OPERATING INSTRUCTIONS

For the 1108 Oxygen Combustion Bomb

SCOPE

These instructions cover the procedures to be followed when using a Parr 1108 Oxygen Combustion Bomb to determine calorific values of solid or liquid combustible material in a Parr calorimeter, or when using an 1108 bomb in a 1901 Oxygen Bomb Apparatus to prepare solid or liquid samples for chemical analysis. The user should study these instructions carefully in order to obtain a complete understanding of the capabilities and limitations of an 1108 Bomb, and to be well aware of the precautions to be observed in its operation. Calorimeter operations and the operation of various oxygen bomb accessories are described in separate instruction sheets listed below, copies of which are available upon request.

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RELATED INSTRUCTIONS

Sheet No.	Description
207M	Analytical Methods for Oxygen Bombs
201M	Limited Warranty

OPERATING THE 1108 OXYGEN BOMB

Precautions. Combustion with oxygen in a sealed bomb is a very effective and reliable method for releasing all heat energy obtainable from a sample and for preparing hydrocarbon compounds and carbonaceous materials for analysis, but there are certain precautions which must always be observed when using this equipment. In particular:

- Do not overcharge the bomb with too much sample or with a sample which might react with explosive violence.
- Do not overcharge the bomb with too much oxygen. The initial charging pressure should not exceed 40 atm (590 psig).
- Do not fire the bomb alone on an open bench without providing a protective cooling medium. The bomb should be completely submerged in water during firing.
- Do not fire the bomb if gas bubbles are released from any point on the bomb when it is submerged in water.
- Do not ignite a volatile sample without using one of the sealed sample holders described on page 6 or the tape technique.
- Stand away from the bomb during and do not handle the bomb for at least 6 minutes after firing.
- Keep the bomb in good condition at all times. Any parts that show signs of weakness or deterioration must be replaced promptly.
- Read the maintenance and safety instructions beginning on page 7 before starting to use the bomb, and urge all operating personnel to re-read these instructions often.
- Screw caps and cylinders are stamped so that each cylinder and screw cap can be identified as a matched set. We recommend that you maintain the match of cylinders and screw caps for your safety and ease of use.

Special Alloy Construction. The standard 1108 oxygen bomb is made of a special columbium-stabilized stainless steel selected for it's excellent resistance to the mixed nitric and sulfuric acids generated in a bomb combustion. It is a superior alloy which will withstand the conditions generated in almost all fuel testing applications, yet neither it nor any other stainless steel will resist the corrosive atmospheres produced when burning samples containing halogen compounds. For these applications, Parr offers the 1108CL bomb described below. It should be noted that all instructions for the 1108 bomb apply equally to the 1108CL bomb as well.

A Chlorine-Resistant Bomb. The 1108CL bomb is the same as the standard 1108 model, but with a head and cylinder made of an alloy with superior corrosion resistance to the free chlorine and halogen acids released when burning chlorinated samples. Users who analyze waste materials and combustible solvents are urged to select the 1108CL bomb instead of 1108 for its longer service life under extreme corrosive conditions. Bomb maintenance is also improved. In most cases, 1108CL bombs returned to the factory for scheduled maintenance can be restored to optimum finish by repolishing instead of having to rebore the cylinder to remove pits.

Other Special Purpose Bombs. Although the 1108 and 1108CL bombs will handle a broad range of test samples, Parr also offers other special purpose combustion bombs, including: a high pressure bomb for explosives, an oversize bomb for large samples and a semi-micro bomb for small samples. Separate operating instructions are issued for these special bombs.

Allowable Sample Size. To stay within safe limits, the bomb should never be charged with a sample which will release more than 8000 calories when burned in oxygen, and the initial oxygen pressure should never exceed 40 atmospheres (590 psig). This generally limits the mass of the combustible charge (sample plus benzoic acid, gelatin, firing oil or any combustion aid) to not more than 1.1 grams. When starting tests with new or unfamiliar materials it is always best to use samples of less than 0.7 of a gram, with the possibility of increasing the amount if preliminary tests indicate no abnormal behavior. To avoid damage to the bomb and possible injury to the operator, it should be a standing rule in each laboratory that the bomb must never be charged with more than 1.5 grams of combustible material.

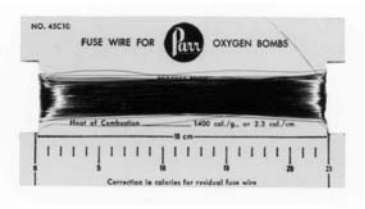
Attaching the Fuse. Set the bomb on an A38A support stand and fasten a 10 cm length of fuse wire between the two electrodes. Parr 45C10 nickel alloy wire is used for most tests, with platinum wire offered as an alternate for certain special procedures. The 45C10 wire is furnished on cards from which uniform 10 cm lengths can be cut without further measurement.

Quick-grip electrodes now installed in all new 1108 oxygen bombs eliminate most of the threading and twisting formerly required when binding the wire to plain electrodes. To attach the fuse to quick-grip electrodes, insert the ends of the wire into the eyelet at the end of each stem and push the cap downward to pinch the wire into place. No further threading or twisting is required. The procedure for binding the fuse to the 4A and 5A plain electrodes in older Parr bombs is illustrated in the instruction manual furnished with the original equipment. For convenience, it is recommended that the user purchase and install new 4A10 and 5A10 quick-grip electrodes as replacements for the 4A and 5A styles in older equipment.

Place the fuel capsule with its weighed sample in the electrode loop and bend the wire downward toward the surface of the charge as shown on page 3. It is not necessary to submerge the wire in a powdered sample. In fact, better combustions will usually be obtained if the loop of the fuse is set slightly above the surface. When using pelleted samples, bend the wire so that the loop bears against the top of the pellet firmly enough to keep it from sliding against the side of the capsule. It is also good practice to tilt the capsule slightly to one side so that the flame emerging from it will not impinge directly on the tip of the straight electrode.

