



# National Institute of Standards & Technology

## Certificate

### Standard Reference Materials<sup>®</sup>

2092 - Low-Energy

2096 - High-Energy

2098 - Super High-Energy

Verification Specimens for Charpy V-Notch Impact Machines

Lot No.:

Standard Reference Materials (SRMs) 2092, 2096, and 2098 are intended primarily for the verification of Charpy V-Notch machines in accordance with the current ASTM Standard E 23 [1]. Each SRM consists of a set of individual 10 mm x 10 mm x 55 mm specimens needed to perform one verification. These SRMs comply with both ASTM Standard E 23 and International Organization for Standardization ISO/DIS 12736 dimensional requirements [2].

**Material Description:** SRMs 2092 and 2096 are made from 4340 alloy steel. SRM 2098 is made from a high strength maraging steel. The bars are finished to length, stamped, heat-treated, and machined in SRM specimen lots of approximately 1200. Each specimen has a lot number and an identification number (three or four digits) stamped on one end of the specimen. Additional information can be found in References [3-5].

**SRM Certification Procedure:** Specimens taken at random from each SRM lot are tested by the NIST Materials Reliability Division on Charpy V-Notch reference machines. The specimen data generated are then statistically evaluated to assure the homogeneity of the lot, establish the certified value, and determine the number of SRM specimens required for a user to perform a valid test. See Table 1 for a list of the approximate energy ranges within which the individual certified values should fall.

If certified values are required immediately after testing, contact the NIST Charpy Program Coordinator as follows: telephone (303) 497-3351; fax (303) 497-5939; or e-mail [daniel.vigliotti@nist.gov](mailto:daniel.vigliotti@nist.gov). The lot number and energy results of the tested specimens must be provided in order to obtain certified values by telephone or fax.

**Expiration of Verification:** The verification report issued on an acceptable machine is valid for one year from the date that 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.

The overall direction and coordination of the technical measurements leading to verification of test specimens and machines, evaluation of test results, and issuance of the report on machine conformance are under the direction of the NIST Materials Reliability Division, Boulder, CO.

The support aspects involved in the preparation, certification, and issuance of these SRMs were coordinated through the NIST Standard Reference Materials Program by R.J. Gettings.

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Gaithersburg, MD 20899  
Certificate Issue Date: 09 August 2000  
*See Certificate Revision History on Last Page*

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Standard Reference Materials Program

**NOTE: THESE ARE NOT CERTIFIED VALUES. THESE ARE THE APPROXIMATE RANGES FOR EACH ENERGY LEVEL.**

Table 1. Approximate Charpy SRM Energy Ranges

SRM No.	(J)	(ft·lbf)
2092	13 - 20	10 - 15
2096	88 - 136	65 - 100
2098	176 - 244	130 - 180

**Storage:** The SRMs are comprised of specimens anticipated to have an indefinite shelf life under normal storage conditions. Each specimen is coated with oil, wrapped in a corrosion inhibiting paper, and sealed in a plastic envelope. It is recommended that the specimen be retained in this package to protect them from moisture until used. The protective oil coating should be wiped from each specimen just prior to testing.

**Use:** Prior to testing a Charpy V-Notch machine, the machine should be checked to assure compliance with the appropriate sections of the current ASTM Standard E 23 [1]. To comply with the testing procedures specified in the standard, SRM 2092 and SRM 2096 shall be tested at  $-40\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F} \pm 2\text{ }^{\circ}\text{F}$ ). SRM 2098 shall be tested at  $21\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  ( $70\text{ }^{\circ}\text{F} \pm 2\text{ }^{\circ}\text{F}$ ). All SRM specimens are to be tested in accordance with the testing procedures of the appropriate sections of the current ASTM Standard E 23. All SRMs shall be tested at the same time. An acceptable machine will produce an average value within 1.4 J (1.0 ft·lbf) or 5 % of the certified energy value, whichever is greater, providing the specimens appear to have normal markings. Because the source(s) and magnitude of error for energy values at one energy level may not be the same at different energy levels, calibration or correction curves shall not be used.

