

Specification for Calorimeter bombs

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- British Gas Corporation
- GAMBICA (BEAMA Ltd.)
- National Coal Board

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Foreword

This revision of BS 4791 has been prepared under the direction of the Laboratory Apparatus Standards Committee. It supersedes BS 4791:1972, which is withdrawn.

The 1972 edition specified requirements for calorimeter bombs used for determining the calorific values and heat of combustion of various fuels and substances. Experience gained since then has justified the revision of this standard, with particular emphasis on safety requirements.

It is a matter of great concern that, from time to time, calorimeter bombs have been submitted for retest or overhaul in a deplorable condition. The faults range from serious damage to parts of the pressure vessel, to deep corrosion in the firing chamber. It is also evident that some combustion bombs have been withdrawn from service too soon. Bomb bodies are discarded because of worn closure threads, although these could be recut and fitted with a new smaller closure ring.

While some users fire their calorimeter bombs only occasionally and deterioration with wear is not likely to be noticeable for several years, other users fire frequently and require a simple, routine, assessment of the wear of the threads as the ring becomes a looser fit on the body. Appendix C describes a method of measurement of slackness of fit of these threads.

In this revision the specified quality of initial fit of the closure threads has been improved. A somewhat relaxed tolerance beyond which the used vessel has to be withdrawn from service has now been given.

The 1972 edition set a limit of 2 000 firings before overhaul: that figure may now be extended by steps, always provided that the maximum tolerance on slackness of fit is not exceeded. The period of validity of the report on a new calorimeter bomb has been correspondingly extended from three to four years.

Previously, rings were untested copies of an approved prototype. In this revision, the proving test on the body is applied to the body and its ring simultaneously. As the input valve has to be replaced at times, the leakage test for valves has been separated appropriately from the proving test.

In this edition, all the previous concern for safety in use has been retained and, further, the risk of damage to the vessel by chemically reactive products is now emphasized.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for materials, construction, design and performance for calorimeter bombs used for the combustion of materials as a means of determining their calorific value and the elements present in the products of combustion.

Precautions for the safe use of the bomb and its ancillary equipment, together with routine maintenance procedures for keeping the calorimeter bomb in serviceable condition, are described in Appendix B, Appendix C and Appendix D.

CAUTION. This standard does not apply to calorimeter bombs for the determination of the calorific value of explosives or other samples if a pressure exceeding 50 bar¹⁾ could be generated.

NOTE 1 Calorimeter bombs in accordance with BS 4791:1972 were approved to tests different from those described in this revision. Retests should be made on the basis of the original test applied and reported accordingly. However, when bomb calorimeters are reconditioned and/or new rings are fitted, it is recommended that the requirements of this current edition be observed.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definition

For the purposes of this British Standard, the following definition applies.

calorimeter bomb

a high pressure vessel used for the determination of calorific values of combustible substances such as solid, liquid and gaseous fuels, foodstuffs and biological samples

NOTE The calorimeter bomb consists of a body, a cap and a closure ring. The test sample is contained in a crucible suspended from the cap. Oxygen is introduced through a valve in the cap and the sample is fired using electrodes that pass through the cap.

WARNING NOTE. A known quantity of the given material is burned in the bomb and the heat released by the combustion is measured using a calorimeter. For most materials, it is necessary to introduce oxygen under pressure to ensure complete combustion. However, certain materials, such as pyrotechnics, generate sufficient oxygen for this purpose on combustion, and the introduction of gaseous oxygen in addition to that in the atmosphere is not therefore required and may be dangerous.

3 Design

3.1 The design shall be such that the bomb can be sealed and opened by hand without the use of tools of any kind.

3.2 The calorimeter bomb seal shall be so designed that, after tightening by hand, an increase of pressure in the bomb will tighten the seal and prevent leakage. Similarly, the fixings of the valve and the electrodes in the cap shall be so designed as to be leakproof when the bomb is fired or brought up to proving pressure.

4 Materials

4.1 Bomb cap and body

The bomb cap and body shall be made of a material that is capable of withstanding the pressures generated by the combustion process and that shall not be corroded by the products of combustion of the test samples.

The bomb cap and body shall each be machined from solid or hollow forgings or bar; they shall not be fabricated from components welded or brazed together.

For a bomb of the design illustrated in Figure 1 and with the minimum dimensions and dimensional ratios given in Table 1, the material shall have the following mechanical properties.

- a) A tensile strength of not less than 490 N/mm², when tested in accordance with BS 18-1.
- b) A yield stress of not less than 210 N/mm², when tested in accordance with BS 18-1.
- c) An elongation at break of not less than 30 %, when tested in accordance with BS 18-1.
- d) An Izod impact value of not less than 68 J, when tested in accordance with BS 131-1.

If the bomb cap and body are made of stainless steel, the steel shall have passed the 90° bend test described in clause 23 of BS 1503:1980.

NOTE If the bomb cap and body are made of a material other than stainless steel, the material supplier should certify that the material has passed a correspondingly suitable test for resistance to intercrystalline corrosion.

4.2 Closure ring

The closure ring shall be made of material, such as aluminium bronze, capable of withstanding the pressure generated by the combustion process.

NOTE Materials should be chosen to minimize galling or seizing of the thread engaging the bomb body.

¹⁾ 1 bar = 100 kPa.