**Macken Instruments, Inc.** **YAG & $CO_2$ Analog Power Probe 500-5,000 & 10,000 Watts**

The Power Probe is a calorimeter-type power meter that measures laser power by measuring the temperature rise in a known mass of material over a known time interval. The laser power is absorbed for a timed interval to create this temperature rise.

## 1.0 OPERATION

**1.1** Zero the Pointer: P10K model Power Probes have a separate zeroing knob adjacent to the knurled knob, turn this knob to zero the pointer.

**1.2** Expose Power Probe to Beam: Hold the Power Probe by the dial end and allow the laser beam to strike a flat side of the gray absorbing head for the calibrated exposure time (this can be found on the attached "Certificate of Calibration", and is printed on the instrument itself). To expose the absorbing head of the Power Probe to the laser beam, either physically move the absorbing head into and away from the laser beam, or hold the absorbing head stationary and shutter the laser beam on and off.

**1.3** Remove Power Probe from Beam and Take a Reading: Remove the Power Probe from the laser beam and allow time for the needle to reach its maximum value. The maximum value is the correct power reading. For increased accuracy, tap lightly on the dial face of the thermometer before taking the power reading. This overcomes a slight frictional sticking in the thermometer. Return the temperature of the head of the Power Probe to nearly room temperature before making another measurement. To rapidly cool the probe head, insert the absorbing head into a beaker of water. Thoroughly dry the head and re-zero the dial before making the next measurement.

## 2.0 COATING DAMAGE CAUTION

The coating on the absorbing head can be damaged by exposing the Power Probe to too high a laser power density. NEVER focus the laser beam on the surface of the Power Probe. Move the absorbing head around slightly while taking the reading, this helps to reduce the possibility of damage.

The coating on the model P10KY is primarily used with YAG lasers and can withstand power densities as high as 1200 $W/cm^2$ for a 2000W beam and 700 $W/cm^2$ for a 10KW laser.

The P10KC has a special high damage threshold coating suitable for use with $CO_2$ lasers only. The damage limits on this coating are more difficult to define because the damage threshold is a function both of power density and total power. The coating can withstand a power density of 1500 $W/cm^2$ for a 2000W beam and 900 $W/cm^2$ for a 10KW beam. Be aware that the power density in the center of a laser beam is often much greater than the average power density. For example if you have a 5000W beam with a diameter of 3 cm the average power density is 707$W/cm^2$, but the power density at the center of the beam will most likely be above the damage threshold of a stationary probe.

If the laser power density is close to the damage threshold, there are several degrees of damage which can occur to the absorbing head. In the case of the "Y" body, any visible discoloration will affect the calibration time. In this case, we recommend returning the Power Probe to Macken Instruments for inspection and/or re-calibration. In the case of the "C" body, discoloration of the absorbing surface has an insignificant effect on the accuracy as long as the coating remains intact. For both body types at very high power densities, it is possible to melt or vaporize the surface and expose bare aluminum. A damaged surface of this type should not be used, and is a safety hazard.

## 3.0 CALIBRATION

Each Power Probe is individually calibrated. Uses either the calibrated exposure time listed on the "Certificate of Calibration" or multiply the reading from the nominal 10 or 20 second exposure by the multiplication factor. The exposure time is also printed on the top of the probe so it is always easily available.

An example will help to clarify how to use the calibrated exposure time, or multiplier. Suppose you have a P10KC Power Probe with an exposure time of 9.8 seconds, if you have the ability to shutter the beam for a specified time period simply set the shutter to 9.8 seconds and take the reading. If you do not have this ability, use a stopwatch and physically move the probe into the beam for 10 seconds, say you get a reading of 4000 Watts you would then multiply this reading by the listed multiplier of .980 to get a result of 3920 Watts.

It is also possible to double or halve the exposure time to obtain different power ranges. For example, the model P10KC has a full scale reading of 10 kilowatts when it is exposed to the laser beam for 10 seconds. If the exposure time were changed to 20 seconds on this model, then the full scale reading would be 5000 watts.

## 4.0 SAFETY CONSIDERATIONS

ALWAYS observe safety precautions, such as wearing eye protection, when using the laser Power Probe. Take care to prevent the laser beam from reflecting off the stainless steel stem.