Parr Acid Digestion Bombs in Five Convenient Sizes

**Clockwise from far left:
4746 High Pressure Bomb,
4748 Large Capacity Bomb,
4744 General Purpose Bomb,
4749 General Purpose Bomb,
and the 4745 General Purpose Bomb.**

SPEED ANALYTICAL PROCEDURES

Parr acid digestion bombs have added a new alternative to the task of preparing analytical samples for analysis. By combining the unique chemical inertness of Teflon* with the advantages of a sealed pressure vessel, these convenient bombs offer a rapid procedure for sample dissolution or digestion which has several important advantages over more traditional methods of sample preparation. By providing a convenient means for holding strong mineral acids or alkalis at temperatures well above normal boiling points, these sturdy digestion bombs will:

- Accelerate digestions which otherwise would proceed slowly if conducted in an open container at atmospheric pressure.
- Permit the use of strong acids, such as HF or aqua regia, which will attack most other conventional containers.
- Dissolve analytical samples without losing trace elements and without adding unwanted contaminants from the container itself.
- Generate a vigorous chemical action which is a great time saver in analytical procedures.
- Obtain complete digestion or dissolution of samples which react slowly or incompletely when treated by other methods.

Chemists who have worked with sealed glass tubes and other cumbersome digestion devices will recognize the attractiveness of these convenient digestion vessels.

***duPont TFE fluorocarbon resin**

DISSOLVE INORGANIC SAMPLES

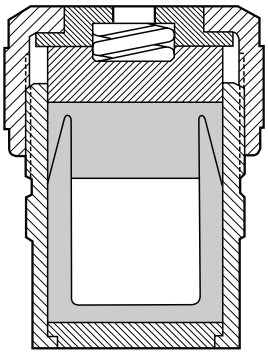
Ores, rock samples, glass and other inorganic materials can be dissolved rapidly in Parr acid digestion bombs using strong mineral acids: HF, HCl, H_2SO_4, HNO_3, Aqua Regia and others. Other chemicals and manufactured products can be leached or dissolved as well, all without introducing unwanted ions and with complete sample recovery. Using reaction temperatures well above normal boiling points, samples can be dissolved or digested rapidly for all types of chemical analysis, particularly for AA and ICP spectroscopy, and for other instrumental methods in which trace elements must be identified.

DIGEST ORGANIC MATERIALS

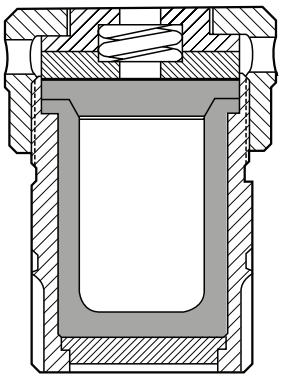
Organic samples can be treated with nitric acid and other oxidizing acids in these bombs with no difficulty, provided certain safety precautions are observed. Alkaline or acid hydrolysis reactions can also be handled equally well.

OTHER REACTIONS

In addition to their normal uses for sample digestion and dissolution, these bombs serve as excellent general purpose reactors for procedures requiring a small, Teflon-lined vessel for use within prescribed pressure and temperature limits. Agitation can be produced with a magnetic stir bar or by shaking or rolling the bomb.



The 4745 Bomb uses an A255AC Teflon liner with a long, tapered closure.



The 4749 Bomb uses an A280AC Teflon liner with a flanged closure.

METAL JACKETED AND MICROWAVE STYLES

Parr Teflon-lined acid digestion bombs are made in two different styles: There is a line of metal-jacketed bombs which can be heated in an oven, sand bath, oil or water bath and in other conventional ways, and a new line of digestion bombs developed specifically for rapid heating in a microwave oven. Both styles are made in several sizes, offering a broad selection of bombs ranging from economical models for routine tests to massive styles for procedures involving extreme conditions or potentially hazardous samples. Each of these bombs has a thick-walled Teflon liner which completely isolates the charge from the supporting body. These liners are removable and can be charged or emptied while outside of the bomb to eliminate any possible contamination from acid contact with metal parts. They can be replaced if they become damaged or contaminated.