**Verification of User's Machine:** The NIST Charpy Program Coordinator will issue a report of findings to the user's facility upon receipt of the fractured specimens and completed questionnaire. If the machine to be verified produces acceptable values and the specimens appear to have normal markings, this report will verify its conformance. If the machine produces values outside the allowable tolerance of the certified energy values or the specimens have abnormal markings, the report may suggest repair or replacement of machine parts, changes in testing techniques, or other appropriate corrective actions. Fractured specimens and completed questionnaires should be returned to the NIST Charpy Program Coordinator, Mail Code 853.07, 325 Broadway, Boulder, CO 80305-3328. A plastic, self-locking bag is provided for the return of broken specimens. The broken specimens shall be taped together as described in the wrapping instructions included with the questionnaire.

**Important Information:** Shipping charges for the return of broken specimens are the responsibility of the user. The mailing label provided with each SRM must be used to expedite shipping and, for overseas shipments, clearance by U.S. Customs.

**Note to International Customers:** Regular overseas shipments of broken specimens should be sent airmail so that after they are cleared by U.S. Customs, they can be forwarded directly to NIST-Boulder. If a more rapid shipping mode is necessary, choose an overnight delivery service that will handle U.S. Customs clearance **AND** will deliver directly to NIST-Boulder. Unless such delivery is assured, air freight packages may be returned to the customer by U.S. Customs.

## REFERENCES

- [1] ASTM E 23, Standard Test Methods for Notched Bar Impact Testing of Metallic Materials, Annual Book of ASTM Standards, **03.01**, ASTM, West Conshohocken, PA.
- [2] ISO/DIS 12736, Metallic Materials - Impact Testing - Preparation and Characterization of Charpy V Reference Test Pieces for Verification of Pendulum Impact Testing Machines, ISO, Geneva, Switzerland.
- [3] Siewert, T.A. and Schmieder, A.K., "Pendulum Impact Machines: Procedures and Specimens for Verification," ASTM STP 1248, ASTM, West Conshohocken, PA, (1995).
- [4] Shepherd, D.A. and Siewert, T.A., "Interlaboratory Test Study for the Determination of Precision and Bias in Charpy V-Notch Impact Testing," ASTM Research Report E 28-1014, ASTM, Philadelphia, PA, (1991).
- [5] Holt, J.M., "Charpy Impact Test - Factors and Variables," ASTM STP 1072, ASTM, Philadelphia, PA, (1990).

**Certificate Revision History:** 09 August 2000 (updated mail and zip codes for Boulder facility); 22 March 2000 (editorial revision); 26 July 99 (editorial revision); 20 February 97 (original certificate date).

*Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet <http://www.nist.gov/srm>.*

## QUESTIONNAIRE FOR CHARPY IMPACT MACHINE VERIFICATION

**IMPORTANT:** This questionnaire contains information to help you perform a successful verification test. Energy results are required for verification. Other specific information is requested to help evaluate the condition of your machine. The questionnaire and the fractured specimens should be shipped to the Charpy Program Coordinator, NIST, Division 853, 325 Broadway, Boulder, CO 80305-3328. Telephone: (303) 497-3351 Fax: (303) 497-5939.

