

Q-100 SUPER GAIN ATHERMAL PHOSPHATE LASER GLASS

Q-100 is a super-gain athermal phosphate laser glass, designed especially for military and industrial applications . . . the YAG alternative.

Q-100 is also available in clad rod form for even higher gain.

Application Notes

Since the gain of Q-100 laser glass is comparable to YAG, one must take the same precautions to suppress parasitic lasing and other performance degrading phenomena. For example, Q-100 laser rod barrels should, in general, not be polished. In air-cooled systems, samarium cavity filters are recommended.

1. Dye Q-switched systems . . .

Q-100, like YAG, requires that anti-reflection coatings be applied to the faces of the laser rod to eliminate the 4% Fresnel reflections, when used with dye Q-switches. The 4% Fresnel reflection is sufficient to cause parasitic lasing during the pump pulse . . . thereby depleting the stored energy and preventing "bleaching" of the dye.

2. Maximum average power . . .

When run for extended periods of time, the maximum average power loading for Q-100 is approximately 100 watts per inch of length. One will notice *no change* in beam divergence when increasing average power . . . even up to the point of rod breakage.

3. Stress-induced birefringence . . .

The onset of significant birefringence occurs at a pumping level of approximately 40 watts per inch of length. Between 40 watts per inch and 70 watts per inch, the output will decrease about 20 percent when used with a polarizing cavity element. The relationship is linear to the point of breakage.

4. Athermal properties . . . The athermal property of Q-100 is determined by the following relationship:

$$\alpha (n-1) = -dn/dt$$

Where:

- α = Thermal expansion
- n = Index of refraction @ 1.054 microns
- dn/dt = Change in index with temperature

This relationship dictates a constant optical path length regardless of temperature when utilized with external mirrors. Mirrors that are vapor deposited upon the rod will negate the athermal or "constant beam divergence" property of Q-100. TIR's or roof prisms fabricated directly on Q-100 laser rods are the exception and can be used without disturbing the athermal character of Q-100.

Spectroscopic Properties

Peak Wavelength (nm)	1054
Cross Section ($\times 10^{-20}$ cm ²)	4.4
Fluorescent Lifetime (usec)	190
Radiative Lifetime (usec)	357
Linewidth (nm) FWHM	21.2
Effective	25.1
Loss @ Lasing Wavelength (%•cm ⁻¹)0008

Thermal Properties

Softening Point °C	470
Transformation Point °C	452
Thermal Expansion ($10^{-7}/^{\circ}\text{C}$) (20°-40°C)96
Thermal Conductivity (W/m•K)	0.82

Optical Properties

Index of Refraction (Nd)	1.555
Nonlinear Index n_2 (10^{-12} esu)	1.2
Abbe No.	62.1
dn/dt ($10^{-6}/^{\circ}\text{C}$) (20°-40°C)	-4.6
Thermal Coefficient of Optical Path (20°-40°C) ($10^{-6}/^{\circ}\text{C}$)	0 ± .5

