal Components

6100 Isoperibol Calorimeter

6100 Calorimeter Open with 1108 Bomb and Bucket

The 6100 Continuously Compensated Calorimeter is a compact, static jacket calorimeter that operates at approximately room temperature taking full advantage of modern microprocessor capabilities. The microprocessor controller in the 6100 will automatically monitor the jacket temperature and apply the required corrections in real time. The advantages of this system include less water, less energy, and less hardware while still affording good precision. The 6100 model also uses the traditional removable bomb and bucket design. This combination along with a reasonable price makes it attractive for waste and refuse disposal work and student instruction.

Semi-Automatic Oxygen Fill

Like the 6200 Calorimeter, the 6100 Calorimeter has a semi-automatic system for charging the bomb with oxygen where the oxygen feed is controlled by a solenoid installed inside the calorimeter. The bomb is filled by slipping the filling hose connector onto the bomb inlet valve and pushing the touch screen to start the filling sequence. Filling then proceeds automatically at a controlled rate to an established operating pressure.

Laboratory Requirements

The calorimeter requires a source of 99.5% oxygen and deionized water for operation.

Expanded System

The 6120 Expanded System includes the following components:

- 6100 Calorimeter
- 1757 Printer
- Extra Bomb and Bucket
- 6008 Bomb Maintenance Kit
- 6109B, 1 Year Service Kit

SPECIFICATIONS

Model Number:
6100

Tests Per Hour:
6 – 8

Operation Time Per Test:
6 Minutes

Precision Classification:
0.2% Class

Jacket Type:
Continuously Compensated

Oxygen Fill:
Semi-Automatic

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1108, Alloy 20
1108CL, Alloy G30
1108P, Alloy 20, Semi-permanent Wire
1108PCL, Alloy G30, Semi-permanent Wire
1109A, 22mL Semi-micro Bomb
1104(B), High Strength Bomb

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
57w x 40d x 43h

6100 Ordering Guide

6100 Compensated Jacket Calorimeter

Model No.	*Voltage*	*Description*
6100EA / EF	115 V / 230 V	6100 Calorimeter with 1108 Oxygen Bomb of Alloy 20
6100CLEA / EF	115 V / 230 V	6100 Calorimeter with 1108 Oxygen Bomb of Alloy G30
6120EA / EF	115 V / 230 V	6120 Expanded System with 1108 Oxygen Bomb of Alloy 20 and Principal Components
6120CLEA / EF	115 V / 230 V	6120 Expanded System with 1108 Oxygen Bomb of Alloy G30 and Principal Components

1341 Plain Jacket Calorimeter

SPECIFICATIONS

Model Number:
1341

Tests Per Hour:
2

Operation Time Per Test:
25 Minutes

Precision Classification:
0.3% Class

Jacket Type:
Static

Oxygen Fill:
Manual

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1108, Alloy 20
1108CL, Alloy G30
1108P, Alloy 20, Semi-permanent Wire
1108PCL, Alloy G30, Semi-permanent Wire
1104(B), High Strength Bomb

Dimensions (cm):
21w x 21d x 29h

The 1341 Plain Jacket Calorimeter is the current version of the static jacket, oxygen bomb calorimeter that Professor Parr developed over 100 years ago. It is a reliable calorimeter that can be used for the same broad range of solid and liquid combustible samples as the 6000 series calorimeters. Its modest cost and simple design make the model suitable for low throughput and minimal precision work such as sample screening and student instruction.

Static Jacket

Although commonly called a plain calorimeter because of its simple design, technically this is a static jacket instrument which operates at or near room temperature with no provision for controlling the jacket temperature. Compensation for any heat loss (or gain) during a test is made by applying a correction computed from heat leak measurements taken before or after each test. Good repeatability can be obtained with the 1341 Calorimeter provided that the temperature rise and heat leak corrections are measured and applied carefully.

Laboratory Requirements

The calorimeter requires a source of 99.5% oxygen, deionized water and an ignition unit for operation.