Liquids in the Bomb. Most bomb combustion procedures call for a small amount of liquid to be placed in the bottom of the bomb as a sequestering agent and absorbent. If the amount and type of liquid are not otherwise specified, add 1.0 mL of distilled or deionized water from a pipet.

A38A Bomb Head Support Stand



45C10 Fuse Wire

Set the bomb head on the A38A support stand when attaching the fuse and arranging the sample.

To attach the fuse: raise the cap; insert the wire through the eyelet; then pull the cap downward to complete the assembly.

Closing the Bomb. Care must be taken not to disturb the sample when moving the bomb head from the support stand to the bomb cylinder. Check the sealing ring to be sure that it is in good condition and moisten it with a bit of water so that it will slide freely into the cylinder; then slide the head into the cylinder and push it down as far as it will go. For easy insertion, push the head straight down without twisting and leave the gas release valve open during this operation. When working with older bombs which have a removable compression ring, be sure that the 104A2 ring is in place above the gasket before attaching the screw cap. Current model A416A3 bomb heads do not require a separate compression ring. Set the screw cap on the cylinder and turn it down firmly by hand to a solid stop. When properly closed, no threads on the cylinder should be exposed. If the screw cap tends to bind to the cylinder at this point, indicating that it might be difficult to open the bomb after it has been fired, turn the screw cap back slightly – but only a few degrees – enough to release the binding, since the bottom thread must remain fully engaged. It is not necessary to use a wrench or spanner on the screw cap. Hand tightening should be sufficient to secure a tight seal.

1825 Oxygen Filling Connection

Filling the Bomb. The instructions below describe a manual system using the 1825 Oxygen Filling Connection furnished with other Parr apparatus.

Oxygen for the bomb can be drawn from a standard commercial oxygen tank. Unscrew the protective cap from the tank and inspect the threads on the valve outlet to be sure they are clean and in good condition. Place the ball end of the connection into the outlet socket and draw up the union nut tightly with a wrench, keeping the 0-55 atm gage in an upright position.

The pressure connection to the bomb is made with a slip connector on the oxygen hose which slides over the gas inlet fitting on the bomb head. Slide the connector onto the inlet valve body and push it down as far as it will go. If it does not slide easily, a drop of water spread around the inlet valve will lubricate the sealing rings. Older bombs use a threaded connector with a knurled coupling which must be turned finger tight.

Close the outlet valve on the bomb head; then open or “crack” the oxygen tank valve not more than one-quarter turn. Open the filling connection control valve slowly and watch the gage as the bomb pressure rises to the desired filling pressure (usually 30 atm., but never more than 40 atm.); then close the control valve. The bomb inlet check valve will close automatically when the oxygen supply is shut off, leaving the bomb filled to the highest pressure indicated on the 0-55 atm. Gage. Release the residual pressure in the filling hose by pushing downward on the lever attached to the relief valve. The gage should now return to zero. If the pressure drops slowly and a large amount of gas escapes when the pressure relief valve is opened, the check valve in the bomb head is not operating properly. This trouble will have to be corrected before the bomb can be used. If too much oxygen should accidentally be introduced into the bomb, DO NOT proceed with the combustion. Detach the filling connection; exhaust the bomb; remove the head and reweigh the sample before repeating the filling operation.

2901 Ignition Unit

Firing the Bomb. The electric current for firing the bomb should be drawn from a Parr 2901EB Ignition Unit connected to an 115v50/60Hz grounded electrical outlet. (For 230v50/60Hz use a 2901EE Ignition Unit). Connect one of the lead wires from the calorimeter to the 10 cm binding post on the ignition unit and the 2nd wire to the middle or "common" terminal.

When using the bomb in a calorimeter, insert the 421A lifting handle into the two holes in the side of the screw cap and lower the bomb partially into the calorimeter water bucket. Press the banana plugs on the two ignition wires firmly into the terminal sockets on the bomb head before the head is completely immersed in the water. After connecting the wires, lower the bomb into the bucket with its feet spanning the circular boss in the bottom of the bucket. Remove the lifting handle and shake off any drops of water back into the bucket. Be careful not to remove any water from the bucket with the fingers.

When using the bomb alone for analytical purposes it should be connected to the ignition unit as described above and held submerged in an A387A or similar water bath during firing.

In all operations, check the bomb for leaks before firing. If any gas leakage is indicated, no matter how slight, **DO NOT FIRE THE BOMB.** Instead remove it from the water bath; release the pressure and eliminate the leak before proceeding with combustion test. If no leakage is indicated, adjust the water flow rate so that the bomb will be covered by a continuous flow of cold water during the firing period, then stand back and press the firing button on the ignition unit to fire the charge.
Caution: Do not have the head, hands or any parts of the body directly over the bomb during the firing period and do not go near the bomb for at least 20 seconds after the firing.

Fire the charge by pressing the firing button on the ignition unit, keeping the circuit closed for about 5 seconds. The indicator light will come on when the button is depressed and will remain on while current flows through the fuse. When the fuse burns off and breaks the circuit, the light will go out. Normally this takes about ½ second, but it is good practice to keep the push switch closed for about 5 seconds regardless of the light. If the light continues to glow while the button is depressed, there is either a short circuit in the firing system or the fuse was not properly arranged. If a 26 gauge platinum wire is used to fire the charge, hold the firing button down for only one or two seconds which should be sufficient to ignite the auxiliary fuse. A longer period may melt the wire. If the wire melts, use the 7 cm terminals on the ignition unit to obtain a lower firing voltage; or add a heavy, one-ohm resistor to the 10 cm firing circuit to lower the voltage.

