Parr Instrument Company

Series 6000 Oxygen Combustion Calorimeters

6000

Designing and Building High Precision Combustion Calorimeters for 120 Years

Founded in 1899

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.

Parr Instrument Company

We are pleased to have this opportunity to tell you about our Oxygen Combustion Calorimeters. In 1899, Professor 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 thorough understanding of the basic fundamentals of calorimetry with our most advanced mechanical designs and the latest in microprocessor based controls and communications. Our objective has always 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 a wide selection of calorimeters at very attractive prices. We believe you will agree that our line of Calorimeters fulfills this design objective.

— Jim Nelson
President, Parr Instrument Company

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Models Overview

Model 6400 Automatic Isoperibol Calorimeter

This calorimeter allows labs to achieve maximum productivity. Designed for laboratories that require high throughput, the 6400 is highly automated and requires only about one minute of operator time per test, freeing up the Lab Technician to run up to four 6400 Calorimeters simultaneously. The 6400 delivers excellent precision and accuracy.

Model 6200 Isoperibol Calorimeter

With a removable bomb and bucket design, the 6200 is our most popular calorimeter. It can achieve the highest level of precision and accuracy of any oxygen bomb calorimeter and conforms to all standards. It is a good choice for high precision quality control work and for research and development.

Model 6100 Compensated Jacket Calorimeter

The 6100 takes advantage of the real time, continuously corrected method originally developed by Parr Instrument Company. This method does not require a water jacket which reduces costs while achieving up to equal results with water jacketed models under good conditions. The 6100 is a favorite for testing coal waste, refuse, and alternative fuels.

Model 6050 Compensated Jacket Calorimeter

This new calorimeter is the first designed by Parr to be controlled by your own personal computer allowing access to the calorimeter's functions and tests. This new moderately priced, compact calorimeter combines a static jacket system with the convenience of automated oxygen filling.

Model 1341 Plain Jacket Calorimeter

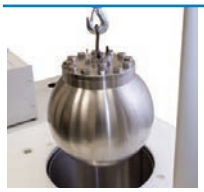
A reliable calorimeter, the 1341 can be used for the same broad range of solid and liquid combustible samples. Its modest cost and simple design make the model suitable for modest throughput and minimal precision work such as sample screening and student instruction, especially physical chemistry.

Model 6725 Semimicro Calorimeter

A compact, static jacket, calorimeter designed specifically for measuring the heat produced by the combustion of small samples. It is often used in Marine Biology and in other applications where limited sample material is available.

Model 6755 Solution Calorimeter

For laboratories that wish to measure enthalpy changes produced by chemical reactions in solution. It is frequently used for instruction at universities.



Model 6790 Detonation Calorimeter

This unique Calorimeter is designed to measure the heat of detonation to aid research in the area of high explosives performance. Sample sizes of up to 25 g can be accommodated in the specially designed spherical combustion chamber.

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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 9001-2015 Certification

Parr Instrument Company's overall Quality Assurance System has been certified to be in compliance with ISO 9001-2015 by TÜV. ISO 9001-2015 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 2004/108/EC for EMC compliance, E.C. Directive 2006/95/EC for low voltage electrical safety, and E.C. Directive 2006/42/EC machinery directive.

ASTM E144

Parr Instrument Company certifies that all vessels have been tested in accordance with ASTM E144, as required.

Chinese and Russian Pattern Approvals

Parr calorimeters also maintain both Chinese and Russian Pattern Approvals.

Standard Test Methods Compliance

The unique design features which provide the high degree of automation in the 6400 Calorimeter cause it 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 6200 Calorimeter is designed with the classic removable vessel and bucket. It easily complies with all standards. The technical staff at Parr Instrument Company would be happy to review additional methods to help determine compliance.

ASTM Standard 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"

Indian Standard Test Method

- IS 1350-2, "Methods of Test For Coal and Coke, Part II: Determination of Calorific Value"

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 and Coke"

Introduction: 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.
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, the 6400 Automatic Isoperibol Calorimeter is an appropriate choice. Loading of the sample involves a simple 1/16th 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 one minute and therefore it is possible for one operator to manage multiple units simultaneously.

