

Specifications

Standard Reference Instrument Series 6009

Radiation Pressure Power Meter

Description: The Radiation Pressure Power Meter is an instrument that measures the optical power output from a laser by measuring the force due to photon momentum imparted on a mirror by the reflected laser light. The description of the concept and the practical implementation as well as analysis of measurement uncertainty are detailed in the referenced publication [1].

Design, assembly and technical measurements leading to the production of this SRI were performed by members of the Sources and Detectors Group of the NIST Applied Physics Division.

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

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Specifications: NIST provides the Radiation Pressure Power Meter as a Standard Reference Instrument (SRI) with performance that is equivalent to the published description of Reference [1] provided that operators follow the best practices listed therein.

Specific uncertainty contributions and the overall expected uncertainty will depend on the scale's force measurement uncertainty as well as the uncertainty of the reflectivity on the mirror. These quantities will be determined for the specific components and provided to the user at the time of delivery. In general, the uncertainty contributions will be comparable to those in Reference [1] and the following table with the necessary uncertainty values will be provided

| | Type A | Type B |
|--|--------|---------|
| Scale calibration, u_{scale} | | 0.0024 |
| Horizontal-vertical force equivalence, u_{H-V} | | 0.0021 |
| Mirror reflectivity, u_{mirror} | | 0.00043 |
| Angle of incidence, u_{angle} | | 0.002 |
| Vibrational noise, σ_p | 10 W | |
| Drift nonlinearity, γ_T | 0.001 | |

where the parameters can be used to estimate the expanded uncertainty $2U$ as

$$2U(P, \Delta t) = 2 \sqrt{u_{scale}^2 + u_{H-V}^2 + u_{mirror}^2 + u_{angle}^2 + \left(\frac{\sigma_p}{P} \sqrt{\frac{60}{\Delta t}} \right)^2 + \gamma_T^2},$$

where P is the averaged laser power and Δt is the averaging interval for the measurement.

In addition, a detailed operations manual will be included, detailing assembly and operation of the instrument.

Standard Configurations

6009 Radiation Pressure Power Meter

6009a Additional Mirror

Delivery: Delivery dates will be determined on a case-by-case basis in coordination with the customer and based on the availability of components and NIST staff.

Shipping: Unless otherwise agreed by the parties, shipping terms shall be [EXW \(Incoterms 2010\)](#). NIST will prepare packaging for shipment of the SRI. Shipping crate dimensions and weight will be included in each quote. Customers are responsible for arrangement of shipping pickup at NIST as well as all customs duties and import fees.

[1] Williams, Paul, et. al, "Portable, high-accuracy, non-absorbing laser power measurement at kilowatt levels by means of radiation pressure," Submitted to *Optics Express*, (2017).

Users of this SRI should ensure that the Specifications Certificate in their possession is current. This can be accomplished by contacting the Office of Reference Materials: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/sri>.