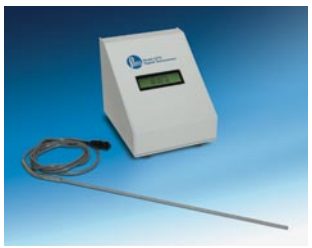
1341 Plain Calorimeter

The 1341 Plain Calorimeter includes the following components:

- 1341 Calorimeter
- Oxygen Bomb
- Oval Bucket
- Oxygen Fill Connection
- 6775 Digital Thermometer
- 6008 Bomb Maintenance Kit

6775 Digital Thermometer

The 6775 Digital Thermometer provides digital precision and reliability for temperature measurements. The thermometer has a working range of 10 to 40 °C and a resolution of 0.001 °C. The readout is displayed on a clear LCD screen. In addition to displaying temperature, the thermometer includes a timer that can be used to manually record the time intervals of specific temperature readings. The thermometer uses high capacity lithium batteries which provide approximately 200 hours of operation. Designed for use with the Parr 1341 Plain Jacket Calorimeter, the 6775 is a replacement for the 1604 and 1623 liquid-in-glass thermometers.



1341 Ordering Guide

1341 Plain Jacket Calorimeter

Model No.	*Voltage*	*Description*
1341EB / EE	115 V / 230 V	1341 Calorimeter with 1108 Oxygen Bomb of Alloy 20
1341CLEB / EE	115 V / 230 V	1341 Calorimeter with 1108 Oxygen Bomb of Alloy G30
2901EB / EE	115 V / 230 V	Ignition Unit for 1341 Calorimeter
6775	NA	Digital Thermometer

6772 Calorimetric Thermometer

6772 Calorimetric Thermometer

The 6772 Calorimetric Thermometer is a high precision temperature measuring system based upon the control systems of the 6000 series calorimeters. It is an integral part of the 6725 Semi-micro Calorimeter and the 6755 Solution Calorimeter. Additionally, the 6772 is able to provide automatic control and communication capabilities to the 1341 Plain Jacket Calorimeter.

Microprocessor Design

The 6772 Thermometer has the ability to collect data from two thermistors. The microprocessor, central to the function of the unit, is able to linearize the temperature signal and provide excellent resolution and precise repeatability over each operating range. An automatic, self-calibrating capability for differential temperature measurements and other unique features are included in this electronic design.

Test Automation

In addition to measuring temperatures, the 6772 Thermometer will determine the net temperature rise, apply all necessary corrections and calculate and report the heat of combustion in the associated calorimeter as selected by the operator.

Data Collection

The addition of the 6772 to a calorimetric system will allow the user to print to an attached printer, obtain weights from a balance and transfer data to a computer.

Any data collected may be sent to a connected printer. This printer may be connected directly through the RS232C port located in the back of the thermometer or the printer may be on the laboratory network.

The 6772 supports input from multiple balance types. Additionally, a generic input driver is provided for communications with balances that do not conform to the eight supported protocols. This communication is through the RS232C port on the back of the thermometer.

The 6772 Calorimetric Thermometer can function as a data logger, collecting data as the test proceeds and transferring the data in csv format. Alternatively, data may be collected internally and displayed or printed as a final report. Test data can be transferred to an Ethernet network connected computer using the FTP File Transfer Protocol. Test reports may also be viewed and printed with a web browser.

SPECIFICATIONS

Model Number:
6772

Operating Range:
10 - 50 °C

Resolution:
0.0001 °C

Absolute Accuracy w/out Calibration:
± 0.100 °C

Absolute Accuracy w/ Calibration:
± 0.0500 °C

Repeatability, Single Point:
± 0.002 °C

Linearity, 10 °C Span:
± 0.002 °C

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
56w x 36d x 31h

6772 Ordering Guide

6772 Calorimetric Thermometer

Model No.	*Voltage*	*Description*
6772EA / EF	115 V / 230 V	6772 Calorimetric Thermometer

6725 Semi-Micro Calorimeter

SPECIFICATIONS

Model Number:
6725

Tests Per Hour:
2 – 3

Operation Time Per Test:
6 – 10 Minutes

Precision Classification:
0.4% Class

Jacket Type:
Compensated, Dewar Flask

Oxygen Fill:
Manual

Bucket Fill:
Manual

Bomb Model Options:
1109, 22mL Auto-check Valve, Semi-Micro Bomb
1109A, 22mL Manual Valve, Semi-Micro Bomb

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
6775: 22w x 33d x 33h
6772: 56w x 36d x 31h

6725 Semi-Micro Calorimeter shown with 6772 Calorimetric Thermometer

The 6725 Semi-Micro Calorimeter is a compact, static jacket, calorimeter designed specifically for measuring the heat produced by the combustion of small samples.