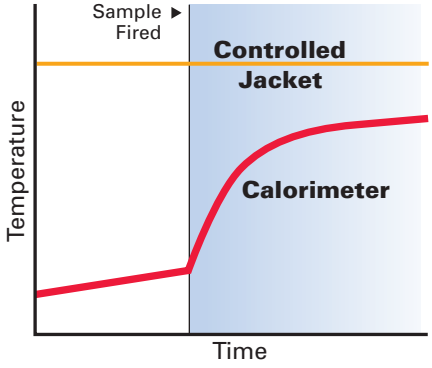
The 6200 Isoperibol Calorimeter, 6100 Compensated Jacket Calorimeter, and the 6050 Compensated Jacket Calorimeter can analyze just as many samples per instrument as an individual automatic calorimeter; however, there is additional operator time per test and therefore fewer instruments can be operated at the same time. The operator time per test is estimated to be 6 minutes.

The 1341 Plain Jacket Calorimeter requires significant user time. 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 9 for Selection Guide.***

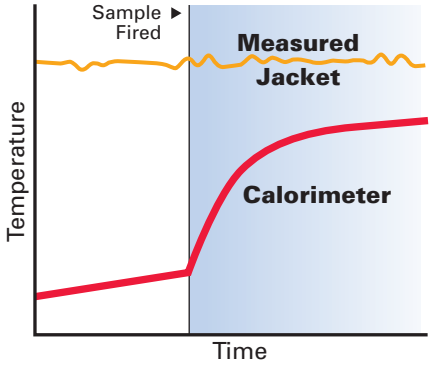
Note:
Historically, burning a sample enclosed in a high pressure oxygen environment is known as Oxygen Bomb Calorimetry and the vessel containing the sample is known as an Oxygen Bomb. The terms bomb and vessel are used interchangeably.

Jacket Designs

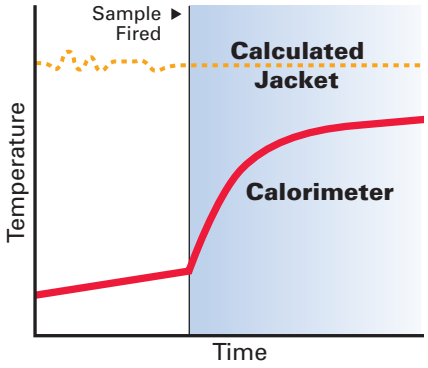
Parr Series 6000 Oxygen Bomb Calorimeters described in this brochure feature a high degree of automation with touch screen operation, Linux operating system and fifth generation microprocessor control.



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 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 Jacket Calorimetry
The Parr 6100 and 6050 Calorimeters take advantage of the real time, continuously corrected method developed by Parr. No attempt is made in the Model 6100 or 6050 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 Calorimetric 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.

Isoperibol Jacket vs. Isoperibol Mode

The most advanced oxygen bomb calorimeters use an Isoperibol water jacket. This a water jacket that is kept at a constant temperature at all times. This results in a consistent and predictable heat exchange between the bucket and jacket throughout the test.

There are two generally accepted methods for calculating the correction for heat gain or loss from a non-adiabatic oxygen bomb calorimeter. The first is the Dickinson method while the second is the Regnault-Pfaundler method.

Some manufacturers claim an Isoperibol Mode even though their calorimeters do not have an isoperibol jacket. This claim is based on using the above methods to calculate the result.

Parr makes the distinction between an isoperibol jacket and these calculations. All of Parr's bomb calorimeters use these calculations to determine the test results, but only the 6400 Automatic Isoperibol Calorimeter and the 6200 Isoperibol Calorimeter are true isoperibol calorimeters.

Parr Removable Bomb and 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 typically 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.

Recommended Applications

Removable bomb calorimeters remain the calorimeter of choice for users with one or more of the following applications or preferences:

- Applications requiring a greater level of control over the test process.
- Combustions which produce unusual amounts of ash or other corrosive residues that would damage the automatic discharge system.
- Users who choose not to perform the additional maintenance that the fully automatic instruments require.
- Student instruction applications with an emphasis on the basic principals of calorimetry.