If the indicator light does not come on when the firing button is pressed there is either an open circuit in the system or a fault in the A1580E circuit board. An open circuit can usually be located with an ohmmeter. Flex the lead wires during any continuity check as the wires may be broken and making only intermittent contact. If the red indicator light glows during ignition but the bomb fuse does not burn, check the system for a voltage leak to ground, most likely in the insulated electrode on the bomb head. Check the electrode using the high impedance scale on an ohmmeter and replace the electrode insulator and seal if leakage is indicated.

Recovering the Combustion Products. Let the bomb stand in the calorimeter or water bath for at least 3 minutes, then lift it out of the water and wipe with a clean towel. Open the valve knob slightly to release all residual gas pressure before attempting to remove the screw cap. Gas release should proceed slowly over a period of not less than one minute to avoid entrainment losses. After all pressure has been released, unscrew the cap; lift the head out of the cylinder and place it on the support stand. Do not twist the head during removal. Pull it straight out to avoid sticking. Examine the interior of the bomb for soot or other evidence of incomplete combustion. If such is found the test will have to be discarded. Wash all interior surfaces of the bomb and the combustion capsule with a jet of distilled water and collect the washings. If any precipitate or residue is present, remove it with a rubber policeman. Do not filter the washings as this might remove valuable constituents. Titrate the washings and measure the unburned fuse wire as required for calorific tests, then analyze the washings for sulfur and other elements, if required.

An Optional Recovery Procedure. If desired, a luer fitting, 518A, can be attached to the bomb to provide a means for washing the bomb and recovering the combustion products with a syringe without opening the bomb and removing the bomb head. To use this procedure, remove the standard A420A valve needle and replace it with an A420A2 needle to which a syringe, 244C, can be attached.

To recover the combustion products via a luer fitting, let the bomb stand in a cooling bath for at least 3 minutes after firing to allow for complete condensation of all residual vapor. Then remove the bomb from the water and attach only the barrel of a 244C syringe to the luer fitting. Open the valve and release the pressure at a slow rate, using at least a full minute to bring the bomb pressure back to atmospheric. The attached syringe barrel will help to retain any condensate spray that might be carried out of the valve during the exhaust period.

Add 30 mL of distilled water to the attached syringe barrel and use the syringe plunge to force the water into the bomb, then close the valve while holding the plunger down. This will develop sufficient pressure within the bomb to seat the inlet check valve and provide enough positive pressure to help remove the washings. Agitate and rotate the bomb in a horizontal position to wet all inner surfaces, then turn the bomb upside down over a 600 mL beaker and open the valve to discharge the washings into the beaker. Tilt the bomb slightly toward the valve to get as much of the water out as possible. Repeat this back-flushing procedure two times, collecting a total of 90 to 100 mL of washings, then open the bomb and recover any liquid that may remain in the cylinder. The three complete back flush and rinse cycles should recover better than 99 percent of the combustion products.

SAMPLES AND SAMPLE HOLDERS

Particle Size and Moisture Content. Solid samples burn best in an oxygen bomb when reduced to 60-mesh, or smaller, and compressed into a pellet with a Parr Pellet Press. Particle size is important because it influences the reaction rate. Large particles may not burn completely and small particles are easily swept out of the capsule by turbulent gases during the rapid combustion. Compression into a pellet is recommended since a pellet burns less vigorously than a loose sample, resulting in fewer incomplete combustions.

Materials such as coal burn well in the as-received or air-dry condition, but **do not burn bone-dry samples.** A certain amount of moisture is desirable in order to control the burning rate. Very dry samples may burn so rapidly that a flame might reach the seals or the soft valve seat in the bomb head, igniting these parts and possibly causing a serious burn-out through the head. Moisture contents up to 20% can be tolerated in many cases, but the optimum moisture is best determined by trial combustions. If moisture is to be added, drop water directly into a loose sample or onto a pellet after the sample has been weighed; then let the sample stand for awhile to obtain uniform distribution.

Combustion Aids. Some samples may be difficult to ignite, or they may burn so slowly that the particles become chilled below the ignition point before complete combustion is obtained. In such cases powdered benzoic acid, white oil or any other combustible material of known purity can be mixed with the sample. Ethylene glycol, butyl alcohol or decalin may also be used for this purpose. It must be remembered, however, that a combustion aid adds to the total energy released in the bomb and the amount of sample may have to be reduced to compensate for the added charge. If benzoic acid is added as a combustion aid, it must be added in a pellet form, .2 gm pellets. Never combust benzoic acid in powder form.

Sample Pellets. One of the most useful techniques for handling powdered samples is to compress the material into a tablet or pellet before it is weighed. Pellets are easier to handle than loose samples and they burn slower in the bomb, thereby reducing the chances for incomplete combustion. The Parr pellet press offers a convenient means for preparing samples in this manner. Pellets produced in this press are ejected into a stainless steel receiver from which they can be lifted and handled easily with a pair of forceps. Most pellets for use in the 1108 oxygen bomb are made in a one-half inch diameter size, but smaller diameters can be produced in the same press using interchangeable punch and die sets. Complete pellet making instructions are furnished with each press.

Combustion Capsules. Non-volatile samples to be tested in Parr oxygen bombs are weighed and burned in shallow capsules meaning approximately 1” dia. and 7/16” deep. These are available in stainless steel, fused silica and platinum alloyed with a 3-1/2% rhodium. Stainless steel capsules are suitable for all tests except those in which a non-metallic (fused silica) holder is desired or where the superior corrosion resistance of a Pt-Rh cup is required. Fused silica capsules should be used for samples containing dissolved metals which can ignite a stainless steel capsule and cause serious bomb damage.