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.

Thermal Jacket

In the 6725 Calorimeter, the heat leak is precisely measured during the calorimetric pre-period. The associated 6772 Thermometer calculates an effective, average temperature of the calorimeter surroundings. This temperature value is then used throughout the test providing the calorimeter heat leak correction. Effective static thermal insulation is provided by using a silvered glass Dewar flask. This vacuum flask holds the semi-micro bomb in the test water.

Data Collection

The 6772 Calorimetric Thermometer is incorporated into the 6725 Semi-micro Calorimeter. This allows the user to print to an attached printer, obtain weights from a balance and transfer data to a computer. Additionally, the ability of the 6772 Calorimetric Thermometer to act as a data logger is very useful when studying materials with very small energy changes.

6725 Ordering Guide

6725 Semi-Micro Calorimeter

Model No.	*Voltage*	*Description*
6725EA / EF	115 V / 230 V	6725 Semi-Micro Calorimeter

6755 Solution Calorimeter

6725 Semi-Micro Calorimeter shown with 6772 Calorimetric Thermometer

The Parr 6755 Solution Calorimeter, utilizing a unique rotating sample cell and a precise microprocessor-based thermometer, 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.

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.

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 PTFE dish which fits snugly into the bell without requiring a gasket or sealing ring. Solid sample (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.

Data Collection

With the 6755, the user is able to print to an attached printer, obtain weights from a balance and transfer data to a computer as the system incorporates the 6772 Calorimetric Thermometer.

Standardization

The 6755 Solution Calorimeter is generally standardized using an exothermic reaction with TRIS. The instrument may also be standardized electrically with a heating probe or through comparison with known samples whose thermochemical behavior is understood.

6765 Combined Solution and Semi-micro Calorimeter

For laboratories that want to perform both solution and semi-micro oxygen bomb calorimetry tests, Parr offers the 6765 Combined Calorimeter. This includes the 6772 Calorimetric Thermometer plus a calorimeter module and conversion parts for both the 6755 Solution Calorimeter and the 6725 Semi-micro Calorimeter.

SPECIFICATIONS

Model Number:
6755

Precision Classification:
0.4% Class (1.5 – 5.0 °C rise at or near room temperature)

Working Temperature Range:
10 – 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

Balance Communication:
RS232C Port

Printer Communication:
RS232C Port

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
6755: 22w x 33d x 33h
6772: 56w x 36d x 31h

6755 Ordering Guide

6755 Solution Calorimeter

Model No.	*Voltage*	*Description*
6755EA / EF	115 V / 230 V	6755 Solution Calorimeter
A274C	N/A	Heating Probe (for electrical standardization, contact Parr technical support)
6765EA / EF	115 V / 230 V	Combined Solution and Semi-Micro Calorimeter

Parr Water Handling Systems

To increase throughput and precision, an effective means of supplying temperature controlled and measured water is desired. There are two basic methods for replacing test water:

Open Loop
In an open loop system, the water from the bucket (and if necessary the jacket) is drained and replaced with cool fresh water from the tap prior to starting another test. If the laboratory has supply of good quality, cool tap water and a convenient drain, an open loop system requires a bare minimum of accessories. This is standard for the 6300 and 6100 models.

Closed Loop
In a closed loop system, the bucket and jacket water is recycled to a holding tank and circulated through a cooler to bring the water back to the desired starting temperature. Users who desire more consistency than tap water provides or where water supplies may be high in mineral contents, which over time can deposit in the calorimeter, will prefer this mode of operation.

6300 Isoperibol Calorimeter Options

Open Loop
For open loop operation, cool tap water is brought into the back of the calorimeter and the hot water discharge line is fed to the drain. The speed at which the calorimeter will recycle between tests is a function of the temperature of the incoming tap water. The performance will slow noticeably above 20 °C and will become sluggish above 25 °C. A 1552 Water Cooler can be installed on the inlet line to assure adequate cooling water and faster recycle times.

6520 Water Handling System

Closed Loop
The 6520A Water Recirculation System provides a convenient means to operate on a closed loop. This method of operation will be desirable for installations where a supply of supply of tap water, or a drain, is not convenient or available or the quality or temperature of the water supply does not meet the operating specifications of the calorimeter. (The 6520A Water Recirculation System includes an integral thermoelectric cooler and eliminates the need for a stand alone cooler).