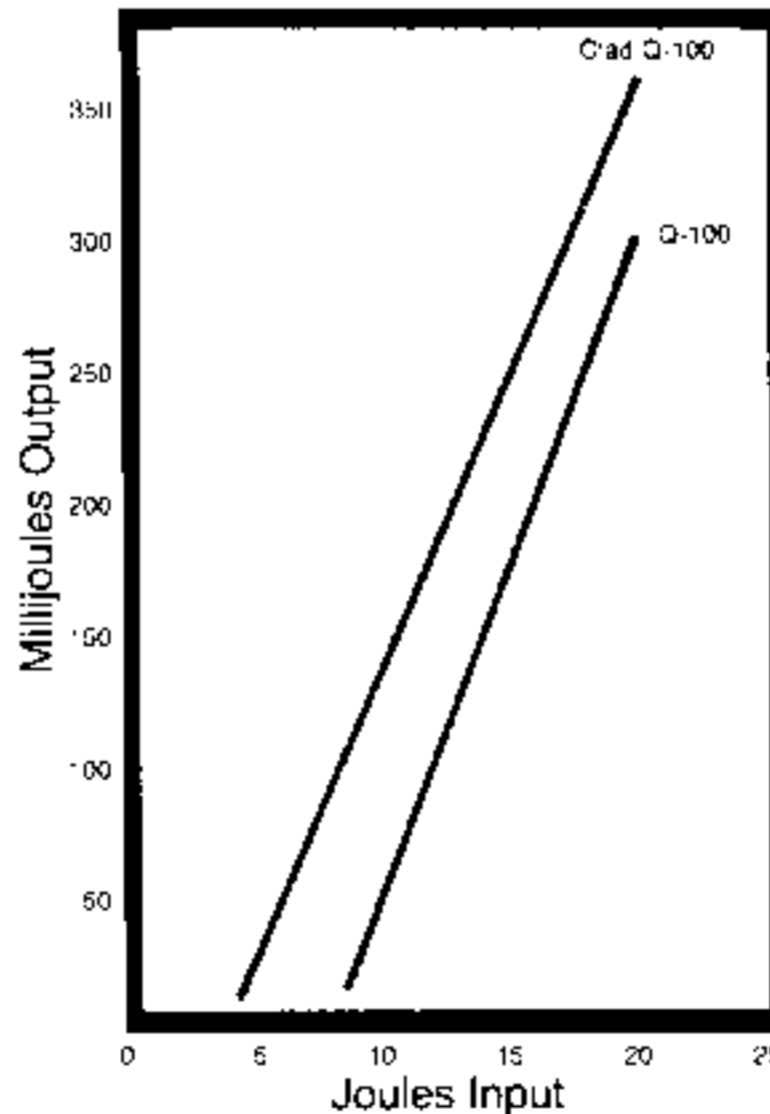
Physical Properties

Density (gm/cc)	3.204
Knoop Hardness	558
Young's Modulus (Kg/mm ²)	7150
Poisson's Ratio	0.24
Damage Threshold (1 ns) J/cm ²	>25
Dw (H ₂ O 100°C 1 hr) wt% loss	0.08