2811 Pellet Press

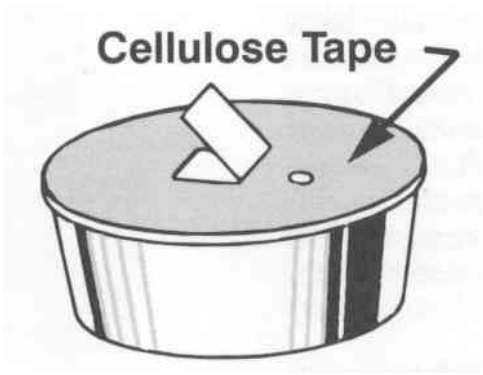
Stainless steel capsules will soon acquire a dull grey finish after repeated use in an oxygen bomb due to the formation of a hard, protective oxide film. This dull finish not only protects the capsule but it also promotes combustion and makes it easier to burn the last traces of the sample. It is recommended, therefore, that new capsules be heated in a muffle furnace at 500 °C for 24 hours to develop this protective coating uniformly on all surfaces. This treatment should be repeated after a capsule has been polished with an abrasive to remove any ash or other surface deposits. Heating in a muffle is also a good way to destroy any trace of carbon or combustible matter which might remain in the capsule from a previous test. After heating, place the capsules in a clean container and handle them only with forceps when they are removed to be weighed on an analytical balance.

Capsules should be monitored for wear. Do not use the capsule if the wall or base thickness is less than 0.025”.

Foodstuffs and Cellulosic Materials. Fibrous and fluffy materials such as vegetable fibers may have to be packed into the combustion capsule and moistened to slow the burning rate, but foodstuffs and cellulosic samples generally burn with little difficulty. Partial drying may be necessary if the moisture content is too high to obtain ignition. But if the sample is heat sensitive and cannot be dried, a water soluble combustion aid such as ethylene glycol can be added to promote ignition.

Coarse Samples. In most cases it may be necessary to burn coarse samples without size reduction since grinding or drying may introduce unwanted changes. There is no objection to this if the coarse sample will ignite and burn completely. Whole wheat grains and coarse charcoal chunks are typical of materials which will burn satisfactorily without grinding and with no additives or special procedure.

3601
Gelatin Capsules



43A6 Combustion Capsule
with Adhesive Tape Seal

43AS Combustion Capsules

Corrosive Samples. Although the Parr bomb is made of corrosion resistant alloys, repeated use with high sulfur samples or with samples containing over 20 mg of chlorine may corrode the metal surfaces and produce a dull film on the inner walls of the bomb. Materials containing appreciable amounts of caustic; such as dried black liquor from a pulp mill, may also damage the bomb, with the caustic attacking the alloy capsule and causing the metal capsule and the bomb electrodes to ignite and burn. These corrosive attacks on the bomb can be reduced by using smaller samples and by increasing the amount of liquid placed in the bottom of the bomb. If a corrosive film develops on the bomb surfaces it should be removed by proper polishing before it grows to a point where deep pitting occurs.

Liquid Samples. Non-volatile samples are treated in the same manner as solid materials. Oils and other liquids which are not volatile at room temperature can be weighed directly into open combustion capsules. The loop of the fuse should be positioned just slightly above the surface of the sample. Some operators place one end of a short piece of fine cotton thread over the fuse loop, with the other end touching the liquid. In any case, the wire itself should not be submerged in the liquid.

Gelatin Capsules. Volatile liquid samples to be burned in an oxygen bomb can be handled conveniently in Parr 3601 Gelatin Capsules. These 0.9 mL capsules consist of two cups which telescope together with a friction fit adequate to retain most liquids. Corrections must be made for the heat of combustion of gelatin (approx. 4600 cal/g) if the capsules are used for calorimetry, and for the sulfur content of the gelatin (approx. 0.35%) if used for sulfur determinations. Blank tests must be run to determine the exact amounts. Gelatin capsules should always be stored in sealed bottles and handled with due regard for their hygroscopic nature.

The blank tests should be repeated at frequent intervals since values determined on a weight basis will change if there are variations in the moisture content of the gelatin.

Tape-Sealed Sample Holders. Volatile samples can be handled in a standard 43AS combustion capsule with a flat top rim, or in a 43A6 platinum capsule with a spun rim by covering the top of the capsule with a disc of adhesive plastic tape. To seal a capsule; stretch a piece of tape across the top and press it firmly against the rim with a flat blade, then trim the excess with a sharp knife. The seal obtained in this manner will be adequate to retain most volatile samples. The tape used for this purpose should be free of chlorine and as low in sulfur as possible. Borden “Mystic Tape” No. M-169-C, or 3M Transparent Tape No. 610 are recommended for this purpose. Equivalent tape can be obtained from Parr under Part No. 517A. The weight of the tape disc must be determined separately and a correction applied for any elements in the tape which might interfere with the determination. This can be done by running a blank test with the tape alone using a sample weighing about 1.0 gram. Tape should always be stored in a sealed container to minimize changes in its moisture content.

Use the following procedure when filling and handling any of these tape-sealed sample holders; Weigh the empty cup or capsule; then cover the top with tape, trim with a knife and press the trimmed edge firmly against the metal rim. Also cut and attach a small flag to the disc; as illustrated at the top of the page. Puncture the tape at a point below the flag, then reweigh the empty cup with its tape cover. Add the sample with a hypodermic syringe; close the opening with the flag and reweigh the filled cup. Set the cup in the loop electrode and arrange the fuse wire so that it touches the center of the tape disc.

Just before closing the bomb, prick the disc with a sharp needle to make a small opening which is needed to prevent collapse of the disc when pressure is applied. Fill the bomb with oxygen to the usual charging pressure, but add oxygen slowly so that the tape will not collapse into the cup. Fire the bomb and complete the test in the usual manner.