The 1564 Water Recirculation System is designed for use with a water cooler. Users who have our 1552 Water Cooler or a similar chiller should select this recirculating system for closed loop operation.

Note: Because the 6300 Calorimeter drains by gravity, the recirculating systems must be installed below the calorimeter (not on the bench top) for closed loop operation

6200 Isoperibol Calorimeter Options

Open Loop

For open loop operation in the 6200 Calorimeter, tap water is brought into the back of the calorimeter and the heated water is fed to the drain. Since this water is only used for cooling the jacket, the 6200 Calorimeter can operate efficiently with the tap water temperature up to 25 °C. Water for the bucket is normally drawn from a faucet supply and will need to adopt a constant and initial temperature compatible with the water supply.

Closed Loop

In the 6200 Calorimeter, the operator must make provisions for precisely adding the correct volume of water at a repeatable starting temperature. The following closed loop systems handle this task, as well as the other functions of closed loop systems.

The 6510 Water Handling System uses thermoelectric cooling and a unique glass pipette to deliver a precise amount of temperature controlled water for filling the bucket and provide cooling water for the jacket.

The 1563A Water Handling System uses the same glass delivery pipette, however a separate water cooler must be used. The Parr 1552 Water Cooler is recommended for this purpose.

6510 Water Handling System

1563A Water Handling System

1552 Water Cooler

Note: Both the 1563A and the 6510 Water Handling Systems operate on the bench top, next to the calorimeter.

Water Handling Systems Ordering Guide

6300 Calorimeter Options

Model No.	*Voltage*	*Description*
6520EA / EF	115 V / 230 V	6520A Water Recirculation System
1564EA / EF	115 V / 230 V	1564 Water Recirculation System w/o Cooling
1552EA / EF	115 V / 230 V	1552 Water Cooler

6200 Calorimeter Options

Model No.	*Voltage*	*Description*
6510EA / EF	115 V / 230 V	6510A Water Recirculation System
1563EA / EF	115 V / 230 V	1563 Water Recirculation System w/o Cooling *(heater option available for cooler climates)*
1552EA / EF	115 V / 230 V	1552 Water Cooler

Parr Data Management Accessories & Bomb Maintenance

6750 Proximate Interface

Parr offers many accessories which have the ability to enhance the productivity of the calorimeter testing lab. These products range from the powerful 6750 Proximate Interface to support service kits. First and foremost are products which allow for transmission and compilation of data.

RS232C ports

Each Parr 6000 Series Calorimeter is equipped with RS232C data ports. One of these is configured for a connection to an analytical balance used to input sample weights. The operating menus allow the user to configure this port for any commercial balance communication protocol. The second port is configured to report results to an attached printer. The third port is a terminal port and is used for factory diagnostics only.

Ethernet Communications

The Parr 6000 Series calorimeters have a Linux based operating system which utilizes TCP/IP networking protocols. The DHCP protocol of the calorimeter will assign an IP address shortly after the calorimeter is turned on or alternatively a static IP address can be assigned by the user. Ethernet hardware allows for communication of the calorimeter to a web browser. Therefore, by using applications such as http or ftp, data can be transferred from the calorimeter to a PC.

Compact Flash Transfers

Run data may also be copied to a removable compact flash memory card. This CF card can be used to transfer data files from the calorimeter to a computer using a USB reader/ writer of the type used for digital cameras. The compact flash port can also be used to update the software in the calorimeter and back up any unique user settings.

1965E Remote Feature Key

The remote interface feature available for the Parr 6000 series calorimeters allows the user to view and interact with an instrument using a simple program (the "viewer"). This remote interface can be used on a stand alone PC, a LAN or the Internet. The remote interface capability has a wide range of applications including instrument administration, diagnostic support and even as a teaching tool. It allows a person at a remote computer to assume control of a calorimeter across a network, as if they were sitting in front of the instrument.