Solarization Resistance

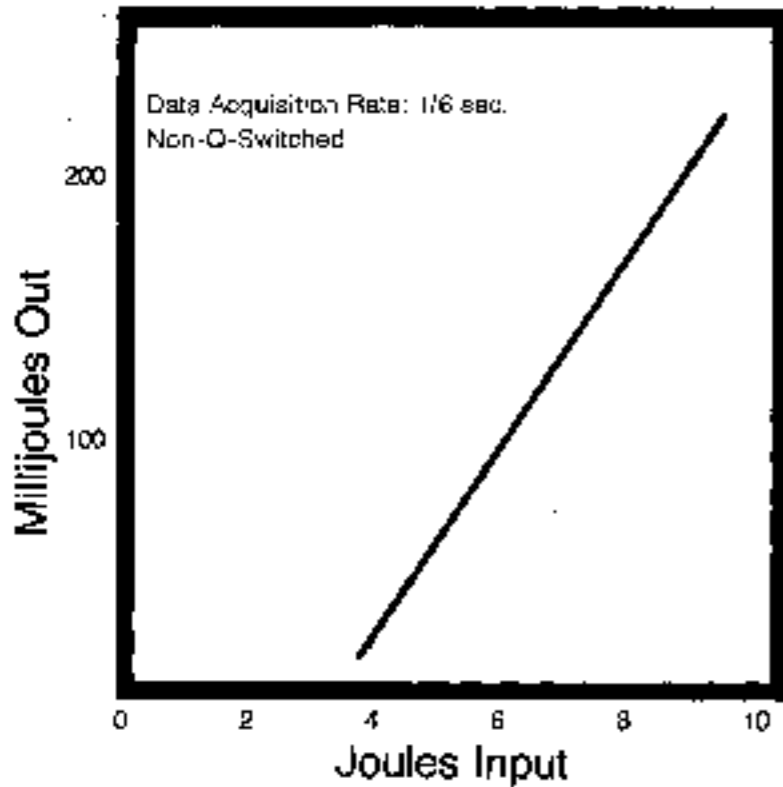
. Excellent

**CLAD Q-100
vs Q-100**



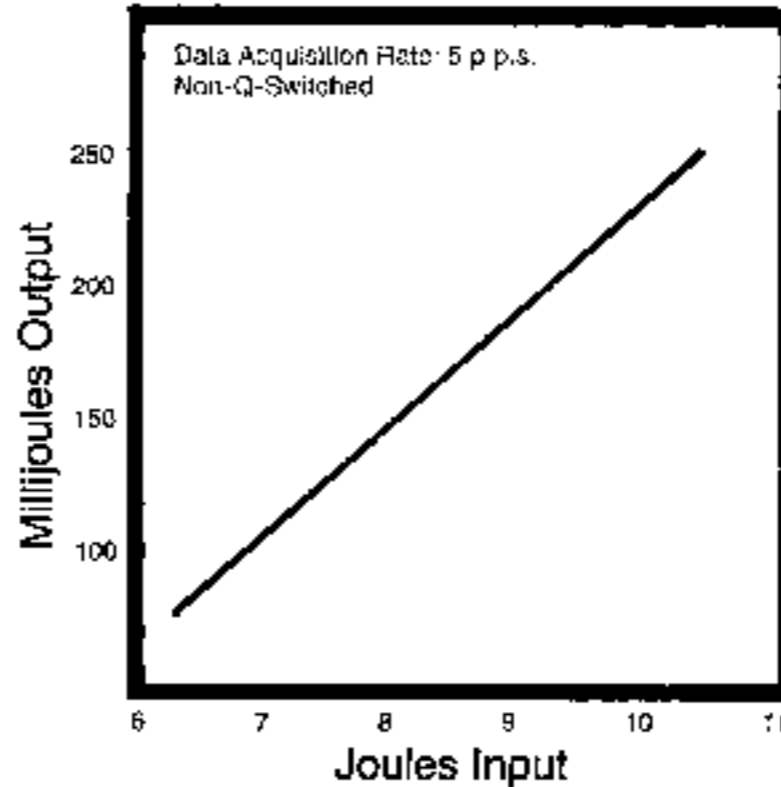
ROD: 1/4 x 3 1/4"
OUTPUT COUPLER: 65% R

**Q-100
Test Data**



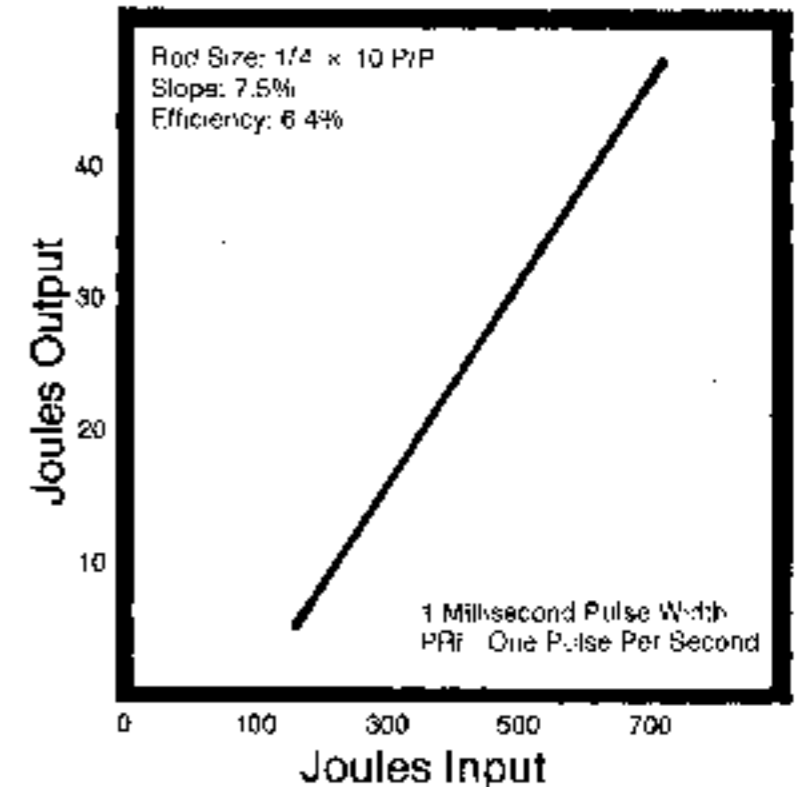
ROD: 5mm x 64mm, No Coatings
OUTPUT COUPLER: 80% R
CAVITY: KSF Filter Glass & BaSO₄
 (Rangefinder Cavity)
COOLANT: NONE

