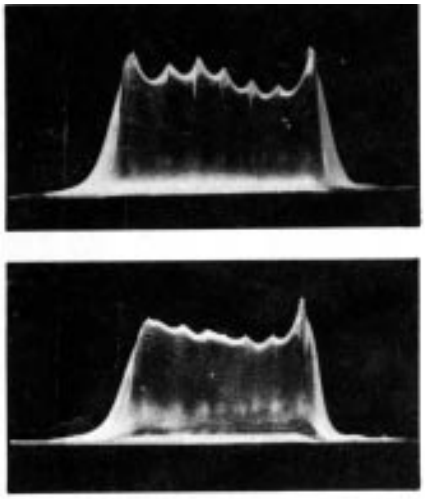

*Figure 1. (top) A burn profile of a Heraeus C66 high-power laser set at 0.5-second exposure and 4.6 kW, and (bottom) the same laser at 4.65 seconds attenuated by a factor of 9.3. The depth of both holes is approximately 7 mm, and mode profiles are similar even at different exposure lengths.*

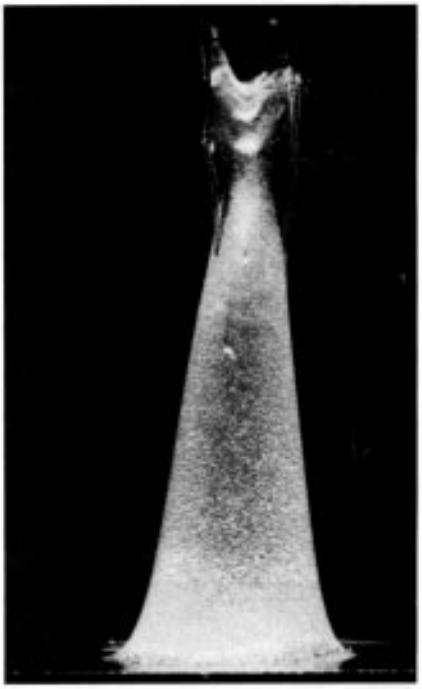

*Figure 3. When the hole depth exceeds three times its width, the burn profile is no longer accurate. This hole was produced with a $TEM_{01}$* mode laser, but has no characteristic doughnut shape.*

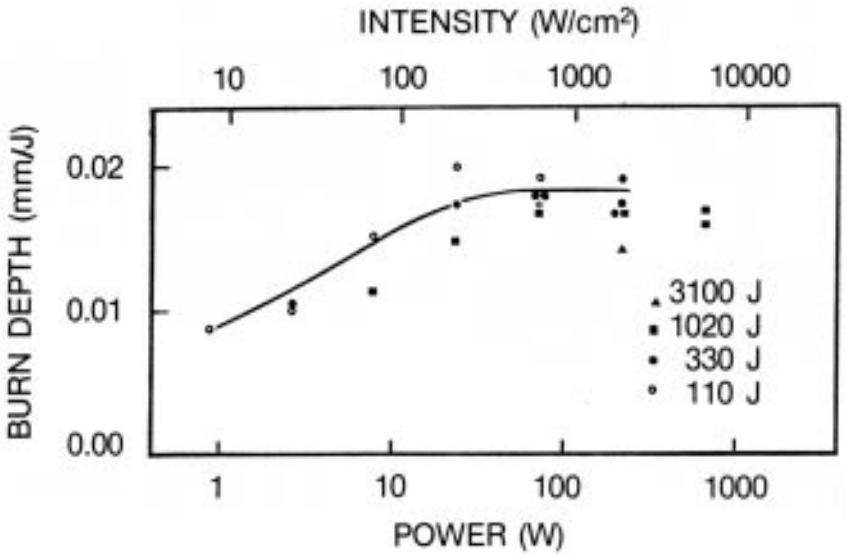


*Figure 2. The graph shows a plateau of peak efficiency for characterizing beam profiles in Plexiglas at 1 kW/cm².*

**MANUFACTURING**

## $CO_2$ Burn Samples—Are They Accurate?

If you've ever been in the market for an industrial $CO_2$ laser, a laser manufacturer most likely sent you a piece of Plexiglas with a sample hole burned in it to show the mode pattern. But how could you be sure that your sample was an accurate representation of the laser you wanted to buy? You couldn't, until recently.

Depending on the power intensity and the duration of the pulse, a Plexiglas mode pattern of a $TEM_{01}$* beam could start to look more like a Gaussian profile than a proper doughnut pattern. But a West German scientist, Fritz Keilmann of Stuttgart, addressed the problem in the course of looking for applications of his firm's infrared high-power beam attenuators. Keilmann found a *window of truth* in the intensity and exposure time for drilling a faithful mode pattern in Plexiglas.

"Plexiglas burns are quite a common way of looking at modes in the industry," Keilmann said. "What we have done is to scale our power over four orders of magnitude with the attenuator without changing the beam shape. We found that the peak of your mode should be on the order of 1 kW per square centimeter to get a faithful recording of the wings—there is less than ten percent distortion at that level."

Keilmann and his assistants set up two $CO_2$ lasers, a Heraeus C66 emitting 4.6 kW, and a Trumpf TLF 1500 at 1.5 kW in a $TEM_{01}$* mode. A Model 305 attenuator from Keilmann's firm, Lasnix, was placed in the beam two meters from the laser head. The attenuator's wire-screen design allowed precision steps of power reduction without changing the beam mode or polarization. The beam was then focused onto the Plexiglas by a telescope made from two ZnSe lenses with a 50-cm focal length, leaving an effective focal distance of 3.3 meters, where the plexiglas target was placed.

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