6750 Proximate Interface

The proximate analysis of a coal sample is a tedious procedure involving several

Accessory Ordering Guide

Model No.	*Voltage*	*Description*
1908E	N/A	USB Reader / Writer
1909E	N/A	PC Adapter for Compact Flash
1910E	N/A	Compact Flash Card
1965E	N/A	Remote Feature Key
6750EA / EF	115 V / 230 V	Proximate Interface
A1950E	N/A	Standard Bar Code Package: Scanner, Printer, Installation CD & Feature Key
A1958E	N/A	Deluxe Bar Code Package: Two Scanners, Printer, Installation CD & Two Feature Keys
A1954E	N/A	Scanner with Power Supply
A1955E	N/A	Bar Code Printer with Power Supply and USB Cable
1394DD	N/A	Bar Code Labels
1757EA / EF	115 V / 230 V	1757 Printer

separate weights and the handling of data from several sources. Operating seamlessly with current laboratory equipment, the 6750 Proximate Interface will act as a remote Air Dry Loss, Total Moisture Interface or Balance Interface, accepting data from a digital balance as generated; organizing and storing it in the correct order, under operator assigned sample IDs. Several selectable options are available to speed the data entry process by allowing the operator to enter consecutive tare and gross weights automatically with a minimum number of keystrokes.

The 6750 will calculate the resulting proximate analysis for each sample on any of four reference bases: As-Determined (AD), As-Received (AR), Dry (DRY) or Dry, Ash-Free (DAF). Btu and sulfur values may be converted and reported based on selected moisture references. The 6750 Proximate Interface supports data entry, storage and reporting for Free Swelling Index (FSI) and Ash Fusion along with the more traditional mass loss or calorimetric based measurements and will produce final or preliminary reports at any time for any sample ID.

Barcode Support Packages

Parr offers two complete packages that can also be sold as individual components for use with the Parr 6000 series instruments. The handheld scanner uses CCD technology to scan codes on any flat, curved or even damaged surfaces. The scanner contains no moving parts liable to wear, is built to withstand repeated drops on a concrete floor and comes with an RS232C cable for simple connectivity.

1757 Printer

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

6750 Proximate Interface Shown with Standard Barcode Support Package

1757 Printer

Oxygen Bomb Repair Service

Oxygen Bombs should be returned on a regular basis to Parr for general overhaul and proof testing. There is a flat rate charge (plus shipping) for the bomb service. Each service includes:

- Disassembly, cleaning and inspection of all bomb parts.
- Re-polishing inner surfaces of the bomb cylinder and head.
- Re-assembly with new electrodes, electrode insulators and seals, sealing rings and valve seats, if needed to restore the bomb to first class condition.
- Proof testing in accordance with ANSI/ASTM E144-94.

If the bomb head, screw cap, or cylinder must be replaced, they will be billed at current parts prices. If the bomb cylinder is badly pitted or corroded and must be re-bored at an additional charge. Any additional labor required to repair or restore the bomb to usable condition will be billed at current labor cost. Repairs for all other bombs will be charged on a time and materials basis.

Oxygen Bomb Maintenance Kits

500 Firing Kits – One Year Supply

6004	For use w/ 1104(B)
6009A	For use w/ 1109(A)
6007	For use w/ 1107
6008	For use w/ 1108(CI)
6008P	For use w/ 1108P(CI)
6036	For use w/ A895DD (1136, 1138)
6038	For use w/ A1450DD (1136, 1138)

Sample Preparation and Maintenance Accessories

2810 Pellet Press

Calorific Standards

Fuel Capsules

Fuse Wire and Ignition Thread

Volatile Matter Crucibles

2810 Pellet Press

The Parr Pellet Press provides a convenient and inexpensive means for compressing powdered samples into pellet form for oxygen bomb calorimetry. Although many materials burn well as a loose powder, others such as benzoic acid must be made into a pellet for safe and complete combustion. Punch and die sets are available in six sizes:

- 1/2 inches
- 1/4 inches
- 1/2 inches
- 1/8 inches
- 3.0 mm
- 4.5 mm

Calorific Standards

Parr offers benzoic acid as a secondary standard, traceable to NIST, for standardizing the bomb calorimeters. Also offered is Trizma base (>99.9% by titration) for standardizing the 6755 Solution Calorimeter.

