



Designation: E 1236 – 91 (Reapproved 1997)

Standard Practice for Qualifying Charpy Impact Machines as Reference Machines¹

This standard is issued under the fixed designation E 1236; 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 approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Some standards for impact testing require that the bias of the machines be evaluated by testing one or more sets of specimens with known impact energy. These specimens are called verification specimens. The known value is determined by tests using three machines which, by consensus, are designated as giving correct results. Such machines will be referred to as reference machines and the impact energy values determined from tests using these machines will be referred to as reference values.

In order to assure an adequate supply of verification specimens and also to assure that the reference values are not influenced by uncontrolled changes in one reference machine, it is necessary to recognize several machines as reference machines. However, when several different machines are used to test a large number of specimens from the same lot, the average impact energy from each machine is usually different from the corresponding values from tests by other machines. This practice provides procedures for minimizing these differences.

1. Scope

1.1 This practice lists the physical requirements that an impact machine shall meet in order to be registered as a reference machine.

1.2 This practice describes the procedure by which a reference machine shall be qualified to make tests to establish reference values.

1.3 These requirements and procedures are not intended to be applied to impact machines and testing procedures used for purposes other than to qualify machines for the determination of reference values of verification specimens.

1.4 This practice does not describe the procedure by which the reference value for a specified reference material is determined. The procedure varies with the material being tested and is to be found in different standards for various specified verification materials.

1.5 Values stated in inch-pound units are to be regarded as the standard. SI units are given for information only.

1.6 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 23 Test Methods for Notched Bar Impact Testing of Metallic Materials²

E 178 Practice for Dealing with Outlying Observations³

E 456 Terminology Relating to Quality and Statistics³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method³

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *coordinator*—the person or agency who conducts the annual interlaboratory coordination program and maintains a file on all reference machines.

3.1.2 *impact energy*—the energy required to break a specimen when tested by an impact machine. It is equal to the difference in the potential energy of the pendulum at the start and at the end of a swing during which a specimen is broken, minus the proportional amount of windage and friction loss which corresponds to the angle of swing.

3.1.3 *lot*—a definite quantity of some commodity manufactured under similar conditions of production.

3.1.3.1 *Discussion*—With the exceptions noted, the definitions of statistical terms given in Terminology E 456 shall apply.

¹ This practice is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.07 on Impact Testing.

Current edition approved Jan. 25, 1991. Published March 1991. Originally published as E 1236 – 88. Last previous edition E 1236 – 88.

² *Annual Book of ASTM Standards*, Vol 03.01.

³ *Annual Book of ASTM Standards*, Vol 14.02.

3.1.4 *reference machines*—impact machines meeting the requirements of this practice.

3.1.5 *reference value*—the impact energy value furnished with verification specimens, determined from tests made using reference machines.

3.1.6 *set*—a group of specimens chosen at random from a lot, to be later tested successively in a single machine.

3.1.6.1 *Discussion*—With the exceptions noted, the definitions of statistical terms given in Terminology E 456 shall apply.

3.1.7 *specified verification material*—any one of several materials that meet a specification given in a standard that describes verification specimens.

3.1.8 *verification specimens*—impact specimens to be used to evaluate the suitability of a machine for material acceptance testing by comparing the impact energy measured by that machine to the reference value furnished with the specimens.

4. Summary of Practice

4.1 Any impact machine that meets the physical requirements of this practice may be a candidate reference machine. Before the machine is permitted to be used to determine reference values, it shall be qualified by participating in an interlaboratory coordination program that compares results from all candidate reference machines at low, medium, and high energy levels. The average value and variability of the test results from each machine are compared to corresponding values from all machines combined. If the differences between the value from a particular machine and the combined value is less than the amounts specified in this practice, that machine is certified as a reference machine for the next twelve months or until the next report of the interlaboratory coordination program is distributed.

5. Significance and Use

5.1 This practice is expected to increase the availability of verification specimens by permitting an increase in the number of qualified reference machines.

