

3.1 Scientific/Technology Laser Applications

3.1.1 Benefits of Beam Profiling

You can get more out of your laser

- Figure 1 shows an industrial Nd:YAG laser, near Gaussian beam, with 100 Watts output power and $1.5\text{kW}/\text{cm}^2$ power density. Figure 2 is the same Nd:YAG beam at greater power, 170 Watts, but it split into 2 peaks producing only $1.3\text{kW}/\text{cm}^2$ power density. The power density of the beam decreased 13% instead of increasing by the 70% expected. Without measuring the beam profile and beam width, you would not know what happened to your power density, and why the performance did not improve.

Laser cavities become misaligned

- Figures 3 & 4 are beam profiles of CO_2 lasers used for ceramic wafer scribing in the same shop. The second laser with the highly structured beam produced mostly scrap parts, until the laser cavity was aligned.

Off axis delivery optics

- Figures 5 & 6 show an industrial Nd:YAG laser with misaligned turning mirror, before and after adjustment.

Alignment of devices to lenses

- Figures 7 & 8 show beam profiles during alignment of a collimating lens to a laser diode. The first profile shows poor alignment of the lens to the diode, which can easily be improved when seeing the profile in real time.

Laser amplifier tuning

- Figures 9 & 10 show a Cr:LiSAF femtosecond laser oscillator beam with a near Gaussian output, and what happens to the oscillator beam with poor input alignment.

All these examples illustrate the need for beam monitoring

- Measurement of the beam profile is needed to know if problems exist, and the profile must be seen to make corrections.
- Most laser processes can be improved,
- Scientific experiments can be more accurate,
- Commercial instruments can be better aligned,
- Military devices can have greater effectiveness,
- Industrial processing produces less scrap,
- Medical applications are more precise.

Just knowing the beam profile can make the difference between success and failure of a process.