Part	*Description*
3403	30 g BA powder
3413	15 BA pellets, 1 g
3414	30 BA pellets, 0.2 g
3415	100 BA pellets, 1 g
3416	500 BA pellets, 1 g
3417	500 BA pellets, 0.2 g
3418	1000 BA pellets, 0.2 g
3421	100 g bottle, Tris

Fuel Capsules

Part	*Description*
43AS	Stainless Steel, 6 pk
43A3	Fused Silica, 2 pk
43A5	Platinum-Rhodium, ea
217A	Heavy Walled, C20 (for use with 1104)
208AC	Cup (for use with semi-micro bombs)

Fuse Wire and Ignition Thread

Part	*Description*
45C10	Ni-Cr, 500 cm, 3 cards
45C3	Platinum, 30 cm, 1 card
840DD2	Semi-permanent Ni-Cr, 60" spool
845DD2	Cotton Ignition Thread, 1000, 4" pieces
845DD	Cotton Ignition Thread Spool

Volatile Matter Crucibles

An inexpensive, 13 mL, nickel-chromium alloy crucible with an insert cover for determining volatile matter in coal and coke. The crucibles will withstand repeated heating to 1000 °C without appreciable change in tare weight, but not recommended for procedures requiring extreme corrosion resistance.

Part	*Description*
3101	VM Crucible w/ cover
3102	VM Crucible w/o cover
3103	Cover only

1 Year Service Kit Ordering Guide

1 Year Service Kits are intended to supply the user with the standard parts generally replaced in the calorimeter and oxygen bomb after one year of service. These kits are tailored to the individual calorimeter and bomb choice of the user.

Bomb Model Number	*6400 Automatic Isoperibol Calorimeter*	*6300 Automatic Isoperibol Calorimeter*	*6200 Isoperibol Calorimeter*	*6100 Compensated Jacket Calorimeter*	*1341 Plain Jacket Calorimeter*
1108		6209B	6109B	1349B	
1108P			6209P	6109P	1349P
1108R			6209R	6109R	1349R
1104			6209Y	6109Y	1349Y
1109			6209X	6109X	
1109A			6209A	6109A	
1136 / 1138		6309B			
1138	6409B	6309C			

Custom Calorimeter Systems

The Parr Instrument Company Technical Staff is available to assist in the design, selection and integration of components for custom calorimeter systems. One such example is the recent design of the Parr Detonation Calorimeter.

Ordinary oxygen bomb combustion calorimetry is used to measure the heat of combustion or reaction of materials in oxygen or inert atmospheres. Even for high strength vessels, such as the Parr 1104 Oxygen Combustion Bomb, the conditions necessary to detonate small amounts of highly reactive materials are often difficult to achieve and can result in unpredictable consequences. For example, the conventional heat of combustion of pentaerythritol tetranitrate (PETN) [$C_5H_8N_4O_{12}$] in oxygen is 1957 cal/g while the heat of detonation in vacuum is 1490 cal/g (a 24% difference).

Additionally, it is well known that the degree of confinement of explosive materials significantly influences the released energy. For unconfined or lightly confined charges, the released energy is largely retained in the products. When the charge is heavily confined, the detonation energy, for the most part, is converted to kinetic and internal energy of the confining case. For example, the conventional heat of combustion of 2,4,6-trinitrotoluene (TNT) in oxygen is 3590 cal/g. The heat of detonation for TNT at a charge density of 1.53 g/cc is 1093 cal/g and at a charge density of 0.998 g/cc is 870 cal/g. In contrast, an unconfined reaction yields approximately 600 cal/g.

Precise fundamental information about the detonation process can be obtained by combining calorimetric and dynamic pressure measurements. These measurements can be used ultimately to predict explosives performance. The Parr Detonation Calorimeter has been designed to aid research in this area.

Detonation Calorimeter with the Parr 1104 Oxygen Combustion Bomb

Parr Instrument Company's heat of detonation calorimeter accepts up to a 25 g high explosive charge with a nominal total energy release per charge of ~160 kJ. The detonation is initiated using a small commercial EBW style detonator incorporating 80 mg of PETN and 450 mg of RDX with a binder. Detonators are fired using a one-microfarad – 4000 V capacitance discharge firing set. A complete calorimetric measurement can be made in a few hours with a precision of several tenths of a percent. The bomb can be optionally fitted with a high-speed pressure transducer that allows the user to gain further insight into the dynamics of the detonation process.

For our latest

Parr Instrument Company is committed to a process for continually upgrading our line of oxygen bomb calorimeters and their accessories. The information contained in this catalog and the specifications for these calorimeters is always subject to change. In addition, new products are continually being added to our offerings. For our most recent listings please visit our website at www.parrinst.com.

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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