Series 1108 Oxygen Bombs

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 g with a maximum energy release of 8000 calories per charge. The 1108B has a larger screw cap and is rated for a maximum release of 10,000 calories. The 1108P and 1108BP 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. All are available in Alloy 20 and Alloy G30.

1110 Bomb for the 6050

The 1110 bomb uses samples up to 1.0 g in size, releasing up to 10,000 calories per test using oxygen charging pressures up to 40 atm. The 6050 features a threaded screw cap for easy closure with 1.5 turns. Standard construction uses T316 Stainless Steel and is also available in Alloy 20 and Alloy G30.

1109A Semimicro Bomb

The 1109A 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 mg, liberating 52 to 1200 calories when burned in oxygen, using initial pressures up to 35 atm. 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.

1109X High Strength Semimicro Bomb

1109X High Strength Semimicro Oxygen Combustion Vessel. The 1109X is similar in most aspects as the 1109A Vessel but has been specially strengthened to be suitable for testing energetic materials and it is optimized for the measurement of small energy releases.

1104 High Strength Bomb

The 1104 is a 240 mL, extra heavy-duty bomb for use 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 an optional combustion cage which serves to muffle the shock forces produced by high-energy samples. Part number 1104B is the High Strength Bomb with the loop terminal only.

Parr Fixed Bomb and Bucket Technology

In the fixed bomb and bucket design used in the 6400 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.

1138 Oxygen Combustion Bomb

1136 Oxygen Combustion Bomb

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 6400 Calorimeter features the patented closure design of the Parr fixed bombs. This design allows the user to seal and lock the head into the cylinder with a simple 1/16th 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 by-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 four to five 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 up to 8000 calories per charge. The straight wall design of this bomb improves bomb rinse recovery, better precision and faster test times.

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.

Please see page 21 for Maintenance Kit Selection Guide.

Parr Calorimeter Selection Guide

Characteristics	*6400 Automatic Isoperibol Calorimeter*	*6200 Isoperibol Calorimeter*	*6100 Compensated Jacket Calorimeter*	*6050 Compensated Jacket Calorimeter*	*1341 Plain Jacket Calorimeter*	*6725 Semimicro Calorimeter*
Calorimeter Type	Isoperibol	Isoperibol	Compensated	Compensated	Static	Static
Operator Time per Test	1 Minute	6 Minutes	6 Minutes	6 Minutes	25 Minutes	6 Minutes
Precision Classification	0.10%	0.05 - 0.10%	0.10 - 0.20%	0.20%	0.30%	0.40%
Number of Vessels	Up to 4	Up to 4	Up to 4	Up to 8	1	Up to 4
Tests per Hour	6 - 7	4 - 8 as equipped	4 - 8 as equipped	4 - 6 as equipped	2	3
Bomb Type and Bucket	Fixed Bomb and Bucket Design	Removeable Bomb and Bucket Design	Removeable Bomb and Bucket Design	Removeable Bomb and Bucket Design	Removeable Bomb and Bucket Design	Removeable Bomb Dewar Flask
Bucket Filling	Automatic	Manual	Manual	Manual	Manual	Manual
Oxygen Filling	Automatic	Automatic	Automatic	Automatic	Manual	Manual
Bomb Washing	Automatic	Manual	Manual	Manual	Manual	Manual
Memory	1000 Tests	1000 Tests	1000 Tests	PC	None	1000 Tests
Printer Connection	Ethernet or USB	Ethernet or USB	Ethernet or USB	Via PC	None or USB	Ethernet
Balance Connection	Ethernet, or USB	Ethernet, or USB	Ethernet, or USB	Via PC	None or USB	Ethernet,
Network Connection	Ethernet	Ethernet	Ethernet	Via PC	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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For our latest specifications

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.

6400 Automatic Isoperibol Calorimeter

SPECIFICATIONS

Model Number:
6400

Tests Per Hour:
6 – 7

Operator 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:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

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

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 1.0 L 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 re-designed 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 percent oxygen, a source of nitrogen or house air at 80 psi, and deionized water.