Low volatile samples with a high water content, such as urine or blood, can be burned in an open capsule by absorbing the liquid on filter paper pulp or by adding a combustion aid, such as ethylene glycol or by freeze drying the sample.

Heavy Oils. Oils and other liquids which are not volatile at room temperature can be weighed directly into open combustion capsules. The cotton thread should be positioned just slightly above the surface of the sample. Some operators place one end of a short piece of fine cotton thread over the fuse loop, with the other end touching the liquid. In any case, the fuse wire itself should not be submerged in the liquid.

Several precautions must be observed when testing heavy oils because of the intense heat which they develop. If the wall of the metal combustion capsule is thin, or if some of the sample happens to have been spread on the thin rim of the capsule, it is possible that the metal may become heated to the point where it will ignite. This condition is serious because of the excessive heat liberated when metal burns in oxygen. Also, the molten metal oxides may damage the interior of the bomb. In extreme cases the bomb electrodes may also ignite and burn with similar results. For these reasons, be sure that any capsule holding a heavy oil is in good condition and not worn thin from prior usage. Also, bend the straight electrode so that it does not project over the cup where it will receive the full flame from the sample. It is always desirable to tilt the capsule slightly in the loop holder so as to direct the flame away from both electrodes. Some operators prefer to use a 10 to 13 mL platinum crucible for holding heavy oil samples because the added depth in a crucible promotes slower combustion and a milder flame.

Explosives and High Energy Fuels. Special precautions must be observed when testing materials which release large volumes of gas upon ignition, or which detonate with explosive force. Although most slow-burning gun powders and rocket propellants can be tested in the conventional 1108 bomb, the user must understand that this bomb is not designed to withstand the shock pressures produced by primers and high explosives. It is much safer to test these materials in a Parr 1104 high pressure oxygen bomb.

OPERATING SUGGESTIONS

Poor Combustion. The difference in combustion characteristics of the wide variety of materials which may be burned in an oxygen bomb make it difficult to give specific directions which will assure complete combustions for all samples. However, two fundamental conditions may be stated. First, some part of the sample must be heated to its ignition temperature to start the combustion and, in burning, it must liberate sufficient heat to support its own combustion regardless of the chilling effect of the adjacent metal parts. Second, the combustion must produce sufficient turbulence within the bomb to bring oxygen into the fuel cup for burning the last traces of the sample.

An incomplete combustion in an oxygen bomb is nearly always due to one or more of the following causes:

1. Excessively rapid admission of gas to the bomb during charging, causing part of the sample to be blown out of the cup.
2. Loose or powdery condition of the sample which will permit unburned particles to be ejected during a violent combustion.
3. The use of a sample containing coarse particles which will not burn readily. Coal particles which are too large to pass a 60-mesh screen may not burn completely.
4. The use of a sample pellet which has been made too hard or too soft. Either condition sometimes causes spalling and the ejection of unburned fragments.
5. The use of an ignition current too low to ignite the charge, or too high, causing the fuse to break before combustion is under way.
6. Insertion of the fuse wire loop below the surface of a loose sample. Best results are obtained by barely touching the surface or by having the wire slightly above the sample.
7. The use of insufficient oxygen to burn the charge, or conversely, the use of a very high initial gas pressure which may retard the development of sufficient gas turbulence within the bomb.
8. Insufficient space between the combustion cup and the bottom of the bomb. The bottom of the cup should always be at least one-half inch above the bottom of the bomb, or above the liquid level in the bomb, to prevent thermal quenching.
9. New 43AS stainless steel combustion capsules should be heated in a furnace at 500 °C for 24 hours to develop a hard oxide finish before they are used in an oxygen bomb. Repeated experiments have shown that capsules with a dull finish produce fewer incomplete combustions than capsules with a bright finish.
10. Excessive moisture or non-combustible material in the sample amounts to approximately 20 percent or more of the charge it may be difficult to obtain complete combustion. This condition can be remedied by adding a small amount of benzoic acid or other combustion aid.

Oxygen Charging Pressure. Operators sometimes disagree as to the most desirable oxygen charging pressure. As a rule, it is best to use the lowest gas pressure that will give complete combustion. Lower pressures permit higher gas temperatures and greater turbulence, both of which help to secure better combustion. The range of charging pressures for Parr oxygen bombs usually falls between 25 and 35 atmospheres, and it should never exceed 40 atmospheres.

MAINTENANCE AND SAFETY INSTRUCTIONS

Bomb Maintenance. Under normal usage Parr oxygen bombs will give long service if handled with reasonable care. However, the user must remember that these bombs are continually subjected to high temperatures and pressures which apply heavy stresses to the sealing mechanism. The mechanical condition of the bomb must therefore be watched carefully and any parts that show signs of weakness or deterioration should be replaced before they fail. Otherwise, a serious accident may occur.

Do not fire the bomb if gas bubbles are observed anywhere indicating a possible gas leak. Disassemble the parts and install new seals immediately. The bomb head parts which require closest attention and most frequent replacement are: the 230A O-ring head gasket, all the 238A sealing rings, the 415A O-ring and the 20VB PCTFE valve seat in the needle valve.

When replacing the 230A head gasket, stretch the new O-ring and let it snap into place to be sure that it moves freely in its groove and is not twisted.

The 20VB valve seat in the needle valve deteriorates with use, not only in the needle area but on the underside of the seat as well. Leakage and a possible serious burn-out can result from a worn or damaged seat if it is not replaced promptly. As a basic rule, the 20VB valve seat and the two 238A O-rings on the valve needle should be replaced after every 500 firings or every six months, whichever occurs first. If the bomb is used for samples containing chlorine, these parts should be replaced after every 250 firings.

