

Thermal Conductivity Suite

Guidance Document

NIST Study 500102

The materials being provided are NIST Research-Grade Test Materials (RGTM)s. These materials are not a NIST Standard Reference Material® or a NIST Reference Material. NIST RGTMs are described in the latest edition of NIST Special Publication 260-136.

Purpose: NIST Research-Grade Test Materials (RGTM)s 10258, 10259, 10260, 10261, and 10262 are provided on a collaborative basis for recipients to contribute thermal property data for Interlaboratory Study 500102. The Interlaboratory Study will provide insights into measurement consensus, assess the agreement between different thermal measurement techniques, and evaluate the potential fitness of purpose as reference materials. Ultimately, Study 500102 will inform the future development of thermal conductivity reference materials, enabling the reliable interlaboratory comparison of data and accelerating the commercialization of materials and devices that rely on critical thermal property measurements.

Description: A unit of 500102 consists of five RGTMs, as follows:

- 10258: Fused Silica (approximately 10 mm x 10 mm x 1 mm in size).
- 10259: Quartz (approximately 10 mm x 10 mm x 1 mm in size).
- 10260: Sapphire (approximately 10 mm x 10 mm x 1 mm in size).
- 10261: Silicon (approximately 10 mm x 10 mm x 1 mm in size).
- 10262: Silicon Carbide (approximately 10 mm x 10 mm x 0.5 mm in size).

These materials were selected based on property values, homogeneity, commercial availability, and relevance for the semiconductor microelectronics industry.

Period of Use: The recipient may use Study 500102 RGTMs from receipt until the nominal expiration date, 01 April 2027.

Reporting of Results: Data shall be uploaded no later than 30 September 2026 to be included in the Interlaboratory Study. Contributed data shall be submitted through the Online Data Submission Portal as outlined in the Thermal Conductivity Suite Data Submission Guide, both available at:
<https://www.nist.gov/programs-projects/transport-property-measurements-semiconductors-and-energy-materials/thermal-0>

Note: The recipient will navigate to the linked website and complete the Data Collection Form; the recipient will be guided to specific metadata questions based on the indicated measurement technique. Contributed data and Form responses will be anonymized. Only data authorized for publication and/or public release shall be submitted. Separate Form submissions will be initiated for each measurement technique used. After submitting the Data Collection Form, a collaborative Box folder (to upload your data) will automatically be created and linked to the Form responses. Supplemental files, including fitting parameters, modeling approaches, sensitivity analyses, plots, and additional instrumentation metadata (instrumentation components, photographs, and related publications), may also be uploaded.

Safety: Refer to the Safety Data Sheet Exemption Letter.

Storage: The RGTMs may be stored at ambient temperature in the container provided or, after the application of transducers or measurement probes, in the recipient's preferred container.

NIST Technical Contact(s): Joshua Martin, joshua.martin@nist.gov, 301-975-3681

Instructions for Use: The recipient is recommended to clean and prepare the RGTM's using their conventional procedures. The recipient is recommended to conduct thermal conductivity (and/or additional thermal property) measurements using their conventional protocols, thermal modeling, and uncertainty analysis. For single-sided measurements, it is recommended to use the surface marked with the serialization number in the bottom left corner.

NIST Additional Information: The RGTM geometries were selected using the results from a thermal community survey, thermal measurement vendor instrument specifications, and discussions with technical experts. Every effort was made to achieve maximum compatibility with the diversity of both commercially available and custom-made measurement instrumentation, methodologies, and sample requirements. Each RGTM wafer measuring approximately 150 mm was diced into 10 mm x 10 mm sections using a uniform serialization pattern, with each square assigned a unique serial number comprising the RGTM number, the wafer number, and the spot location number. The spot numbers were hand-scribed onto the bottom left corners to enable identification. Each RGTM was removed from the dicing tape and individually cleaned in the NIST Nanofab class 100 cleanroom to remove protective photoresist film and dicing debris using the following procedure: acetone rinse, approximately 10 min. acetone soak, acetone rinse, approximately 10 min. isopropyl alcohol (IPA) soak, IPA rinse, deionized water rinse, and nitrogen blowdown evaporation. The RGTM's were then individually packaged into labeled hydroentangled polyester optical pouches. This cleaning procedure was for packaging purposes only and shall not substitute the recipient's conventional sample preparation procedures.

Selected RGTM Properties.

RGTM	Material	Material Grade	Orientation	Resistivity (Ω -cm)
10258	Fused Silica	Corning 7980 0F	—	—
10259	Quartz	SAW; Q: 1.8M; Incl.: Grade II	Z	—
10260	Sapphire	High Purity \geq 99.996 %	C	—
10261	Silicon	Prime, B-doped	<100>	5 to 10
10262	Silicon Carbide	4H Semi-Insulating ZMP Grade	<0001>	>1E5

Disclaimer: *Certain commercial equipment, instruments, or materials may be identified in this Guidance Document 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.*