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
- A1589DD Rinse Tank
- 1759 Printer
- Extra A1450DD Bomb Head Assembly
- 6038 Bomb Maintenance Kit
- 6409B, 1 Year Service Kit

6400 Automatic Isoperibol Calorimeter Ordering Guide

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

6200 Isoperibol Calorimeter

SPECIFICATIONS

Model Number:
6200

Tests Per Hour:
4 – 8

Operator Time Per Test:
6 Minutes

Precision Classification:
0.05 - 0.1% Class

Jacket Type:
Isoperibol, Water Jacket

Oxygen Fill:
Automatic

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1108, Alloy 20
1108CL, Alloy G30
1108B, Alloy 20
1108BCL, Alloy G30
1108BP, Alloy 20
1108BPCL, Alloy G30
1108P, Alloy 20
1108PCL, Alloy G30
1109A, 22mL Semimicro
1109X, 22mL High Strength Semimicro
1104, High Strength

Balance Communication:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

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

6200 Isoperibol Calorimeter

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.

Automatic Oxygen Fill

To speed and simplify the bomb filling operation, the 6200 Calorimeter has an 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 presses a button on the touch screen to start the filling sequence.

Laboratory Requirements

The calorimeter requires a source of 99.5 percent oxygen and two liters of water per test. If a closed loop system is chosen, the water handling system must be installed so that the fan will not blow on the calorimeter.

Expanded System

The 6220 Expanded System includes the following components:

- 6200 Calorimeter
- 6510 Water Handling System
- 1759 Printer
- Extra Bomb and Bucket
- 6008P Bomb Maintenance Kit
- 6209P 1 Year Service Kit

6220 Expanded System

6200 Isoperibol Calorimeter Ordering Guide

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

6100 Compensated Jacket Calorimeter

6100 Calorimeter open with 1108P Bomb and Bucket

The 6100 Compensated Jacket 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 coal testing, waste and refuse disposal work, and other sample testing.

Automatic Oxygen Fill

Like the 6200 Calorimeter, the 6100 Calorimeter has an automatic system for charging the bomb with oxygen where the oxygen feed is controlled by a solenoid installed inside the calorimeter. To fill the bomb, the operator simply slips the filling hose connector onto the bomb inlet valve and presses a button on the touch screen to start the filling sequence. Filling then proceeds automatically at a controlled rate to an established operating pressure.

Good Repeatability

With careful control of the testing environment, and a routine calibration schedule, the Parr 6100 Compensated Jacket Calorimeter with its static jacket can achieve a precision classification of 0.1 percent. Please see our website, or refer to the operator's manual for more details.

Laboratory Requirements

The calorimeter requires a source of 99.5 percent oxygen, and two liters of water per test.

Expanded System

The 6120 Expanded System includes the following components:

- 6100 Calorimeter
- 1759 Printer
- Extra Bomb and Bucket
- 6008P Bomb Maintenance Kit
- 6109P, 1 Year Service Kit

SPECIFICATIONS

Model Number:
6100

Tests Per Hour:
4 – 8

Operator Time Per Test:
6 Minutes

Precision Classification:
0.1 – 0.2% Class

Jacket Type:
Continuously Compensated

Oxygen Fill:
Automatic

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1108, Alloy 20
1108CL, Alloy G30
1108B, Alloy 20
1108BCL, Alloy G30
1108BP, Alloy 20
1108BPCL, Alloy G30
1108P, Alloy 20
1108PCL, Alloy G30
1109A, 22mL Semimicro
1109X, 22mL High Strength Semimicro
1104, High Strength

Balance Communication:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

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

6100 Compensated Jacket Calorimeter Ordering Guide

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

6050 Compensated Jacket Calorimeter

SPECIFICATIONS

Model Number:
6050

Tests Per Hour:
4 – 6

Operator Time Per Test:
6 Minutes

Precision Classification:
0.2% Class

Jacket Type:
Continuously Compensated

Oxygen Fill:
Automatic

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
1110, 250 mL, T316SS
1110CC, 250 mL, Alloy 20
1110CL, 250 mL, Alloy G30

Balance Communication:
Via PC

Printer Communication:
Via PC

Network Connection:
Via PC

Dimensions (cm):
27w x 45d x 42h

The Model 6050 Compensated Jacket Calorimeter is the first calorimeter designed by Parr to be controlled by your own personal computer. The 6050 is a compact, static jacket calorimeter that operates at room temperature.

