



Standard Method of Test
for



Sampling Procedure for Impact Testing of Structural Steel

AASHTO DESIGNATION: T 243M/T 243-97¹
(ASTM DESIGNATION: A 673/A 673M-95)

1. SCOPE

1.1 This specification establishes the procedure for longitudinal Charpy V-notch testing of structural steel and contains two frequencies of testing. The impact properties of steel can vary within the same heat and piece, be it as rolled, control rolled or heat treated. The purchaser should, therefore, be aware that testing of one plate, bar, or shape does not provide assurance all plates, bars, or shapes of the same heat as processed will be identical in toughness with the product tested. Normalizing or quenching and tempering the product will reduce the degree of variation.

1.2 This specification is intended to supplement specifications for structural steel when so specified.

1.3 This specification does not necessarily apply to all product specifications; therefore, the manufacturer or processor should be consulted for energy absorption levels and minimum testing temperatures that can be expected or supplied.

1.4 Two frequencies of testing (P and H) are prescribed.

1.5 The values stated in either SI units or inch-pound units are to be regarded as standard. Within the text, the English units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

¹This text method is identical to ASTM A 673/A 673M-95 except for inch-pound units, rather than SI units, shown in brackets.

2. REFERENCED DOCUMENTS

- 2.1 *AASHTO Standards:*
- | | |
|---------|--------------------|
| M 160M/ | General Require- |
| M 160 | ments for |
| | Steel, Plates, |
| | Shapes, Sheet Pil- |
| | ing, and Bars for |
| | Structural Use |
| T 244 | Mechanical Testing |
| | of Steel Products |

3. ORDERING INFORMATION

3.1 The inquiry and order shall indicate the following:

3.1.1 The frequency of testing, (P) or (H).

3.1.2 The test temperature to be used.

3.1.3 The absorbed energy (J [ft-lbf]) requirements.

3.1.4 Condition of material: as rolled, stress relieved, normalized, normalized and stress relieved, or quenched and tempered.

4. TESTS

4.1 An impact test shall consist of three specimens taken from a single test coupon or test location, the average of which shall comply with the specified minimum with not more than one value below the specified minimum, but in no case below either two-thirds of the specified minimum or 7 J [5 ft-lbf], whichever is greater (see T 244).

4.2 The specimen for plates and bars shall be taken adjacent to the tension test specimen and the specimen for shapes shall be taken from the end of a shape at a point one-third the distance

from the outer edge of the flange or leg to the web or heel of the shape (see Figures 1 and 2). For plates produced from coils, three impact tests shall be taken from the product of each coil or qualifying coil (see Section 5). One test shall be taken adjacent to each of the tension tests (see M 160M/M 160) and a third test coupon shall be obtained immediately after the last plate produced to the qualifying specification.

4.2.1 The longitudinal axis of the specimen shall be parallel to the final direction of rolling of the plate or parallel to the major axis of the shape.

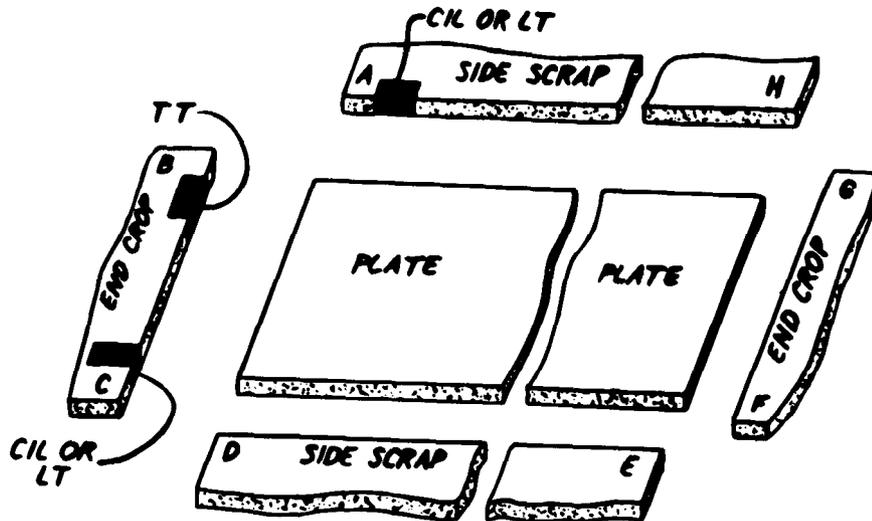
4.2.2 The center longitudinal axis of the specimen shall be located as near as practicable mid-way between the surface and the center of the material thickness and the length of the notch shall be perpendicular to the rolled surface of the material.

4.3 The impact energy values obtained on sub-size specimens shall not be less than shown in Table 1, which are proportional to energy values required for the full-size specimen.