### Location of Machine

Company \_\_\_\_\_

Address \_\_\_\_\_

State or \_\_\_\_\_

City \_\_\_\_\_ Province \_\_\_\_\_

Zip or \_\_\_\_\_

Country \_\_\_\_\_ Postal Code \_\_\_\_\_

### Mailing Address for Verification Letter (if different from above)

Company \_\_\_\_\_

Address \_\_\_\_\_

State or \_\_\_\_\_

City \_\_\_\_\_ Province \_\_\_\_\_

Zip or \_\_\_\_\_

Country \_\_\_\_\_ Postal Code \_\_\_\_\_

### Test Machine (Circle appropriate units where indicated)

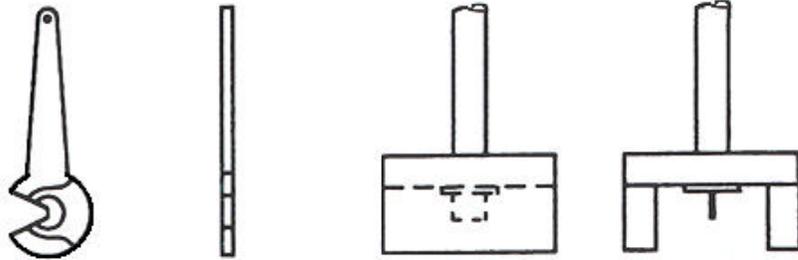
1. Machine manufacturer and serial number \_\_\_\_\_
2. What is the maximum energy capacity of the machine? \_\_\_\_\_ Joules or ft-lbf
3. If the machine is adjustable, what capacity was used for this test? \_\_\_\_\_ Joules or ft-lbf
4. The machine should be securely bolted to a concrete foundation or a steel block having a mass not less than 40 times that of the pendulum. Also, according to ASTM Standard E23, the machine should be level.
  - (a) What types of bolts are used to mount the machine? (i.e., J, lag, etc.) \_\_\_\_\_
  - (b) Is the machine level in accordance with ASTM Standard E 23?       Yes     No
5. Is your machine equipped with a carbide striker?       Yes     No
6. Is your machine equipped with carbide anvils?       Yes     No