The 6050 Calorimeter has been designed to provide the user with:

- A traditional design calorimeter with removable oxygen bomb and bucket.
- A moderately priced calorimeter which uses real time temperature measurements to determine heat leaks without using a controlled calorimeter jacket.
- A full featured calorimeter that does not require circulating water.
- A compact calorimeter requiring minimum laboratory bench space.
- Modern USB connection to PC.

The 6050 takes advantage of the real time, continuously corrected method developed by Parr. 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.

Features of the 6050 Calorimeter:

- PC Control: The 6050 is attached directly to a Windows PC using a standard USB cable. All functions and tests are accessible with the click of a mouse using Parr's 6050 Software Package, installed on your own PC
- Automatic Oxygen Filling: The 6050 fills the combustion vessel with the correct amount of oxygen for each test automatically – removing one manual step from the standard combustion vessel preparation routine

6050 Calorimeter Expanded System

- Operates at room temperature
- Time per test is 8 minutes in Dynamic Mode, and 12 minutes in Equilibrium Mode.

Laboratory Requirements

The calorimeter requires a source of 99.5 percent oxygen and 1 liter of water per test.

Expanded System

The 6052 Expanded System includes the following components:

- 6050 Calorimeter
- Extra 1110 Oxygen Combustion Vessel
- Extra A1559DD Bucket
- 6059B 1 Year Service Kit

6050 Compensated Jacket Calorimeter Ordering Guide

Model No.	Voltage	Description
6050EA / EF	115 V / 230 V	6050 Calorimeter with 1110 Oxygen Bomb of T316 Stainless Steel
6050CLEA / EF	115 V / 230 V	6050 Calorimeter with 1110 Oxygen Bomb of Alloy G30 for Chlorine Service
6052EA / EF	115 V / 230 V	6052 Expanded System with 1110 Oxygen Bomb of T316 Stainless Steel and Principal Components
6052CLEA / EF	115 V / 230 V	6052 Expanded System with 1110 Bomb of Alloy G30 for Chlorine Service and Principal Components

1341 Plain Jacket Calorimeter

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.

1341 Plain Jacket Calorimeter shown with 6775 Digital Thermometer and 2901 Ignition Unit.

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 percent oxygen and 2 liters of water per test.

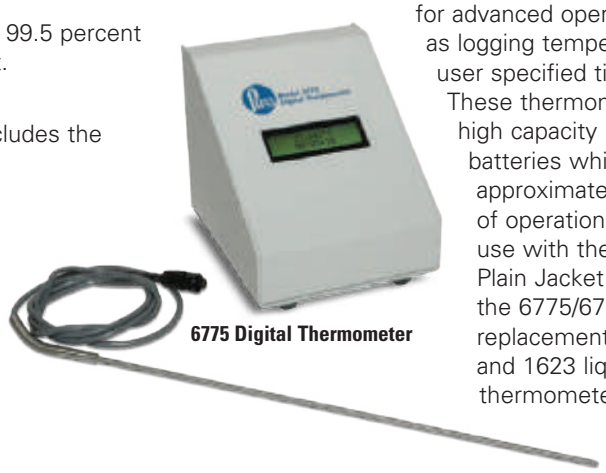
1341 Plain Jacket Calorimeter

The 1341 Plain Jaket Calorimeter includes the following components:

- 1341 Calorimeter
- Oxygen Bomb
- Oval Bucket
- Oxygen Fill Connection
- 6775 Digital Thermometer
- 6008 Bomb Maintenance Kit
- 2901 Ignition Unit

6775/6775A Digital Thermometers

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 with a free-running timer. 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 6775A Data Logging Dual Channel Digital Thermometer comes equipped with a serial RS-232C interface. This interface is used to configure the thermometer for advanced operation such as logging temperatures at a user specified time interval. These thermometers use high capacity lithium batteries which provide approximately 200 hours of operation. Designed for use with the Parr 1341 Plain Jacket Calorimeter, the 6775/6775A is a replacement for the 1604 and 1623 liquid-in-glass thermometers.



