



# National Institute of Standards & Technology

## Certificate

### Standard Reference Material<sup>®</sup> 2113

#### Dynamic Impact Force Verification Specimens

(Self-Verification, 8-mm Striker; 33 kN nominal)

Lot No.: LL-103

This Standard Reference Material (SRM) is 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]. A unit of SRM 2113 consists of a set of four specimens needed to perform a single verification. SRM 2113 can also be used to verify the absorbed energy scale of the impact machine at the low-energy level. When testing is performed at room temperature, the force and absorbed energy scales can be verified simultaneously. This SRM can also be used to verify the absorbed energy scale at a test temperature of  $-40^{\circ}\text{C}$ , but no force information is available at this temperature.

**Material Description:** SRM 2113 is made from 4340 alloy steel. The bars are finished to length, stamped, 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).

**SRM Certification Procedure:** Specimens taken from each SRM lot were tested by the NIST Applied Chemicals and Materials Division on Charpy reference machines for absorbed energy, and via an interlaboratory comparison (round robin) [3] for maximum force. These data were statistically evaluated to ensure the homogeneity of the lot, establish certified value, and determine the number of SRM specimens required for a user to perform a valid verification. A NIST certified value 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 [4]. The measurand is absorbed energy as measured by the NIST Charpy reference machines, and maximum force as established from the interlaboratory comparison. Traceability is to the SI units joule (absorbed energy) and kilonewton (force). The certified values for the SRM 2113 specimens are given in Tables 1 and 2.

**Expiration of Certification:** The certified values and uncertainties furnished in this certificate are valid indefinitely. 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 retested and reverified (see "Instructions for Handling, Storage, and Use"). Currently, there are no requirements for the verification of the force scale. However, it is recommended to verify the calibration of the instrumented striker of the small-scale Charpy machine every time the striker undergoes repairs or adjustment, or damage is suspected, and every time the impact machine is indirectly verified for absorbed energy.

**Maintenance of SRM Certification:** NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Overall direction and coordination of the technical measurements leading to verification of test specimens and machines are under the direction of the NIST Materials Reliability Division, Boulder, CO.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

James Fekete, Chief  
Applied Chemicals and Materials Division

Gaithersburg, MD 20899  
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*Certificate Revision History on Last Page*

Steven J. Choquette, Director  
Office of Reference Materials

Table 1. Certified Absorbed Energy Values and Expanded Uncertainty for SRM 2113<sup>(a)</sup>

Room temperature (21 °C ± 1 °C)		Room temperature (-40 °C ± 1 °C)	
Absorbed Energy (J)	Expanded Uncertainty (J)	Maximum Force (kN)	Expanded Uncertainty (kN)
18.2	0.1	15.3	0.1

<sup>(a)</sup> The uncertainties in the certified values provided are expanded uncertainties about the means to cover the measurands. The expanded uncertainty is calculated as  $U = ku_c$ , where  $u_c$  represents the combined uncertainty consistent with the ISO/JCGM Guide [5]. For room temperature, the coverage factor  $k = 1.9939$  is based on 71 effective degrees of freedom and corresponds to an approximate 95 % confidence interval. For -40 °C, the coverage factor  $k = 1.9944$  is based on 70 effective degrees of freedom and corresponds to an approximate 95 % confidence interval.

Table 2: Certified Maximum Force Values and Expanded Uncertainty for SRM 2113<sup>(a)</sup>

Room temperature (21 °C ± 1 °C)	
Maximum Force (kN)	Expanded Uncertainty (kN)
33.00	1.86

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

## INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

**Handling:** The protective oil coating should be wiped from each specimen with a lint-free cloth just prior to testing.

**Storage:** The SRMs are anticipated to have an indefinite shelf life under normal storage conditions (20 °C ± 20 °C, ≤ 50 % relative humidity).

**Use:** Prior to 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 2113 is typically tested at room temperature (21 °C ± 1 °C) using an instrumented 8-mm striker, so that both the absorbed energy scale and the force scale can be verified in accordance with the applicable standard (ASTM or ISO). However, SRM 2113 can also be tested at -40 °C ± 1 °C using an 8-mm striker when no force data is needed.

SRM 2113 can be used to meet the indirect verification requirements of ASTM E23 and ISO 148-2 [6,7]. When using SRM 2113, the user performs a self-service verification of the test machine. The data and specimens **are not** returned to NIST following the test. NIST provides **no** letter or certification sticker for the machine tested.

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).

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@boulder.nist.gov](mailto:charpy@boulder.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; *Steel - Charpy V-notch Pendulum Impact Test - Instrumented Test Method*; International Organization for Standardization: Geneva, Switzerland.
- [3] 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](https://ws680.nist.gov/publication/get_pdf.cfm?pub_id=50616) (accessed Oct 2018)
- [4] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definition of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136; U.S. Government Printing Office: Washington, DC (2000); available at <https://www.nist.gov/srm/upload/SP260-136.PDF> (accessed Oct 2018).
- [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 (JCGM) (2008); available at [https://www.bipm.org/utls/common/documents/jcgm/JCGM\\_100\\_2008\\_E.pdf](https://www.bipm.org/utls/common/documents/jcgm/JCGM_100_2008_E.pdf) (accessed Oct 2018); 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/sites/default/files/documents/2017/05/09/tn1297s.pdf> (accessed Oct 2018).
- [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.

<b>Certificate Revision History:</b> 16 October 2018 (Editorial changes); 17 January 2018 (Title update; editorial changes); 09 December 2011 (Original certificate issue date).
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*Users of this SRM should ensure that the Certificate in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <https://www.nist.gov/srm>.*