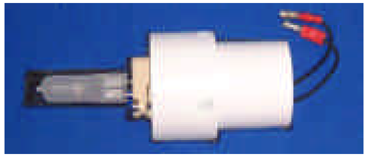
TSRF Standard of Total Spectral Radiant Flux
User notes

Overview



The Bentham TSRF is a calibrated standard of total spectral radiant flux for use with Bentham's range of integrating spheres. This calibration is traceable to the NPL. Please refer to the accompanying certificate for calibration results.

The TSRF is fitted with a quartz halogen lamp of a rating commensurate with the intended application.

Mechanical

The TSRF is provided in a holder for attachment to a post to set the lamp at a central location inside the integrating sphere. It should be noted that the lamp should be used in the same configuration as that in which it was calibrated, pins-down or pins up.

After lamp operation, allow the lamp to cool down for a few minutes prior to moving, to prevent damage to the filament. Bullet connectors are provided for electrical connection.

Lamp Operation

It is recommended to operate the lamp from a constant current supply such as the Bentham 605/608; the required currents for the main variants are as follows:-

Source	Current (A)	Nominal Voltage (V)	Typical Operating Voltage (V)
TSRF-20W	3.200	6	~5.2
TSRF1000	8.500	12	~11.2
TSRF1800	10.400	24	~21.4

For correct lamp operation, and to preserve the validity of the calibration, the following should be observed.

- Ensure the correct polarity is respected at all times
- Ensure the pin orientation is as the calibration
- Do not remove bulb from holder nor touch bulb with bare fingers
- Bentham recommend that the device should be re-calibrated every 100hrs use or 1 year, whichever comes first
- Do not run the lamp at a current lower than that at which it was calibrated
- The lamp requires approximately five minutes warm-up time

Furthermore, it is of use to note the voltage displayed on the 605/ 608 LCD. Whilst this is for indication only, it can be used to determine lamp condition: these lamps tend to fail via either catastrophic rupture or bridging of the filament. The former is visibly obvious, yet the latter not necessarily so. Here, adjacent filament struts collapse, short-circuiting part of the filament; at a given current the lamp voltage, and lamp output is therefore reduced.

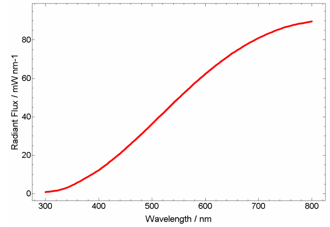
Bentham Instruments Limited
2 Boulton Road, Reading, Berkshire, RG2 0NH, UK
Tel: +44 (0)118 975 1355 Fax: +44 (0)118 931 2971
Email: sales@bentham.co.uk Internet: www.bentham.co.uk

The Quartz Halogen Lamp

During use, an incandescent lamp filament reaches very high temperatures, around 3000K, at which temperature some of the tungsten, of which the filament is composed, evaporates and moves around inside the bulb by convection. Should the envelope be cold, it is likely that the tungsten is deposited thereupon, leading to gradual discolouration, as often seen in such household lamps.

Furthermore, as the tungsten is evaporated, the structure is of the filament is gradually thinned in places, leading to runaway failure: as the resistivity of the thinned sections increase, so does power dissipation and temperature, with as consequence a higher rate of evaporation. These factors conspire to thin the filament further until such point that the filament breaks, or "bridges".

The quartz halogen lamp was introduced to mitigate these problems with two main design changes brought to promote what is termed the halogen cycle.



Typical TSRF output

Firstly, in order to maintain the envelope at high temperature, it is brought as close to the filament as possible (without melting). Quartz, which can withstand higher temperatures than conventional glass, is used as the envelope material.

Furthermore, the bulb is filled with a halogen gas which combines with the evaporated tungsten from the filament. Provided that the envelope of the bulb is sufficiently hot, the tungsten-halogen compound does not condense thereupon, and eventually returns via convection to the filament, at which point the tungsten is re-incorporated, releasing the halogen to continue the process.

Envelope temperature being important for the halogen cycle to operate, the lamp must be run for long enough to heat up the lamp, and should not be under-run. Operating the lamp at less than 80% of rated voltage will result in failure of the halogen cycle due to the lower bulb temperature.

Furthermore, the orientation of the lamp may become important where the envelope is not equidistant above/ below the filament. Running such a lamp in the pins down orientation is satisfactory since the upper part remains hot through convection, but in the pins down orientation, it is possible that it becomes sufficiently cool to condense tungsten. It is possible to re-evaporate tungsten deposited on the envelope by letting the lamp run at a level at which shall re-initiate the halogen cycle.

The lamp operating conditions provided overleaf lead to moderate under-running along with which comes an increase in lamp lifetime to a few thousand hours.

Finally, whilst the emission of the tungsten filament is close to that of a black body, it should be noted that it is modified by the transmission of the envelope material (without which the filament would quickly oxidise and fail). Quartz transmits over the region 200-3000nm with an absorption feature around 2500nm.

WEEE statement:

Bentham are fully WEEE compliant, registration number is WEE/CB0003ZR.
Should you need to dispose of our equipment please telephone 0113 385 4352 or 4356, quoting account number 135419.

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