6775 Digital Thermometer

SPECIFICATIONS

Model Number:
1341

Tests Per Hour:
2

Operator 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
1108B, Alloy 20
1108BCL, Alloy G30
1108BP, Alloy 20
1108BPCL, Alloy G30
1108P, Alloy 20
1108PCL, Alloy G30
1104, High Strength Bomb

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

1341 Plain Jacket Calorimeter Ordering Guide

Model No.	Voltage	Description
1341EB / EE	115 V / 230 V	1341 Calorimeter with 1108P Oxygen Bomb of Alloy 20
1341CLEB / EE	115 V / 230 V	1341 Calorimeter with 1108PCL Oxygen Bomb of Alloy G30
2901EB / EE	115 V / 230 V	Ignition Unit for 1341 Calorimeter (Included with 1341)
6775	NA	Digital Thermometer (Included with 1341)
6775A	NA	Data Logging Dual Channel Digital Thermometer (Optional Upgrade)

6772 Calorimetric Thermometer

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:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

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

6772 Calorimetric Thermometer

The 6772 Compensated Jacket Calorimeter 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 Semimicro 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 and comes with one thermistor standard. 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.

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 USB 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 USB 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.

6772 Calorimetric Thermometer Ordering Guide

Model No.	Voltage	Description
6772EA / EF	115 V / 230 V	6772 Calorimetric Thermometer
1168E2	NA	Thermistor Probe

6725 Semimicro Calorimeter

6725 Semimicro Calorimeter shown with 6772 Calorimetric Thermometer

SPECIFICATIONS

Model Number:
6725

Tests Per Hour:
2 – 3

Operator 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:
1109A, 22mL Manual Valve, Semimicro
1109X, 22mL High Strength, Semimicro

Balance Communication:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

Dimensions (cm):
6725: 22w x 33d x 33h
6772: 56w x 36d x 31h

The 6725 Semimicro 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 mg 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 semimicro bomb in the test water.

Data Collection

The 6772 Calorimetric Thermometer is incorporated into the 6725 Semimicro 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.

High Strength Option

The 1109X High Strength Semimicro Oxygen Combustion Bomb is also available for use in the 6725 Calorimeter. The 1109X is similar in most aspects as the 1109A Vessel but has been specially strengthened to be suitable for testing energetic materials and it is optimized for the measurement of small energy releases.

6725 Semimicro Calorimeter Ordering Guide

Model No.	Voltage	Description
6725EA / EF	115 V / 230 V	6725 Semimicro Calorimeter
6758	NA	6759 Conversion Package 6725 to 6755
6765EA / EF	115 V / 230 V	Combined Solution and Semimicro Calorimeter

6755 Solution 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

Energy Equivalent:
100 – 145 Calories/°C

Maximum Volume, Solute:
20 mL

Required Volume, Solvent:
90 – 120 mL

Balance Communication:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

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

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

6755 Solution Calorimeter shown with 6772 Calorimetric Thermometer

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 samples (up to 2 g) 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 pipette 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 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 plus a calorimeter module and conversion parts for both the 6755 Solution Calorimeter and the 6725 Semimicro Calorimeter.

6755 Solution Calorimeter Ordering Guide

Model No.	Voltage	Description
6755EA / EF	115 V / 230 V	6755 Solution Calorimeter
A274C	NA	Heating Probe (for electrical standardization, contact Parr technical support)
6765EA / EF	115 V / 230 V	Combined Solution and Semimicro Calorimeter
6729	NA	6729 Conversion Package 6755 to 6725

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 is drained and replaced with cool, fresh water from the tap prior to starting another test. If the laboratory has a 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 6200.

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 content, which over time can deposit in the calorimeter, will prefer this mode of 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.

6510 Water Handling System operates on the bench top, next to the calorimeter.

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 6400 Automatic Isoperibol Calorimeter

In the 6400 Calorimeter, the water handling system is built in. There is no need for an external water handling system.

Water Handling System Option for the 6200 Calorimeter Ordering Guide

Model No.	Voltage	Description
6510EA / EF	115 V / 230 V	6510 Water Recirculation System

Parr Data Management Accessories and 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.

USB Port

Each Parr 6000 Series Calorimeter is equipped with a USB data port. This port can be used to attach a printer, balance, or bar code scanner. If more than one device will be attached, then a USB hub will need to be used.