**Q-100
Test Data**



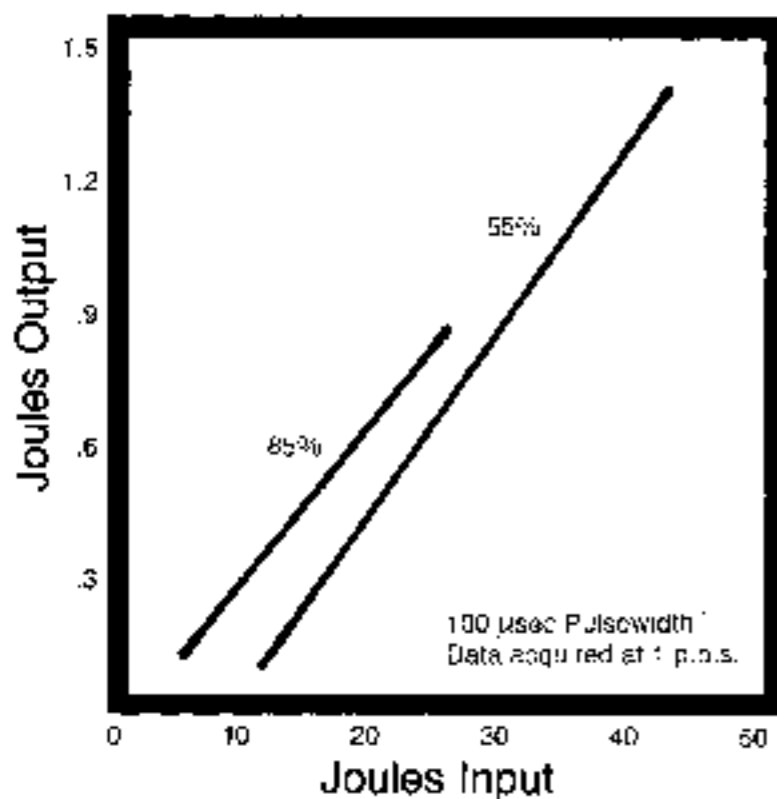
ROD: 1/4 x 4", No Coatings
OUTPUT COUPLER: 85% R
CAVITY: ILS YAG Cavity
COOLANT: H₂O

**Q-100
Test Data**



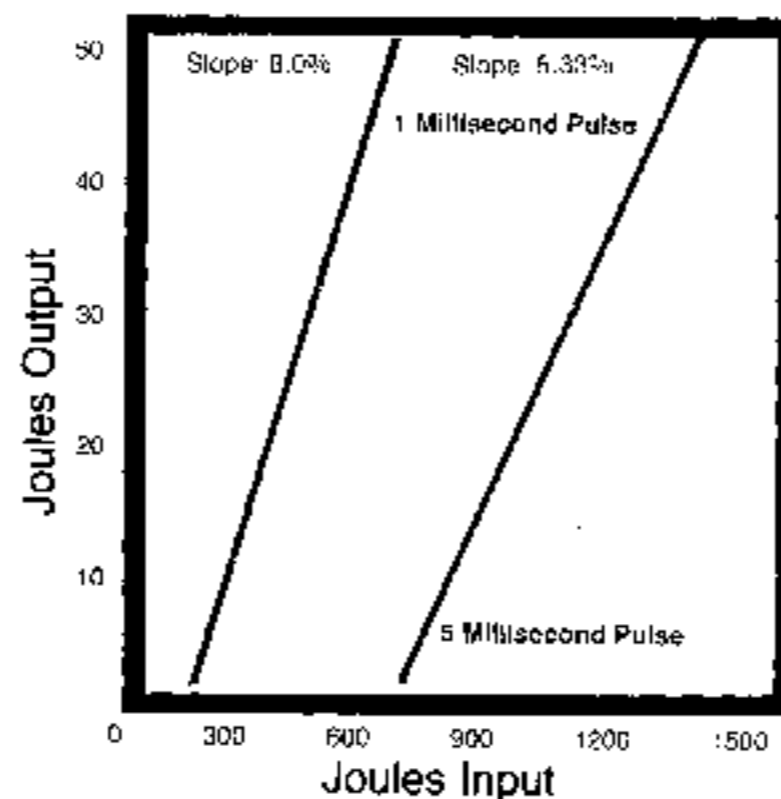
ROD: 1/4 x 10", No Coatings
OUTPUT COUPLER 26% R
CAVITY: Kigre 50-Watt Laser
 Cavity Assembly
COOLANT: H₂O

**Q-100
Test Data**



ROD: 1/4 x 3 1/4", No Coatings
OUTPUT COUPLERS: 55% & 85% R
CAVITY: Kigre, Silver-Coated Ellipse
COOLANT: H₂O

**Q-100
Test Data**



ROD: 1/4 x 14" (10 inches pumped)
OUTPUT COUPLER: 26% R
CAVITY: Laser, Inc.