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Standard Practice for Safe Use of Oxygen Combustion Vessels[1]

This standard is issued under the fixed designation E144; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice covers methods for judging the soundness of new and used oxygen combustion vessels, and describes the precautions to be observed in oxygen combustion vessel methods.

1.2 This practice is applicable to all procedures in which samples are completely oxidized by combustion in a metal vessel containing oxygen under pressure. Where there is conflict with specific precautions in individual ASTM methods, the latter shall take precedence.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Physical Requirements

2.1 *Initial Test*—The manufacturer of oxygen combustion vessels for use in ASTM test methods shall furnish a certificate with each new vessel showing that it has satisfactorily passed the hydrostatic and proof tests described in Sections 3 and 4. When requested, the manufacturer shall supply evidence that the vessel is designed and constructed in accordance with recognized practices for pressure vessel equipment.

2.2 *Periodic Inspection*—All seals and other parts that are recommended by the manufacturer shall be replaced or renewed after each 5000 firing or at a more frequent interval if the seals or other parts show evidence of deterioration. The hydrostatic and proof tests described in Sections 3 and 4 shall be repeated if any of the following have occurred:

2.2.1 Five thousand firings.

2.2.2 Firing with an excessive charge of either sample or oxygen.

2.2.3 Ignition of any internal part of the vessel, including fuel capsule.

2.2.4 The evidence of corrosion or surface defects which exceed 80 % of the manufacturer's stated corrosion allowance for the vessel.

2.2.5 Any change in thread tolerances of vessel enclosures which exceed the manufacturer's specifications.

3. Hydrostatic Test

3.1 Fill the vessel with water at room temperature and connect to a suitable hydraulic pressure system. Be sure that all air has been displaced from the vessel and from the connecting gas passages. Support the vessel so that the diameter at the midsection of the cylinder can be measured with a micrometer caliper, and the deflection at the center point of the bottom can be measured with a micrometer dial indicator. Apply water pressure which is 1.5 times the manufacturer's recommended working pressure test pressure of the vessel and check the vessel and pressure connections for leaks.

3.2 With the hydraulic system at atmospheric pressure, measure the diameter at the midsection of the cylinder and obtain a zero reading for the dial indicator in contact with the center point of the bottom of the vessel. Raise the hydrostatic pressure to test pressure and repeat these measurements, then release the pressure and take a third set of measurements with the system at atmospheric pressure. If the application of test pressure produces a deflection greater than 0.005 in. (0.127 mm) at the midsection of the cylinder or at the center point of the bottom of the vessel, or if any of the vessel parts do not resume their original dimensions when pressure is released, reject the vessel as unsafe.

4. Proof Test

4.1 Record the outside diameter at the midsection of the vessel cylinder as measured with a micrometer caliper, then assemble the vessel for firing with a tablet or pellet of compressed benzoic acid that gives an energy release that is 1.5

[1] This practice is under the jurisdiction of ASTM Committee E41 on Laboratory Apparatus and is the direct responsibility of Subcommittee E41.06 on Laboratory Instruments and Equipment.

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*A Summary of Changes section appears at the end of this standard

times the manufacturer's recommended energy release limit. Admit oxygen slowly to an initial pressure that represents the manufacturer's maximum charging pressure, then submerge the vessel in water and check for gas leaks. If none appear, arrange the vessel for firing in a water bath protected by a heavy barricade. (**Warning—**This is a proof test with an excess charge, therefore the operator must be fully protected (5.1.4) in case the vessel should rupture when fired.)

4.2 Fire the vessel and allow it to stand for 10 min while cooling water is circulated through the bath. Remove the vessel, release the residual pressure, open and examine the parts, also measure the diameter at the midsection of the cylinder. If any of the vessel parts do not resume their original dimensions after this test, reject the vessel as unsafe.

5. Precautions in Use of Combustion Vessels

5.1 Observe the following precautions in all oxygen combustion vessel methods:

5.1.1 *Sample Weight*—The total weight of combustible material (sample plus gelatin, firing oil, or any other combustion aid) shall not exceed the maximum energy release recommended by the manufacturer. Initial tests with materials that might be expected to burn rapidly, or to have explosive characteristics, shall be conducted with caution using only a fraction of the allowable maximum sample.

5.1.2 *Oxygen Filling System*—The oxygen filling system shall include a pressure regulator or other automatic device to prevent overcharging beyond the maximum allowable pressure specified in the appropriate ASTM test method. There must be no oil or other combustible materials in this system. Check the pressure gauge or gauges for accuracy at regular intervals, or whenever there is any reason to suspect that they are inaccurate. The combustion vessel must not be fired if an over-charge of oxygen should accidentally be admitted.

5.1.3 *Ignition System*—The vessel must be completely submerged in water during firing, and the charge must not be ignited if there is any evidence of gas leakage. Draw the ignition current from a suitable source (e.g., stepdown transformer, battery, or capacitive storage device) using the lowest practicable voltage recommended by the manufacturer. Control the circuit to prevent inadvertant firing (e.g., by a double-pole push switch that can be closed only when the operator presses the ignition button, or other appropriate controller).

5.1.4 *Safety Barricade*—Protect the operator by a barricade when firing the vessel and for 15 s thereafter. The barricade shall consist of ¼-in. (6.35-mm) steel plate or other equivalent protective material.

6. Keywords

6.1 combustion; oxygen; vessels

SUMMARY OF CHANGES

Committee E41 has identified the location of selected changes to this standard since the last issue (E144–94(2011)) that may impact the use of this standard.

(1) Subsection 4.1 Warning statement. The phrase "twice-normal" has been replaced with the word "excess." This is to reinforce that benzoic acid charge should be 1.5 times as described earlier in subsection 4.1.
(2) Throughout this standard, the term "bomb" has been replaced by "vessel" or "combustion vessel." Historically, burning a sample enclosed in a high pressure oxygen environment is know as "oxygen bomb calorimetry," and the vessel containing the sample is known as an "oxygen bomb." However, the word "bomb" has the potential to be misunderstood by the general public and create a barrier to trade in international commerce. In this context, the apparatus is better described as a "vessel."