7. Check the appropriate pendulum design below.

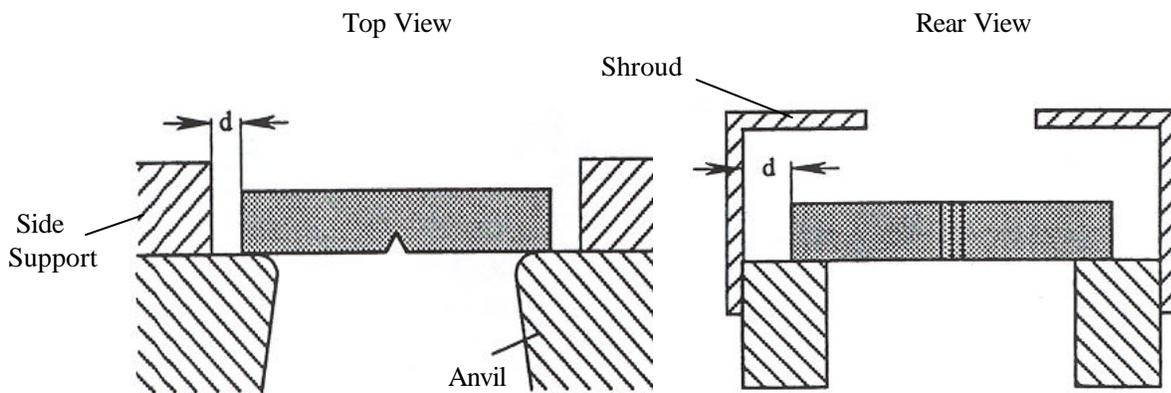
(A) \_\_\_\_\_

(B) \_\_\_\_\_

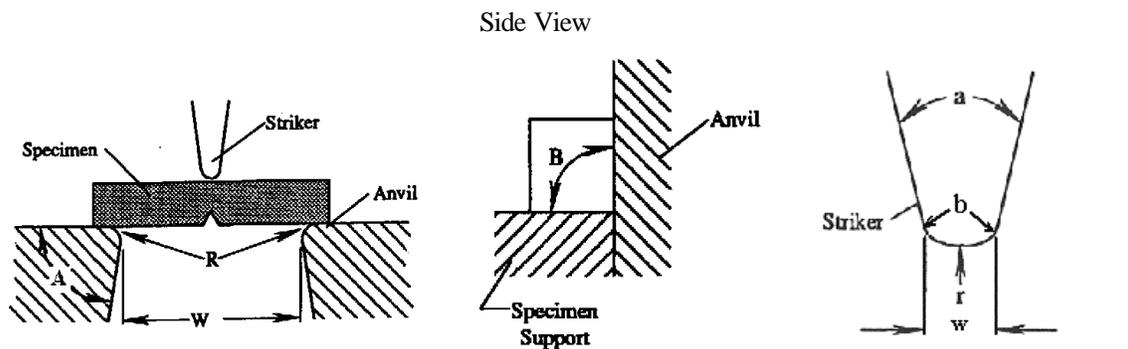
(C) Sketch below \_\_\_\_\_



8. If side supports or shrouds are used, what is dimension "d"? \_\_\_\_\_ mm or inches



9. Your anvils and striker should conform to the dimensions below:



**Anvils**

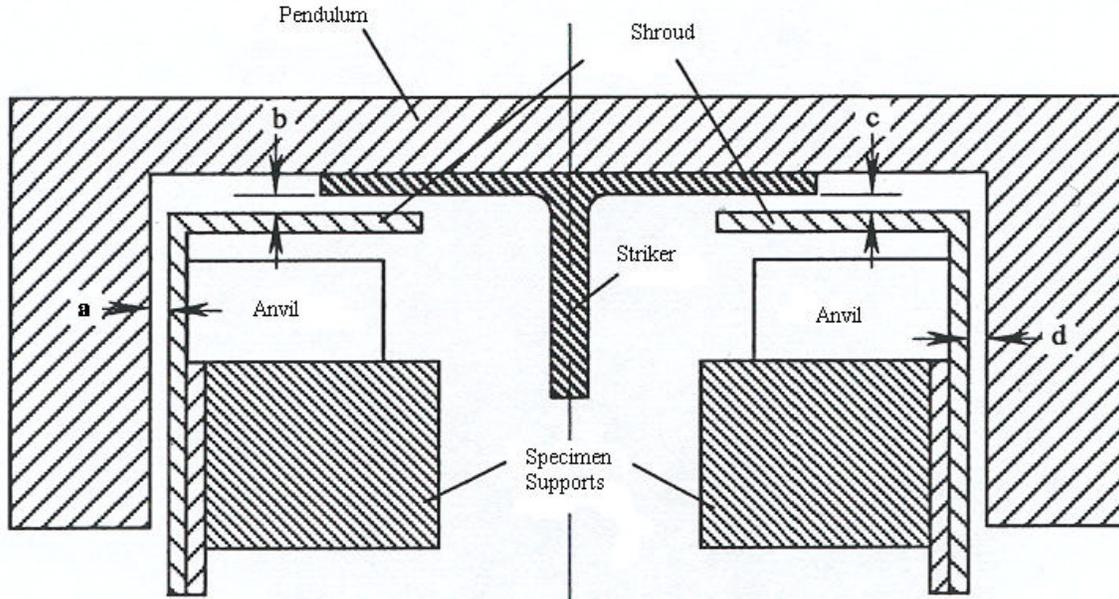
- A: 80° approx.
- R: 1 mm ± 0.05 mm  
(0.039 mm ± 0.002 in)
- W: 40 mm ± 0.05 mm  
(1.574 in ± 0.002 in)
- B: 90° ± 10 minutes

**Striker**

- a: 30° approx.
- r: 8 mm ± 0.25 mm  
(0.315 in ± 0.010 in)
- w: 4 mm approx.  
(0.157 in)
- b: 0.25 mm  
(0.010 in)

10. If shrouds are used to contain broken specimens, the following requirements should apply:

- (A) The shrouds should have a minimum hardness of 45 HRC.
- (B) The thickness of the shrouds should be approximately 1.5 mm (0.06 in).
- (C) Dimensions a, b, c, and d below should not exceed 1.5 mm (0.06 in).
- (D) If dimension “d” in item 8 is more than 13 mm (0.5 in), requirements (B) and (C) above do not apply.



11. The striker should pass through the center of the anvils within 0.40 mm (0.016 in).

12. With the pendulum in the free hanging position, engage the energy indicator. The indicator should read within 0.2 % of the maximum energy range being used.