4.4 The test temperature should be specified on the order. At the manufacturer's option, the actual test temperature may be lower than the specified test temperature. This accommodation does not change the required impact energy values unless there has been prior agreement between the purchaser and the manufacturer to do so. The actual test temperature shall be reported with the test results.

5. FREQUENCY OF TESTING

5.1 *Frequency (H) Heat Testing for Plates, Shapes, and Bars*—One impact test (a set of three specimens) shall be made for each 45 Mg [50 tons] of the same type of product subject to the re-



NOTE 1—LT (Longitudinal tensile test) For widths through 600 mm [24 in.], may be taken at any location, A through H.

NOTE 2—TT (Transverse tensile test) For widths over 600 mm [24 in.], may be taken at locations B, C, F, or G.

NOTE 3—CIL (Charpy impact longitudinal) May be taken at any location, A through H.

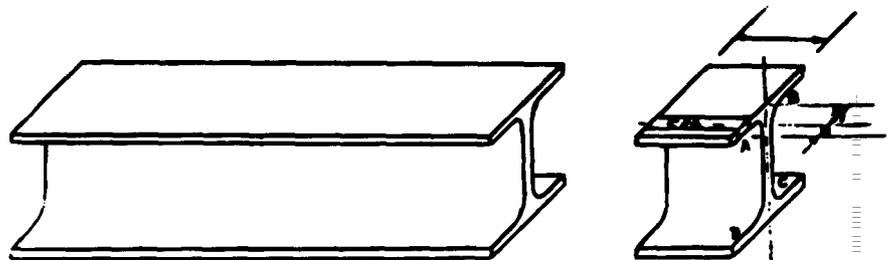
FIGURE 1 Plate Test Location

quirements of this specification produced on the same mill from the same heat of steel. The impact test(s) shall be taken from different as-rolled or heat-treated pieces. Impact specimens shall be selected from the thickest material rolled subject to the following modifications: When material rolled up to 50 mm [2 in.] inclusive in thickness differs 10 mm [$\frac{3}{8}$ in.] or more in thickness, one impact test shall be made from both the thickest and thinnest material rolled. When material rolled over 50 mm [2 in.] in thickness differs by more than 25 mm [1 in.] in thickness, one impact test or more shall be made from both the thickest and thinnest material rolled that is more than 50 mm [2 in.] in thickness. If insufficient pieces of the thickest or thinnest material are produced to permit compliance with the above, then testing may proceed to the next nearest thickness available. When plates are produced from coils, three impact tests shall be taken from each qualifying coil (see 4.2). One such coil shall be tested for 45 Mg [50 tons] of the same product produced on the same mill from the same heat of steel. When material from one heat differs 2 mm [$\frac{1}{16}$ in.] or more in thickness, tests shall be made from both the thickest and thinnest material rolled regardless of the number of coils represented.

5.2 Frequency (P) Piece Testing:

5.2.1 *Plates*—One Charpy V-Notch impact test (a set of three specimens) shall be made from each plate as-rolled except for material that has been heat treated by quenching and tempering, in which case specimens shall be selected from each heat-treated plate. When plates are produced from coils, three impact tests shall be taken from each coil.

5.2.2 *Shapes*—One Charpy V-notch impact test (a set of three specimens) shall be made from at least each 15 Mg [15 tons] or each single length of 15 Mg [15 tons] or more, of the same nominal shape size, excluding length, from each heat in the as-rolled condition. If the shapes are heat treated, one test shall be taken from each heat of each furnace lot.



NOTE 1—CIL = Charpy impact longitudinal.

NOTE 2—Test coupon for impact specimens may be taken from locations A, B, C, or D as shown laid out at location A.

FIGURE 2 Shape Test Location

For shapes heat treated in a continuous furnace, a lot shall not exceed 15 Mg [15 tons].

5.2.3 *Bars*—One Charpy V-notch impact test (a set of three specimens) shall be made for each 5 Mg [5 tons] of the same heat and same diameter or thickness if the material is furnished as rolled or is heat treated in a continuous-type furnace. For material heat treated in a non-continuous furnace, one test shall be taken from each heat of the same bar diameter or thickness for each furnace charge.

6. HEAT TREATMENT

6.1 The material shall be heat treated when specified on the purchase order.

6.2 When the plates are to be supplied in the as-rolled condition the manufacturer or processor (see M 160M/M 160) has the option to heat treat the plates by normalizing and stress relieving to meet the desired toughness properties.

6.3 When the fabricator elects to perform the required heat treatment or fabricates by hot forming instead of heat treating, the plates shall be accepted on the basis of tests made on full-thickness specimens heat treated in accordance with the purchaser's order requirements. If the heat treatment temperatures are not indicated on the purchase order, the manufacturer or processor shall heat treat the specimens under conditions considered appropriate for grain refinement and to meet the toughness requirements. The plate manufacturer or processor shall inform the purchaser of the procedure followed in treating the specimens.

