

# National Bureau of Standards Certificate

## Standard Reference Material 1855 Ultrasonic Power Transducer Standard

Serial No.

This Standard Reference Material (SRM) consists of a multifrequency ultrasonic transducer and a special electrical impedance-matching unit.<sup>1</sup> When operated in combination with user-provided equipment described herein, this SRM serves any application requiring the generation of accurately-known levels of continuous-wave ultrasonic power radiated into a reflectionless water load. A principal application is the point-by-point calibration of apparatus used to measure ultrasonic power. Other applications include the testing and calibration of hydrophones used to probe ultrasonic fields.

The transducer will generate the amount of ultrasonic power listed for each operating frequency when the level of radio frequency energy applied to the input terminals of the impedance-matching network has been adjusted so that the corresponding listed value of dc voltage is measured at the designated terminals of the network.

<u>Operating Frequency (MHz)</u>	<u>Power Output (mW)</u>	<u>Output at "Voltmeter" Connector (Volts dc)</u>
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The certification of this SRM is valid only if it is used as specified in the Operating Conditions for Proper Usage. It is certified that values of output power actually reproduced will differ from the stated values by an amount not greater than 3% of the stated values of power, for operating frequencies below 6 MHz. The uncertainty as just defined is 7% for operating frequencies between 6 MHz and 16 MHz, and is 12% for operating frequencies between 16 MHz and 21 MHz. Certification is voided by the alteration of or the occurrence of any damage to this SRM. Damage will be highly unlikely if the detailed instructions furnished with this SRM are followed.

The technical work leading to the development of SRM 1855 was performed in the Ultrasonic Standards Group of the NBS Mechanical Production Metrology Division by S.E. Fick, F.R. Breckenridge, Carl E. Tschiegg, and D.G. Eitzen.

The overall direction of the technical efforts was performed by D.G. Eitzen.

The support for the production and certification of this SRM was coordinated through the Office of Standard Reference Materials by L.J. Kieffer and R.L. McKenzie.

Gaithersburg, MD 20899  
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Stanley D. Rasberry, Chief  
Office of Standard Reference Materials

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## OPERATING CONDITIONS FOR PROPER USAGE

Detailed instructions for the use and operation of this SRM are provided in the instruction pamphlet supplied with each unit. The successful use of SRM 1855 to reproduce calibrated levels of ultrasonic power is unavoidably contingent upon certain of its operating conditions. The conditions under which the uncertainty estimates and calibration are valid are:

1. Operation of the transducer into a reflectionless water load.
2. Use of single-frequency continuous-wave (100% duty factor) rf excitation.
3. Verification that any and all spurious components of rf excitation voltage are at least 60 dB below level at fundamental frequency.
4. Verification that leakage resistance of the cable used to interconnect matching network and transducer or auxiliary matching unit is not less than 15,000 megohms.
5. Use, at matching network voltmeter connection, of a dc voltmeter with accuracy of 0.1% and input resistance of  $10.00 \pm 0.01$  megohms.
6. Use of rf excitation equipment incapable under any circumstances, including worst-case conditions of self-oscillation, of delivering more than four watts, measured instantaneously, into a 50 ohm resistive load.

The accuracy of the calibration data provided with SRM 1855 is certified only under conditions of operation which meet all of the listed conditions. Failure to satisfy condition 6 may result in irreparable damage to the transducer. Certification is voided by any occurrence of damage by any cause.

### General Information

Testing of prototype units has indicated that the long-term drift, if any, in the calibration of this SRM is insignificant compared to the uncertainties associated with a single measurement of ultrasonic power by any method available at NBS. In some circumstances the need for independent verification of the long-term stability of ultrasonic power-measuring equipment in the field may best be served by periodic recalibration of this SRM by NBS.

The transducer of this SRM is a cylindrical assembly 30 mm in diameter and 115 mm long. Ultrasonic output is taken from the circular active area, 15.9 mm in diameter, of a disc-shaped piezoelectric element which constitutes an end face of the transducer. The piezoelectric element is air-backed, and is made of lithium niobate in the 36 degree Y cut. The transducer and its matching network were calibrated using the NBS ultrasonic force balance facility.

### References

1. An Ultrasonic Absolute Power Transfer Standard, Fick, S.E., Breckenridge, F.R., Tschiegg, C.E., and Eitzen, D.G., NBS J. Res. 89, No. 2, 1984.
2. Ultrasonic Transducer Power Output by Modulated Radiation Pressure, J. Acoust. Soc. Am., 63, No. 4, 1978.