13. What is the friction/windage loss of your machine? \_\_\_\_\_ Joules or ft-lbf

- (A) Raise the pendulum to the latched position. Without a specimen in the machine, release the pendulum and permit it to swing 11 half cycles; after the pendulum starts its 11th half cycle, align the pointer between 5 % to 10 % of scale range capacity and record the dial reading.
- (B) Divide the value by 11, then divide by the maximum scale range of the machine and multiply by 100. This is the friction/windage loss of your machine. Record the result above; it should not exceed 0.4 %.

14. With the specimen removed from the machine and the pendulum released from its latched position, what is the dial reading after one swing? \_\_\_\_\_ Joules or ft-lbf

This reading should be zero. If this reading is **NOT** zero and your machine is equipped with a compensated scale, please adjust the dial to read zero. If your machine is equipped with a non-compensated scale, please compensate the energy values for windage and friction by subtracting the friction/windage loss calculated in item 10.

**15. When was this machine last verified by the NIST? Date:**

16. Is your machine equipped with a direct reading scale or a non-compensated scale?

\_\_\_\_\_

## IMPORTANT INFORMATION

The following procedures should be followed closely to obtain accurate results. The test temperature is near the ductile-brittle transition temperature of the steel for the NIST reference specimens. Therefore, small variances in temperature and procedure may cause considerable error in energy values.

- The cooling bath should be placed directly beside the machine. This enables the operator to remove specimens from the bath and fracture them in the machine quickly.
- It is very important that the specimens be removed from the bath and fractured in less than 5 seconds. Taking longer than 5 seconds can increase the energy values, which may cause the low energy specimens to exceed the allowable energy limit.
- If your machine is equipped with a centering device, it is **NOT** recommended that you use it to center specimens when performing low temperature testing. Instead, the use of centering tongs as described in the current ASTM Standard E 23 is recommended. The centering tongs should be cooled with the specimens.
- Verify temperature-measuring equipment at least twice annually. Checking a medium with a constant temperature such as dry ice [-78.6 °C (-109.3 °F)] or ice water [0.0 °C (32.0 °F)] can be used to check the measurement equipment immediately before the test.
- The anvils should be checked between each test for material left by the previous test when testing super-high energy level specimens or other ductile materials.
- It is recommended that practice specimens be broken before NIST specimens are tested when the anvils are replaced.