THE NATURE OF TEFLON

The use of Teflon for the sample cup in these bombs is an obvious choice, not only because of its unique inertness to strong acids and high temperatures, but also because it is transparent to microwave energy, allowing energy to flow directly to the sample while serving also as an insulator to restrict heat flow from the reaction zone. Teflon does, however, have two characteristics which make it somewhat less than perfect for this application, and the user who understands these deficiencies will be able to minimize their effect upon his work.

First, Teflon has a tendency to creep or flow under pressure or load. This tendency is present even at room temperature and it is accentuated at higher temperatures. At temperatures below 150 °C the tendency to creep will be negligible. But as temperatures rise above 150 °C the creep effect will become more pronounced, making it more difficult to maintain tight seals and resulting in deformation and shorter life for the Teflon components. The extent of the creep effect will be roughly proportional to the maximum operating temperature.

Secondly, Teflon is a porous material. Although the materials and designs used in Parr acid digestion bombs minimize the effects of this porosity, users of these bombs can expect to see evidence of vapor migration across the cover seal and through the wall of the liner itself. Parr is able to minimize these problems by machining these parts from virgin Teflon which has been molded at an optimum pressure selected to reduce any porosity to an absolute minimum. The thick walls and effective seals used in these bombs also help to overcome these undesirable properties. Experiments have shown that the amount of solute lost in this manner during a normal digestion is negligible, but vapor migration into the walls of the Teflon cup will occur and cannot be avoided.

UNIQUE CLOSURES

Several designs are used to keep Parr acid digestion bombs tightly sealed during consecutive heating and cooling cycles when conventional seals might leak. One of these designs uses a tapered closure between the Teflon cup and cover with an unusually long sealing face which tends to become self-sealing. This long path also minimizes the tendency for acid migration through the joint. Bombs using this design can be sealed by simply turning down a knurled cap by hand without using a wrench or spanner. For applications requiring higher temperatures and pressures, the Teflon lines are made with a broad, flanged closure and sealed by tightening the bomb cap with a spanner or, in a larger design, by using cap screws to develop the sealing force. Tight closures for the Teflon cup in Parr microwave bombs are developed and maintained with self-sealing Teflon O-rings.

SPRING-LOADED SEALS

Since Teflon has a much larger coefficient of thermal expansion than the materials within which a liner is enclosed, a Teflon liner will expand and contract more than its enclosure when these bombs are heated and cooled. To compensate for this difference and to maintain a constant loading on the Teflon seal, all Parr acid digestion bombs have spring-loaded closures which will continue to maintain pressure on the liner seal throughout the operating cycle, and particularly during cooling when Teflon parts would otherwise relax and leak.

SAFETY RUPTURE DISCS

Safety rupture discs are provided in most Parr acid digestion bombs to protect the bomb and the operator from the hazards of unexpected or dangerously high internal pressures. The burst pressure in each installation is established by a frangible metal disc installed as a sandwich with a matching inner disc which serves as a corrosion barrier to protect the rupture disc from corrosive vapor.

4745 GENERAL PURPOSE BOMB

23 mL
150 °C
1200 psig

This is the original acid digestion bomb introduced by Parr in 1969 to provide a Teflon lined metal bomb of simple design and minimum cost that can be used safely for routine sample preparation purposes. Its wide acceptance over the intervening years has proven it to be an excellent design for general digestion procedures in which temperatures and pressures are held below 150 °C and 1200 psig. It can be used occasionally above 150 °C, but at elevated temperatures it becomes increasingly difficult to maintain a tight seal.

The bomb does not have a safety rupture disc, but it is designed so that the bottom plate will shear out and release the charge if the bomb pressure should exceed 7000 psig. This "weak link" design, while effective in preventing a lateral burst which might injure a bystander, is not an adequate substitute for a frangible rupture disc as provided in other Parr designs. For this reason, the 4745 bomb is not recommended for experimental procedures in which explosive pressures may be generated.