6. Apparatus

6.1 *Reference Machines*, used to determine the reference values for a specified verification material, shall comply with the requirements of the standard for verification specimens of that material.

6.1.1 Unless specifically stated otherwise in the standard for verification specimens, reference machines shall comply with the requirements of Test Method E 23, except as modified in 6.1.2.

6.1.2 The requirements for reference machines shall differ from those given in Test Method E 23, as follows:

6.1.2.1 The capacity of a reference machine shall be 240 ft-lbf (330 J) or greater.

6.1.2.2 The portions of the striker and anvils that contact the specimen and apply or react to the impacting force shall have a hardness of 56HRC or greater.

6.1.2.3 The angular position of the pendulum at the extremes of the swing or the impact energy calculated therefrom shall be automatically recorded in digital or graphical form.

These records shall be in permanent form suitable for evaluation at any time until 1 year after all the specimens from the same lot have been tested or sold.

6.1.2.4 If impact energy is automatically calculated and printed, the value shown shall be rounded to 0.1 ft-lbf (0.1 J) or, optionally, 0.5 % of the impact energy, if greater.

6.1.2.5 If pendulum position is recorded, the record shall be readable to an angle corresponding to the larger of 0.2 ft-lbf (0.3 J) or 1 % of the impact energy.

6.2 Environment of the reference machine shall be similar to that of the average quality control environment with specific attention to the following factors:

6.2.1 The machine shall be in an enclosed area with sufficient lighting and clearance around the equipment to permit convenient access for conducting the necessary periodic inspections and maintenance.

6.2.2 Normal room temperature and humidity is satisfactory. No concentrated heating or cooling sources shall be located near or directed toward the machine or its indicating mechanism.

6.2.3 The atmosphere shall be sufficiently clean to prevent the accumulation of dust or foreign material that could contaminate the bearings or otherwise cause damage to the equipment which would affect its performance.

6.2.4 The reference machine shall not be subjected to external (random) vibrations induced by other equipment in close proximity, such as forging hammers, presses, vehicular movements, and so forth. Vibrations discernable by placing the hand on the pendulum would be considered excessive.

NOTE 1—Excessive vibration from a machine firmly fastened to the floor indicates the need of a separate foundation or base connected to the floor by vibration isolators.

7. Selection of the Coordinator of the Interlaboratory Coordination Program

7.1 The machine owner accepting responsibility for the coordinative function has the option of assigning an employee or of contracting with a person or agency outside the owner's organization to serve as coordinator.

7.2 *Timing*—The coordinator of the next program shall be designated within 60 days of the distribution of the report of the preceding program.

7.3 For the first year of the program, the coordinative responsibility will be assigned to the owner of reference machine A.

7.4 For the second and subsequent programs, the machine owner who last accepted responsibility will request successively, in alphabetical order, the other owners to designate the coordinator for the next program.

7.4.1 If none of the owners voluntarily accept the coordinative responsibility, the responsibility shall be assigned to the owner whose machine has the first alphabetical identification letter among those who have previously accepted the responsibility the least number of times per reference machine owned. If that owner refuses to accept the assignment, that machine shall be excluded from the next program and thereby loses reference machine status.

8. Calibration and Standardization

8.1 Calibration and verification of reference machines shall conform to Test Methods E 23.

8.2 *Registration of Reference Machines:*

8.2.1 Registration shall be initiated by a letter of application from the machine owner to the coordinator. The letter shall furnish the information and make the commitments that follow:

8.2.1.1 Identify the machine and certify that the requirements of Section 6 are satisfied.

8.2.1.2 State that the owner agrees to participate in the annual interlaboratory coordination program.

8.2.1.3 State that the owner will permit suppliers and users of the verification specimens tested by this machine to see the machine and examine the permanent records required by this practice. These inspections are to be by appointment at the owner's convenience.

8.2.2 The coordinator will assign the next letter of the alphabet to that machine for identification.

8.2.3 The coordinator will acknowledge the receipt of the application by a letter addressed to the owner. An attachment will list all currently registered reference machines by identifying letter and give the name, address, and telephone number of the owner of each machine.

