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A Brief Introduction to Laser Lamp Design

The laser lamp is an integral component in the resonator sub-assembly for those laser systems, which fall in the category of lamp pumped solid-state lasers. Laser lamps are manufactured using a number of materials including: fused silica (quartz), tungsten, grade glass, and either a xenon or a krypton fill gas. They are generally linear in construction and have a number of defining parameters such as arc gap, overall length, lamp bore diameter, and gas fill pressure.

The laser lamp has two primary functions: to convert electrical energy/power to radiant energy/power and to act as a stable, long lived pump source for the solid-state crystal (also known as the laser rod). Typically, a lamp converts between 40-60% of the electrical input energy/power that is delivered by the power supply into radiant output energy/power over a broad spectral range from the ultraviolet (as low as 180nm) to the near infrared (1000nm+). The exact characteristics of a lamp's spectral output will be determined in part by the lamp's inherent design and its mode of operation. Laser lamps generally operate in a pulsed, continuous, or quasi-continuous mode and are typically water-cooled. The majority of the radiant energy/power is unusable and is simply absorbed into the coolant as heat, which is continuously removed from the system. A small portion of the radiated output is extremely useful; however, because it overlaps the absorption spectrum for the laser crystal and can therefore be transferred to the crystal. The crystal then acts as a gain medium and "lases" at its characteristic wavelength. This lasing energy/power is then directed to a target area where it can perform a number of functions including: heat treatment, drilling, cutting, or marking. Although there are many types of crystals that can be pumped by laser lamps, the most commonly employed is the Nd:YAG crystal, which is utilized in the widely commercialized family of Nd:YAG lasers.

A well-designed lamp will take into consideration many factors. For continuous wave (CW) DC arc lamps, the lamp design must provide stable continuous radiant output while at the same time handle the heat load and power dissipation at the intended power levels. For pulsed flashlamps, the design considerations include: the input energy, the pulse width, and the repetition rate, along with other parameters too numerous to list here. If a lamp is well designed and optimized with the other system parameters, the result is a reliable laser that provides good output energy/power with relatively long operating lamp life and predictable replacement intervals.

For more information on how New Source Technology can support your lamp requirements or for general information on our products or capabilities, please contact us or our local representative.