Ethernet Communications

The Parr 6000 Series Calorimeters have a Linux based operating system which utilizes TCP/IP networking protocols. The DHCP server on the network will assign an IP address to the calorimeter 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 File Transfer Protocol (FTP), data can be transferred from the calorimeter to a PC.

SD Memory Card and USB Flash Drive Transfers

Run data may also be copied to a removable SD memory card or USB flash drive. The SD 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 while the USB can go direct to a PC. The SD and USB 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. 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.

Accessory Ordering Guide

Model No.	Voltage	Description
2202E	NA	USB SD Reader
2201E	NA	SD Memory Card
1965E	NA	Remote Feature Key
6750EA / EF	115 V / 230 V	Proximate Interface
A1950E4	NA	Standard Bar Code Package: Scanner, Printer, Installation CD and Feature Key
A1958E4	NA	Deluxe Bar Code Package: Two Scanners, Printer, Installation CD and Two Feature Keys
A1952E2	NA	Bar Code Scanner
A1955E	NA	Bar Code Printer with Power Supply and USB Cable
1394DD	NA	Bar Code Labels
1759EA / EF	115 V / 230 V	1759 Printer
2183E	NA	Samba Server Feature Key

The 1965E 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 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.

6750 Proximate Interface Shown with Standard Barcode Support Package

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 a USB cable for simple connectivity.

1759 Printer

For users who prefer to have a dedicated printer at the calorimeter, Parr offers the model 1759 Printer. The 1759 Printer is a compact, dot matrix printer setup for 40-column reports. It is 6.5-inches wide, 10-inches deep and 6-inches high and operates from its own power supply.

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 ASTM E144.

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, there will be 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)

Model No.	For Use With
6004	1104/B
6007	1107
6008	1108/CL
6008P	1108P/CL
6008R	1108R/CL
6009A	1109A
6009X	1109X
6010	1110/CC/CL
6036	1136/38/CL with A895DD Head Style
6038	1136/38/CL with A1450DD Head Style

Parr Data Management Accessories and Bomb Maintenance

2810 Pellet Press

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:

Part	Description
A51PR	1/2 in. punch & die set
A51PR3	3/8 in. punch & die set
A51PR12	1/4 in. punch & die set
A51PR13	1/8 in. punch & die set
A51PR14	3.0 mm punch & die set
A51PR15	4.5 mm punch & die set

Calorific Standards

Calorific Standards

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

Part	Description
3403	30 g BA powder
3413	15 BA pellets, 1 g
3414	100 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
3422	100 g bottle, Tris Calorific Test Substance

Fuel Capsules

Fuel Capsules

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

Volatile Matter Crucibles

Fuse Wire and Ignition Thread

Part	Description
45C10	Ni-Cr, 500 pieces/card, 3 cards
45C3	Platinum, 300 cm, 1 card
840DD2	Heat Wire, Ni-Cr, 60" length
845DD2	Cotton Ignition Thread, ~1000, 4" pieces
845DD	Cotton Ignition Thread Spool

Volatile Matter Crucibles

An inexpensive, 13 mL, Alloy 600 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 with cover
3102	VM Crucible without cover
3103	Cover only

Sealing Tape

Volatile samples can be handled in a standard 43AS or in a 43A6 platinum capsule by covering the top of the capsule with a disc of adhesive tape. Parr's 517A tape is free of chlorine and low in sulphur.

Part	Description
517A	Adhesive Sealing Tape

Gelatin Capsules

Volatile liquid samples to be burned in an oxygen bomb can be weighed and handled conveniently in these two-piece capsules. Each 00 capsule holds 0.9 mL.

Part	Description
3601	Gelatin Capsules, Size 00, Bottle of 100

1 Year Service Kit

These 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 calorimeter and bomb choice of the user.

1 Year Service Kit Ordering Guide

Bomb Model No.	6400 Automatic Isoperibol Calorimeter	6200 Isoperibol Calorimeter	6100 Compensated Jacket Calorimeter	6050 Compensated Jacket Calorimeter	1341 Plain Jacket Calorimeter
1108		6209B	6109B		1349B
1108P		6209P	6109P		1349P
1108PCL		6209PCL	6109PCL		1349PCL
1104		6209Y	6109Y		1349Y
1109A		6209A	6109A		
1109X		6209X	6109X		
1110				6059B	
1138	6409B				

6790 Detonation Calorimeter

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 design of the Parr 6790 Detonation Calorimeter.