To replace the valve seat, unscrew the 397A compression nut; remove the valve stem and the old seat, and disassemble all of the parts. Drop a new 20VB valve seat into the body and push it down into place. Slide a 7VBCM Monel washer, two 238A O-rings and the 378A packing cup onto the A420A valve needle assembly with the needle pointed upward; then adjust the parts on the needle so that the tip of the needle is flush with-or slightly recessed into-the bottom of the packing cup. Insert this assembly into the 396A outlet valve body and press it firmly against the valve seat by tightening the 397A compression nut to 100 inch-pounds of torque.

A Parr 475A Service Clamp offers a convenient means for clamping the bomb head firmly in a vise without damaging the head when replacing any of the bomb head parts.

Keep the 397A compression nut on the valve needle tightened firmly at all times. Frequent tightening is important. This nut, if slightly loose, may allow a leak to develop during the rapid pressure rise upon ignition. This type of leak may not be detectable before firing; but if it develops, the hot gases can ignite the 20VB valve seat and burn through the head.

Do not use extreme force when closing the needle valve. A moderate but firm turn on the valve knob should be sufficient to stop all gas flow. Excessive needle pressure will deform and possibly close the gas passage. If this happens, unscrew the valve body and replace the 20VB valve seat. Accumulated salt deposits may also clog the gas passage, making it difficult to release pressure at the end of a run. To avoid this, clean the passage through the valve needle and deflector nut with a small drill.

The 238A sealing ring in the insulated electrode should be replaced with the same frequency as the 20VB valve seat. Also, keep the 411A terminal nut tight at all times. As the 238A sealing ring ages and hardens it becomes a partial electrical conductor, permitting misfires and producing unwanted heating effects. Periodic replacement will eliminate this potential problem.

The threads on the screw cap should be checked routinely for any burns or other deformity. After long use, the threads on the screw cap may become worn to the point where they will no longer provide a safe closure for the bomb, and the screw cap will have to be replaced. The following procedure can be used to check the extent to which the threads have become worn:

Assemble the bomb with the head in the cylinder and count the number of turns required to bring the screw cap down firmly against the head. Then open the bomb; remove the head and replace the screw cap, but turn it down to only one-half of the turns previously counted. This will usually be about four turns. With the screw cap in this position, use a dial gage to measure the vertical deflection when lifting the screw cap upward. If this measurement exceeds 1/32 inch (0.030”), the screw cap is unsafe and should be discarded. The cylinder can then be returned to the factory for inspection. If the threads on the cylinder are in good condition, a new screw cap can be custom-fitted to the cylinder.

Never under any circumstances use oil on the O-rings which seals the bomb head or on any of the valves or fittings which handle compressed oxygen. This precaution applies to all of the oxygen bombs parts to the oxygen filling connection as well.

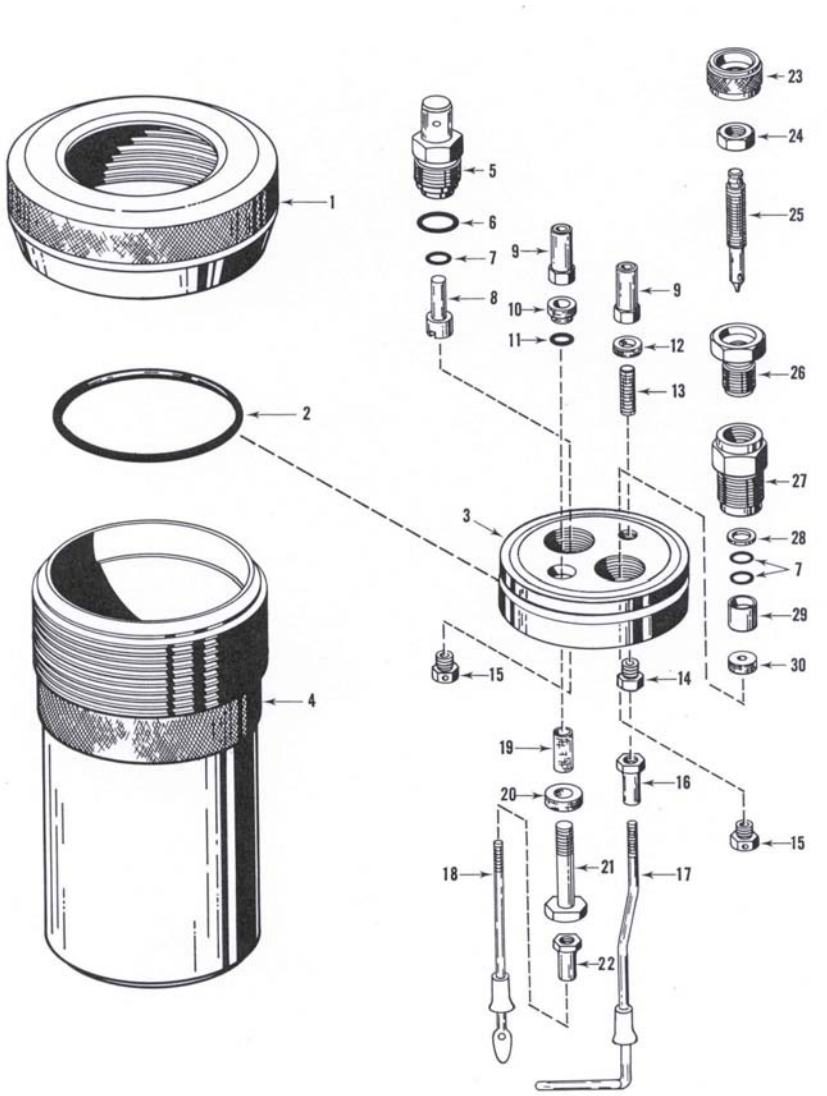
Although Parr oxygen bombs are made from alloys which will withstand most corrosive gases, these bombs will not resist chlorine, fluorine or bromine in the presence of moisture. If samples yielding appreciable amounts of these elements are burned in a Parr bomb, the interior surfaces may become etched or corroded. In such cases the bomb should be emptied and washed as quickly as possible after each combustion.