ORDERING INFORMATION

4745	Acid digestion bomb, 23 mL
A255AC	Replacement Teflon cup with cover, 23 mL

4749 Bomb with A284AC Tumbling Ring

4749 GENERAL PURPOSE BOMB

23 mL
250 °C
1800 psig

This is a 23 mL, general purpose acid digestion bomb, similar to the original 4745 model, but modified with a thick-walled Teflon Liner and a broad flanged seal for use at temperatures and pressures up to 250 °C and 1800 psig maximum. The bomb is sealed by tightening the cap with a hook spanner while holding the bomb in a special fixture. Should the operator inadvertently fail to follow the recommended operating procedures, resulting in the development of internal pressures well above the 1800 psig limit, a metal disc above the Teflon cover will rupture at approximately 3500 psig, releasing the charge through an opening in the bomb cover. This safety feature, combined with its higher temperature limit, make the 4749 bomb an excellent choice for all general digestion purposes, and particularly for experimental procedures in which the behavior of the reactants has not been well established.

One of the original applications for this bomb, which continues to be one of its principal uses, is for digesting alumina samples at temperatures to 250 °C. For this and other difficult digestions, Parr offers an optional tumbling ring which can be attached to the bomb body. With this ring in place, the bomb will roll smoothly when placed on a powered roller, thus providing a convenient means for agitating the charge during long digestion procedures.

Accessories such as the spanner wrench, holding fixture and tumbling ring are not included with the bomb and must be ordered separately.

ORDERING INFORMATION

4749	Acid digestion bomb, 23 mL
A280AC	Replacement Teflon cup with cover, 23 mL
286AC	Corrosion disc, .001", T347SS
287AC	Rupture disc, .0025", Inconel
264AC2	Hook spanner wrench
A285AC	Holding fixture
A284AC	Tumbling ring

The 4744 and 4749 Bombs can be held firmly in an A285AC Holding Fixture while tightening the cap with a 264AC2 Hook Spanner.

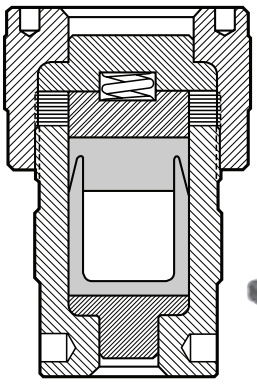
4744 GENERAL PURPOSE BOMB

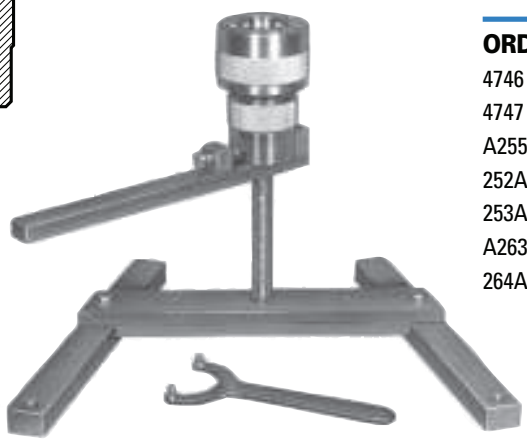
45 mL - 250 °C
1800 psig

This is a 45 mL modification of the 23 mL, 4749 Teflon lined bomb for users who want additional capacity in this popular model. It is made with the same closure as the 23 mL bomb, using a similar thick-walled Teflon cup, 3-3/4" deep inside, with a broad flanged seal. Safety blow out protection is provided with a rupture disc which will release pressure through an opening in the cover. It's maximum temperature and pressure ratings, 250 °C and 1800 psig, are the same as for the 4749 model. The 4744 bomb is sealed by turning the screw cap down until it is hand tight, then tightening the cap not more than one-eighth turn with a hook spanner. The spanner and holding fixture required for this operation are the same as used with the 4749 bomb. These accessories must be ordered separately.

ORDERING INFORMATION

4744	Acid digestion bomb, 45 mL
A280AC2	Replacement Teflon cup with cover, 45 mL
286AC	Corrosion disc, .001", T347SS
287AC	Rupture disc, .0025", Inconel
264AC2	Hook spanner wrench
A285AC	Holding fixture
A284AC	Tumbling ring





4746 & 4747 HIGH PRESSURE BOMB

23 mL - 250 °C
5000 & 3300 psig

This is a high strength acid digestion bomb with a 23 mL, A255AC Teflon cup and cover in a strong outer body which can be made either of stainless steel or nickel. The 4746 stainless bomb is intended for use with nitric, sulfuric or other oxidizing acids, offering best resistance to any acid vapors which might migrate through the Teflon cup under high pressures. The 4747 bomb with a nickel body is to be used with HCl, HF and other reducing acids. Working pressures up to 5000 psi and temperatures to 250 °C can be handled in the 4746 stainless bomb, but pressures in the 4747 nickel bomb must be limited to 3000 psi due to the lower physical strength of nickel. The 4746 stainless bomb has a safety rupture disc which will release through a passage in the bottom of the bomb. The nickel bomb does not have a blow-out passage since reactions with reducing acids are not potentially explosive.