8.3 The interlaboratory coordination program will consist of specimen procurement and testing, and the comparison of test results to determine whether the deviation and variability of each machine is within the limits specified in 8.3.6 and 8.3.7.

8.3.1 The specimen shall meet the dimensional requirements given in Test Methods E 23 for Charpy Impact Specimens-Type A, and any additional requirements imposed by the standard for verification specimens.

8.3.2 If all of the candidate machines are under the control of one person or organization, that owner shall be responsible for conducting the interlaboratory coordination program and for keeping a summary report on file.

8.3.3 If the candidate reference machines are under the control of two or more owners, the coordinator shall conduct the interlaboratory coordination program as described in 8.3.3.1-8.3.8.2.

8.3.3.1 During January of each year, the coordinator shall request quotations of price and delivery for the specimens needed for the interlaboratory coordination programs.

(a) Requests shall be addressed to each known supplier of verification specimens and to all other manufacturers who have had experience in producing Charpy specimens and who have asked to be considered.

(b) The request shall be for separate quotations for verification specimens in one or more of the following energy ranges: low, 10 to 15 ft·lbf (13 to 20 J); medium, 65 to 90 ft·lbf (88 to 122 J); high, 130 to 180 ft·lbf (176 to 244 J), whose specifications are shown in standards for verification specimens.

(c) The request shall stipulate that the quotation shall include the material specification from the manufacturer and a certificate stating that all material furnished to that specification was taken from a single billet or melt.

(d) The request shall require that the quotation include the results of tests on specimens randomly selected from the lot being offered. These results shall include average impact energy, the standard deviation, the test temperature, the number of specimens tested, and all other information needed to show that the offered lot meets the specifications of the standard for verification specimens of that material.

(e) The request shall state that the minimum number of specimens required to be in each lot shall be equal to the product of 1.5 times the number of registered reference machines and the number of specimens in each set. Unless otherwise required by the standard for the verification specimens, each set shall consist of 25 specimens. The inquiry shall state that the quoted lot size shall be reserved for use in the interlaboratory coordination program for at least twelve months after the first specimens are delivered.

(f) The request shall require that the specimen be permanently marked with coded letters to identify the lot from which it was drawn and also with a number to uniquely identify that specimen from all others within the lot and that the specimens for each set shall be drawn at random from the lot. The specimen numbers for each set shall be retained in a permanent record.

(g) The request shall state that only quotations submitted before the end of February will be considered.

8.3.3.2 The coordinator shall then send copies of all quotations for specimens to participating machine owners. Each owner shall be requested to vote during April for a specimen supplier at each energy level. Each owner shall have one vote for each of the owner's machines that is to be qualified.

8.3.3.3 During May, the coordinator shall notify the supplier whose proposal received the most votes at an energy level to expect orders for specimens at that level. The coordinator shall notify all others who quoted that their proposal did not receive the most votes. In the case of a tie, the coordinator shall cast the deciding vote.

8.3.3.4 During May, the coordinator shall send a letter to each voter stating that a set of specimens for each candidate reference machine at each level shall be obtained by sending a purchase order to the chosen supplier(s). The letter shall also give a schedule for reporting the results of the tests and a blank form for recording the data and all other information required for the summary report.

8.3.4 Each owner shall test a set of specimens at each energy level and report the results on the forms furnished by the coordinator.

8.3.4.1 Before testing any specimen from the set, all specimens shall be inspected for dimensional accuracy. If any are found to be out of tolerance, the whole set shall be returned to the supplier with a note listing the defects. A replacement set shall be requested.

8.3.4.2 The testing procedure shall be in accordance with 9.1.

8.3.4.3 If a testing error involving more than two specimens is known to have occurred, a replacement set shall be ordered and tested. No substitution of specimens from outside the original set is permitted. If the testing error involved only one or two specimens, the original set of specimens need not be