National Institute of Standards and Technology
U.S. Department of Commerce

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Standard Reference Material® 2112
Dynamic Impact Force Verification Specimens

(Self-Verification, 8 mm Striker; 24 kN nominal)

Lot No.: HH-103

CERTIFICATE

Purpose: The certified values delivered by this Standard Reference Material (SRM) are intended primarily for the verification of the maximum force measured dynamically using a Charpy machine equipped with an instrumented 8 mm striker, in accordance with the current ASTM Standard E2298 [1] or the current ISO Standard 14556 [2].

Description: A unit of SRM 2112 consists of a set of four specimens needed to perform a single verification. SRM 2112 is made from 4340 alloy steel. The bars are finished to length, heat-treated, and machined in SRM specimen lots of approximately 1200 to 2000 specimens. Each specimen has a lot number and an identification number (three or four digits).

Certified Values: A NIST certified value, as used within the context of this certificate, is a value for which NIST has the highest confidence in its accuracy, in that all known or suspected sources of bias have been investigated or taken into account [3,4]. Traceability is to the International System of Units (SI) units of joule (J, absorbed energy) and kilonewton (kN, force). The certified values determined for the SRM 2112 specimens are given in Tables 1 and 2.

Table 1: Certified Absorbed Energy Values and Expanded Uncertainties for SRM 2112[(a)]

Test temperature: 21 °C ± 3 °C		Test temperature: –40 °C ± 1 °C	
Absorbed Energy (J)	Expanded Uncertainty (J)	Absorbed Energy (J)	Expanded Uncertainty (J)
105.3	0.6	97.5	0.6

[(a)] The uncertainties in the certified values provided are expanded uncertainties. The expanded uncertainty is calculated as $U = ku_c$, where u_c represents the combined uncertainty consistent with the JCGM Guide [5]. For 21 °C, the coverage factor, $k = 1.9944$, is based on 70 effective degrees of freedom and corresponds to an approximate 95 % confidence interval. For –40 °C, the coverage factor, $k = 1.9955$, is based on 68 effective degrees of freedom and corresponds to an approximate 95 % uncertainty interval.

Table 2: Certified Maximum Force Value and Expanded Uncertainty for SRM 2112[(a)]

Test temperature: 21 °C ± 3 °C	
Maximum Force (kN)	Expanded Uncertainty (kN)
24.06	0.70

[(a)] The uncertainty in the certified value provided is an expanded uncertainty. The expanded uncertainty is calculated as $U = ku_c$, where u_c represents the combined uncertainty consistent with the JCGM Guide [5]. The coverage factor, $k = 2.447$, is based on 6 effective degrees of freedom and corresponds to an approximate 95 % uncertainty interval.

John D. Perkins, Chief
Applied Chemicals and Materials Division

Steven J. Choquette, Director
Office of Reference Materials

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Period of Validity: The certified values and uncertainties furnished in this Certificate are valid indefinitely. The certified values are nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified. The indirect verification result for the absorbed energy scale is valid for one year from the date on which the SRM was tested. If a user's machine is moved or undergoes any major repairs or adjustments, the current verification will be invalidated, and the machine must be reverified.

Maintenance of Certified Values: NIST will monitor this SRM over the period of its validity. If substantive technical changes occur that affect the certification, NIST will issue an amended certificate through the NIST SRM website (https://www.nist.gov/srm) and notify registered users. SRM users can register online from a link available on the NIST SRM website or fill out the user registration form that is supplied with the SRM. Registration will facilitate notification. Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (https://www.nist.gov/srm).

Storage: SRM 2112 is anticipated to have an indefinite shelf life under normal storage conditions (20 °C ± 20 °C, ≤50 % relative humidity).

Use: The protective oil coating should be wiped from each specimen with a lint-free cloth just prior to testing. Prior to indirectly verifying a Charpy machine equipped with an 8 mm striker, the machine should be checked to ensure compliance with the appropriate sections of the applicable ASTM or ISO standard. SRM 2112 is typically tested at 21 °C ± 3 °C using an instrumented 8 mm striker, so that both the absorbed energy scale (at the high-energy level) and the force scale can be simultaneously verified in accordance with the applicable standard (ASTM or ISO). However, SRM 2112 can also be tested at –40 °C ± 1 °C using an 8 mm striker when no force data is needed (force information is not available at this temperature).