These bombs were developed initially for dissolving nuclear fuel samples but many other applications with refractory or highly active materials are indicated. Their heavy construction will be reassuring when working with mixtures which are potentially explosive or whose behavior is unknown and therefore must be handled with care.

The extreme pressures developed in these bombs will tend to deform the Teflon cup, making it difficult to remove the cup from the bomb. To overcome this problem, Parr offers an A263AC spanner jack that will push the cup out of the bomb with a smooth, uniform pressure without damaging the cup. This spanner jack is not included with the bomb and must be ordered separately.

ORDERING INFORMATION

4746	Acid digestion bomb, high pressure, stainless steel
4747	Acid digestion bomb, high pressure, nickel
A255AC	Replacement Teflon cup with cover, 23 mL
252AC	Corrosion disc, .002", T347SS
253AC	Rupture disc, .010", T347SS
A263AC	Spanner jack assembly with 264AC face spanner
264AC	Face spanner only

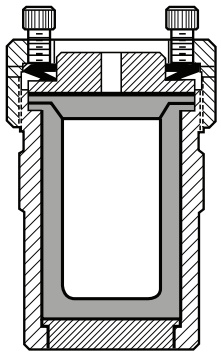
The A263AC Spanner-Jack holds the 4746 Bomb firmly during opening and closing operations and provides a convenient tool for pressing the Teflon cup out of the body.

4748 LARGE CAPACITY BOMB

125 mL - 250 °C
1900 psig

The 4748 bomb is the largest of all Parr acid digestion bombs. It has a 125 mL, removable Teflon cup in a stainless steel body with six cap screws in the screw cap to seal the flanged Teflon cup. An expandable wave spring maintains continuous pressure on the seal during the cooling cycle when Teflon parts might otherwise relax and leak. Stirring can be provided with a magnetic stir bar.

Temperatures and pressures in the 4748 bomb should not exceed 250 °C and 1900 psig, and held well below these limits whenever possible. It also is advisable to test any new procedure in one of the smaller bombs before scaling up to this size. If recommended procedures are not followed and excessive pressure develops in the bomb, a metal disc above the Teflon cover will rupture at approximately 3500 psig, releasing the charge through an opening in the cover. A wrench for the cap screws is furnished with the bomb. No other accessories are required.



ORDERING INFORMATION

4748	Acid digestion bomb, 125 mL
A305AC	Replacement Teflon cup with cover, 125 mL
310AC	Corrosion disc, .001", T347SS
311AC	Rupture disc, .0025", Inconel

Acid Digestion Bombs Specifications

Model Number	4745	4749	4744	4746	4748
Size, mL	23	23	45	23	125
Maximum charge, grams,					
Inorganic sample	1.0	1.0	2.0	1.0	5.0
Organic sample	0.1	0.1	0.2	0.1	0.5
Maximum Temperature, °C					
Recommended	150	250	250	250	250
Absolute	250				
Maximum pressure, psig					
Absolute	1200	1800	1800	5000	1900
Body Material	Stainless Steel				
Cup seal	Tapered	Flanged	Flanged	Tapered	Flanged
Rupture disc	No	Yes	Yes	Yes	Yes
Closure style	Hand Tighten	Spanner Wrench	Spanner Wrench	Hand Tighten	Six Cap Screws
Bomb dimensions, cm					
Height overall	8.45	8.45	13.53	12.70	15.2
Maximum O.D.	6.05	6.35	6.35	8.41	9.52
Cup dimensions, cm					
Inside diameter	3.10	2.64	2.64	3.10	4.45
Inside depth	3.09	4.37	9.50	3.09	8.25
Bomb weight, grams	965	1020	1430	3700	3750

Indicates specifications that change within models