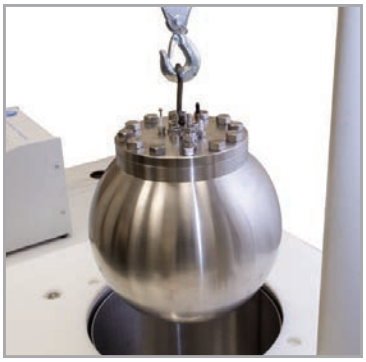
Ordinary oxygen bomb combustion calorimetry is used to measure the heat of combustion or reaction of materials in oxygen or inert atmospheres. Even for high strength vessels, such as the Parr 1104 Oxygen Combustion Bomb, the conditions necessary to detonate small amounts of highly reactive materials are often difficult to achieve and can result in unpredictable consequences. For example, the conventional heat of combustion of pentaerythritol tetranitrate (PETN) [C5H8N4O12] in oxygen is 1957 cal/g while the heat of detonation in vacuum is 1490 cal/g (a 24 percent 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 Detonation Calorimeter Bomb stored in its rack.

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 Parr Detonation Calorimeter Bomb being lifted using the hoist.

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.

SPECIFICATIONS

Model Number:
6790

Tests per hour:
1

Operator Time Per Test:
20 Minutes

Jacket Type:
Continuously Compensated

Oxygen Fill:
Manual

Bucket Fill:
Manual

Bomb Wash:
Manual

Bomb Model Options:
A500A

Balance Communication:
USB

Printer Communication:
USB

Network Connection:
TCP/IP via Ethernet

The Parr Limited Warranty

Parr Instrument Company (Parr) combustion bombs, calorimeters, reactors, pressure vessels 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 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.

WARRANTY CONDITIONS:

1. **Non-assignable.** The warranties herein extend only to the original purchaser-user and to the distributors to such users. These warranties or any action or claims based thereon are **not assignable or transferable.**
2. **Use of product.** The warranties herein are applicable and enforceable only when the Parr product:
   a. Is installed and operated in strict accordance with the written instructions for its use provided by Parr.
   b. Is being used in a lawful manner.
   c. Has not been modified by any entity other than Parr Instrument Company.
   d. Has been stored or maintained in accordance with written instructions provided by Parr, or if none were provided, has been stored and maintained in a professionally reasonable manner.
3. **The user's responsibility.** Parr engineers and sales personnel will gladly discuss available equipment and material options with prospective users, but the final responsibility for selecting a reactor, pressure vessel or combustion bomb which has the capacity, pressure rating, chemical compatibility, corrosion resistance and design features required to perform safely and to the user's satisfaction in any particular application or test must rest entirely with the user – not with Parr. It is also the user's responsibility to install the equipment in a safe operating environment and to train all operating personnel in appropriate safety, operational and maintenance procedures.
4. **Warranty period.** Unless otherwise provided in writing by Parr, the warranties herein are applicable for a period of one year from date of delivery of the product to the original purchaser/user. Note, however, that there is no guarantee of a service life of one year after delivery.
5. **Notification.** To enforce any express warranty created herein, the purchaser/user must notify Parr in writing within thirty (30) days of the date any defect is detected. Upon request of Parr, the part or product involved must be returned to Parr in the manner specified by Parr for analysis and non-destructive testing.

EXPRESS WARRANTIES

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

1. Are as described in the applicable Parr sales literature, or as specified in Parr shipping documents.
2. Will function as described in corresponding Parr sales bulletins or, for specially engineered assemblies, as stated in the sales proposal and purchase agreement.
3. Will remain free from defects in materials and workmanship for the Warranty Period.

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:

1. **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.
2. **Disclaimer of consequential damages.** In no event shall Parr be liable for 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.

INDEMNITY AND HOLD HARMLESS

Original purchaser-user agrees to indemnify and hold Parr harmless for any personal injuries to original purchaser-user, its employees and all third parties where said injuries arise from misuse of Parr products or use not in accordance with specifications and instructions for use supplied with the Parr products.

Parr Instrument Company

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