SRM 2112 can be used to meet the indirect verification requirements of ASTM E23 and ISO 148-2 [6,7]. When using SRM 2112, the user performs a self-service verification of the test machine. The test results and specimens/specimen pictures are not returned to NIST following the test. NIST provides no letter or certification sticker for the machine verified.

The energy level of the SRM appropriate for verifying the performance of a particular Charpy machine can be determined by considering the energy for the SRM, the maximum capacity of the machine, and the requirements of the applicable test method (ASTM or ISO).

Currently, there are no requirements for the verification of the force scale in ASTM or ISO test methods. However, it is recommended to verify the calibration of the instrumented striker every time the striker undergoes repairs or adjustments, or damage is suspected, and every time the impact machine is indirectly verified for absorbed energy.

SRM Certification Procedure: Specimens from SRM 2112 were certified by the NIST Applied Chemicals and Materials Division on Charpy reference machines for absorbed energy, and via an interlaboratory comparison (round-robin) [8] for maximum force. These data were statistically evaluated to ensure the homogeneity of the lot, establish certified values, and determine the number of SRM specimens required for a user to perform a valid verification. The measurands are absorbed energy as measured by the NIST Charpy reference machines, and maximum force as established from the interlaboratory comparison.

For questions concerning the production or use of this SRM please contact the NIST Charpy Program Coordinator as follows: telephone (303) 497-3351; fax (303) 497-5939; or e-mail charpy@nist.gov.

REFERENCES

[1] ASTM E2298; *Test Method for Instrumented Impact Testing of Metallic Materials*; Annual Book of ASTM Standards, Vol. 03.01; ASTM: West Conshohocken, PA.

[2] ISO 14556; *Metallic Materials – Charpy V-notch Pendulum Impact Test – Instrumented Test Method*; International Organization for Standardization: Geneva, Switzerland.

[3] JCGM 200:2012; *International Vocabulary of Metrology — Basic and General Concepts and Associated Terms*; 3rd ed.; JCGM (2012); available at https://www.bipm.org/en/committees/jc/jcgm/publications (accessed Jun 2023).

[4] Beauchamp, C.R.; Camara, J.E.; Carney, J.; Choquette, S.J.; Cole, K.D.; DeRose, P.C.; Duewer, D.L.; Epstein, M.S.; Kline, M.C.; Lippa, K.A.; Lucon, E.; Molloy, J.; Nelson, M.A.; Phinney, K.W.; Polakoski, M.; Possolo, A.; Sander, L.C.; Schiel, J.E.; Sharpless, K.E.; Toman, B.; Winchester, M.R.; Windover, D.; *Metrological Tools for the Reference Materials and Reference Instruments of the NIST Material Measurement Laboratory*; NIST Special Publication (NIST SP) 260-136, 2021 edition; U.S. Government Printing Office:

Washington, DC (2021); available at https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-136-2021.pdf (accessed Jun 2023).
[5] JCGM 100:2008; *Evaluation of Measurement Data — Guide to the Expression of Uncertainty in Measurement* (GUM 1995 with Minor Corrections); Joint Committee for Guides in Metrology (2008); available at https://www.bipm.org/en/committees/jc/jcgm/publications (accessed Jun 2023); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at https://www.nist.gov/pml/nist-technical-note-1297 (accessed Jun 2023).
[6] ASTM E23; *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*; Annual Book of ASTM Standards, Vol. 03.01; ASTM: West Conshohocken, PA.
[7] ISO 148-2; *Metallic Materials – Charpy Pendulum Impact Test – Part 2: Verification of Testing Machines*; International Organization for Standardization: Geneva, Switzerland.
[8] McCowan, C.N.; Splett, J.D.; Lucon, E.; *Dynamic Force Measurement: Instrumented Charpy Impact Testing*; NISTIR 6652; National Institute of Standards and Technology, U.S. Department of Commerce: Gaithersburg, MD (2008); available at https://ws680.nist.gov/publication/get_pdf.cfm?pub_id=50616 (accessed Jun 2023).

Certificate Revision History: 09 June 2023 (Editorial changes); 02 December 2021 (Updated format; editorial changes); 17 January 2018 (Title update; editorial changes); 09 December 2011 (Original certificate issue date).

Certain commercial equipment, instruments, or materials may be identified in this Certificate to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Users of this SRM should ensure that the Certificate in their possession is current. This can be accomplished by contacting the Office of Reference Materials 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300; telephone (301) 975-2200; e-mail srminfo@nist.gov; or the Internet at https://www.nist.gov/srm.

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