TABLE 1 Equivalent Absorbed Energy for Various Specimen Sizes

Full Size, 10 by 10 mm		³ / ₄ Size, 10 by 7.5 mm		² / ₃ Size, 10 by 6.7 mm		¹ / ₂ Size, 10 by 5 mm		¹ / ₃ Size, 10 by 3.3 mm		¹ / ₄ Size, 10 by 2.5 mm	
J	[ft-lbf]	J	[ft-lbf]	J	[ft-lbf]	J	[ft-lbf]	J	[ft-lbf]	J	[ft-lbf]
54	[40]	41	[30]	37	[27]	27	[20]	18	[13]	14	[10]
48	[35]	35	[26]	31	[23]	24	[18]	16	[12]	12	[9]
41	[30]	30	[22]	27	[20]	20	[15]	14	[10]	11	[8]
34	[25]	26	[19]	23	[17]	16	[12]	11	[8]	8	[6]
27	[20]	20	[15]	18	[13]	14	[10]	10	[7]	7	[5]
22	[16]	16	[12]	15	[11]	11	[8]	7	[5]	5	[4]
20	[15]	15	[11]	14	[10]	11	[8]	7	[5]	5	[4]
18	[31]	14	[10]	12	[9]	8	[6]	5	[4]	4	[3]
16	[12]	12	[9]	11	[8]	8	[6]	5	[4]	4	[3]
14	[10]	11	[8]	10	[7]	7	[5]	4	[3]	3	[2]
10	[7]	7	[5]	7	[5]	5	[4]	3	[2]	3	[2]

7. RETESTS

7.1 If more than one value is below the specified minimum average, or if one specimen is below the greater of 7 J [5 ft-lbf] or two-thirds of the specified minimum, a retest of three additional specimens shall be made, each of which must have a value equal to or exceeding the specified minimum.

7.2 If the required energy values are not obtained upon retest, the material may at the option of the manufacturer or processor be heat treated in the case of as-rolled material or reheat treated in the case of heat-treated material.

7.3 After heat treatment or reheat treatment, a set of three specimens shall be tested and qualified in the same manner for the original material.

7.4 If the impact test fails for the thickest product tested when testing to Frequency (H) that material shall be rejected and the next thickest material tested to qualify the heat in accordance with 4.1. At the option of the manufacturer or processor retests may be made on the rejected material in which case each piece shall be accepted or rejected on the basis of the results of its own test.

8. TEST REPORTS

8.1 Test reports for each heat supplied are required when specified by the purchase order.

8.1.1 Test reports shall show the results of each test required by the specification. However, for (H) frequency, only one test need be reported when the amount of materials from shipment is less than 45 Mg [50 tons] or two tests when the amount of materials from a shipment is 45 Mg [50 tons] or more.

8.1.2 The thickness of the product tested may not necessarily be the same as an individual ordered thickness when (H) heat testing is ordered. Tests from materials thicknesses in accordance with 5.1 and encompassing the thicknesses in a shipment shall be sufficient for qualifying the material in the shipment. These test thicknesses may or may not be within previously tested and shipped thicknesses from the same heat.

8.1.3 For plates produced from coils, all three test results shall be reported for each qualifying coil. If only half or less of a coil is utilized, then only one test from the outer lap and one from the innermost portion shipped need be reported.

8.1.4 For plates produced from coils, both the manufacturer and processor shall be identified on the test report.

8.1.5 A signature is not required on the test report. However, the document shall clearly identify the organization submitting the report. Notwithstanding the absence of a signature, the organization submitting the report is responsible for the content of the report.

8.1.6 When finished material is supplied to a purchase order specifying T 243M/T 243, the organization supply-

ing that material shall provide the purchaser with a copy of the original manufacturer's test report.

9. KEYWORDS

9.1 Charpy V-notch; impact; sampling procedure; steel; structural steel; testing.

APPENDIX

(Nonmandatory Information)

XI. VARIATION IN CHARPY V-NOTCH TESTS

X1.1 A survey of the variation to be expected in Charpy V-notch test results obtained from three common fine grain plate steels was conducted by the American Iron and Steel Institute (AISI).² The results of the survey are contained in a Contributions to the Metallurgy of Steel entitled, "The Variations of Charpy V-Notch Impact Test Properties in Steel Plates," (SU/24), published January 1979. The survey data consists of test values obtained from six locations in addition to the locations shown in Figure 1 of this specification. The plate conditions tested involved as-rolled, normalized and quench and tempered. Sufficient full-size specimens were taken from each sample so that three longitudinal and three transverse specimens could be broken at three test temperatures defined for each grade. The data is presented in tables of probability that impact properties at other than the official location which may differ from those of the reported test location. Additional data of the same type, but utilizing samples from thicker plates, will be published by AISI as SU/27.

² Originally published by the American Iron and Steel Institute, 1133 15th St., N.W., Washington DC 20005. Available from ASTM Headquarters as PCN: 29-00039002.