If the interior of the bomb should become etched as mentioned above, the resistance of the metal to further attack can be improved by restoring the surface to its original highly polished condition. Bombs needing repolishing or other repair work can be returned to the factory. A periodic overhaul and test at the factory will help to keep any Parr oxygen bomb in first-class condition.

Bomb Repairs and Proof Tests. The 20VB valve seat, 230A, 415A, and the four 238A O-rings should be replaced after every 500 firings, or every six months, whichever occurs first. If the bomb is used for samples containing chlorine, these repairs should be made after every 250 firings. Parr oxygen bombs can be returned at any time for repair and testing. A factory test is recommended after every 5000 firings, or conditions; (a) fired with an excessive charge, (b) ignition of any internal components, (c) machined by any source other than the factory, (d) damaged by corrosive vapors that might have exceeded 80% of the corrosion allowance, or (e) any changes in the threads on the bomb cylinder and/or screw cap.

When returning a bomb to the factory, ship it to Parr Instrument Company, 211 53rd Street, Moline, Illinois, 61265, with the package marked for the attention of the Repair Department. A purchase order covering the repair work should be included with the shipment or mailed to the same address as no repairs will be started without specific instructions. Be sure to include a return shipping address and the name and telephone number of the individual to be contacted if questions arise concerning excessive repair costs or other problems. Individual repair parts can be ordered from any Parr dealer or direct from the factory.

PARTS FOR THE 1108 OXYGEN BOMB

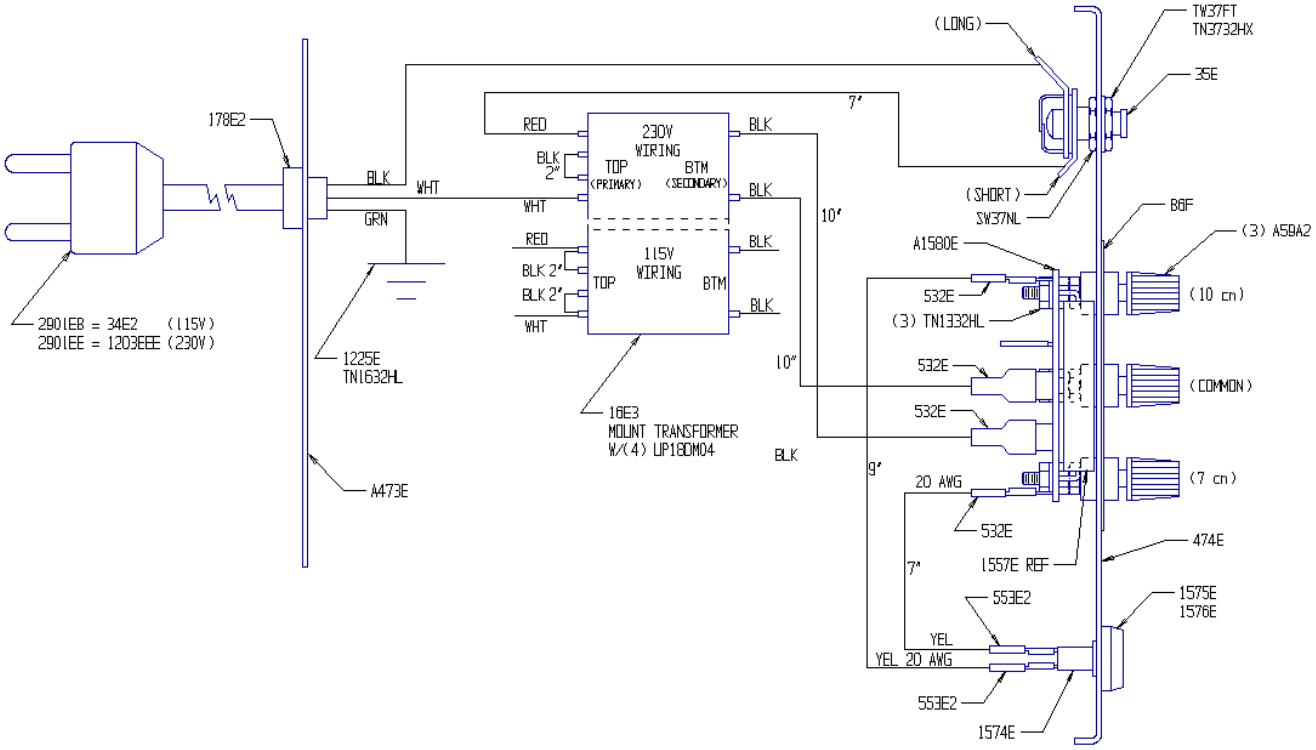


Key No.	Part No.	Description
1	103A	Screw Cap
2	230A	O-Ring,2-3/8 ID, Buna-N
3	394A12	Bomb Head, Bare
	394A12CL	Bomb Head, Bare, for Chlorine service
4	A101A	Bomb Cylinder, sold only with 103A screw cap as Part No. AA101A
	A101ACL	Bomb Cylinder, sold only with 103A screw cap as Part No. AA101ACL
5	395A2	Inlet Valve Body
6	415A	O-Ring, 7/16 ID, Buna-N
7	238A	O-Ring, 3/16 ID, Buna-N
8	403A	Check Valve
9	411A	Terminal Nut
10	143AC	Insulator, Delrin
11	238A	O-Ring 3/16 ID, Buna-N
12	388A	Spacer
13	SC1932SC10	Soc. Hd. Set Screw
14	278A3	Adapter Bushing
15	404A2	Deflector Nut
16	406A	Lock Nut
17	5A10	Loop Electrode with sleeve
18	4A10	Straight Electrode with sleeve
19	401A	Sleeve Insulator
20	96AC	Electrode Insulator
21	402A	Electrode Core
22	406A	Lock Nut
23	407A	Valve Knob
24	398A	Lock Nut
25	400A	Valve Needle
	A420A	Valve Needle with knob (Nos. 23,24,25)
26	397A	Compression Nut
27	396A	Outlet Valve Body
28	7VBCM	Washer, Monel
29	378A	Packing Cup
30	20VB	Valve Seat, PCTFE