## TESTING TECHNIQUE

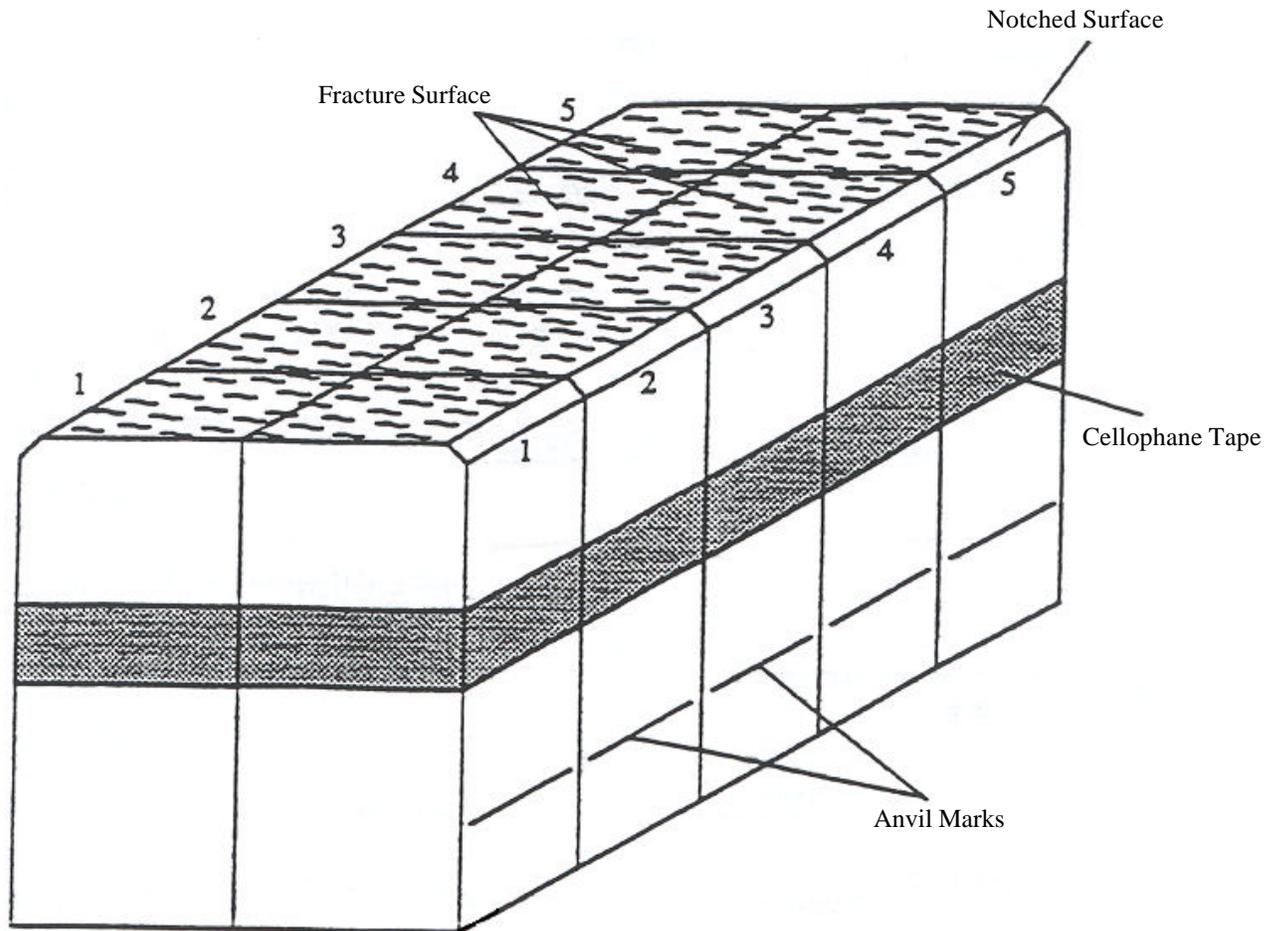
1. Test temperature for SRM 2092 low energy and SRM 2096 high energy level specimens should be  $-40\text{ °C} \pm 1\text{ °C}$  ( $-40\text{ °F} \pm 2\text{ °F}$ ).
2. Test temperature for SRM 2098 super-high energy level specimens should be  $21\text{ °C} \pm 1\text{ °C}$  ( $70\text{ °F} \pm 2\text{ °F}$ ).
3. How long were the specimens held at temperature? (NIST recommends a minimum of 10 minutes.)
4. What instrument was used to remove the specimens from the bath and center them in the machine?

## STATE REASON FOR VERIFICATION

1. Compliance with annual ASTM Standard E 23 Indirect Verification \_\_\_\_\_
2. Changed striker and/or anvils \_\_\_\_\_
3. Moved machine \_\_\_\_\_
4. Changed bearings or pendulum \_\_\_\_\_

## WRAPPING INSTRUCTIONS

To expedite the evaluation of your machine, please secure the broken specimens (all halves) from a particular energy series, as one unit with **clear cellophane tape** according to the following instructions. See diagram below.



1. Keep broken halves correctly paired (back to back) with the fracture surfaces facing upward and notched surfaces facing outward.
2. Coat the **FRACTURE SURFACES ONLY** with a light coat of oil. **DO NOT** use grease or coat in plastic.
3. Include this completed questionnaire with the fractured specimens.
4. Be sure that you use the **MAILING LABEL** provided with the specimens and attach the label so that it is clearly displayed on the **OUTSIDE** of the package. This will expedite delivery to the Charpy Program Coordinator. Customers returning specimens from outside the United States should include the following statement on the U.S. Customs Declaration:  
**Contents include U.S. manufactured steel test bars being returned to the U.S. for evaluation and are valued at less than 10 U.S. dollars.**