Complete Assemblies

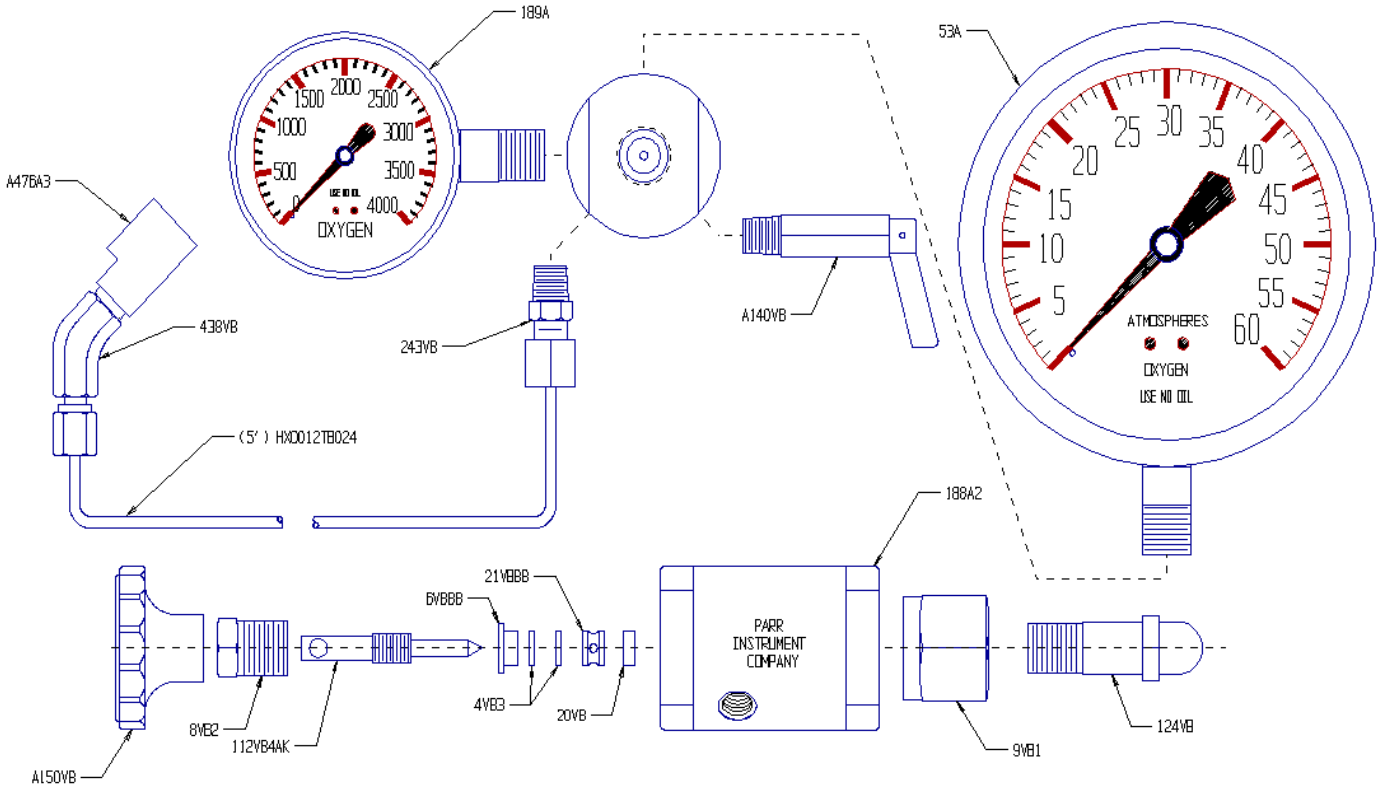
AA101A	Bomb Cylinder with 103A screw cap
AA101ACL	Bomb Cylinder for chlorine service with 103A screw cap
A416A3	Bomb Head Assembly
A416A3CL	Bomb Head Assembly for chlorine service

PARTS FOR THE 2901 IGNITION UNIT



16E3	Transformer, 115/230v.21v
34E2	Cord set w/115v plug
35E	Push switch
A59A2	Binding post
1203EEE	Cord set w/ 230v plug
1574E	Indicator lamp socket
1575E	Lens Cap
1576E	Indicator lamp
A1580E	Circuit board assembly

PARTS FOR THE 1825 OXYGEN FILLING CONNECTION



4VB3	Packing gasket
6VBBB	Packing cover, brass
8VB2	Packing nut
9VB1	Union nut, brass, CGA540
20VB	Valve seat, PCTFE
21VBBB	Lantern ring, brass
53A	Oxygen gage, 3-1/2", 0-60 atm
112VB4AK	Valve needle
124VB	Union nipple, brass, CGA540
A140VB	Toggle relief valve
A150VB	Valve knob
188A2	Filling connection body, bare
243VB	Tube connector, male
438VB	Elbow connector, 45°, male
A476A3	Slip connector with o-rings
394HCJE	O-ring for A476A3 slip connector (2 required)
HX0012TB024	Pressure tubing, 1/8" OD, Nylon, 5-ft

PARR INSTRUMENT COMPANY

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