

## *A Toolkit for the Laser Safety Officer*

A trained Laser Safety Officer (LSO) will be very effective in ensuring the safe use of lasers and contribute to process optimization if he or she is equipped with a proper set of tools. These include tools for finding, measuring, and managing laser radiation hazards.

### **Beam Hazard Analysis Tools**

The LSO at a minimum must be able to calculate maximum permissible exposure limits (MPE), optical density requirements (OD), nominal hazard zones (NHZ). These and other more complicated calculations are taught during laser safety training. There are many software packages available to assist in making these calculations. In our opinion, the best of these packages have 3 characteristics: 1) the user interface should make it easy for even novice users to obtain reliable and repeatable results; 2) the system should store calculations for future reference; and 3) the software should generate both high-level management reports as well as more detailed reports documenting assumptions and results.

We caution our customers, however, not to substitute such software packages for the expertise of a Laser Safety Officer. The LSO is trained to examine beam divergence, power fluctuations, diffuse reflection potentials, options for beam delivery systems, and both maintenance constraints and operating conditions before making recommendations for safety protocols.

### **Beam Locating Tools**

For indirect beam viewing, shop for frequency converting ceramic type imagers or phosphor materials, either of which is incorporated into pocket-sized cards and geometric shapes attached to hand-held wands. The materials make the invisible “visible” through up-conversion and energy transformation. Suppliers specify these products according to active wavelengths, laser power density, and need for re-charging. [Note that “burn paper” is also very useful, and very cost-effective. The LSO can ascertain beam location by inserting the paper directly into the beam path.](#)

For active beam viewing, consider IR viewers and cameras which allow the user to see the beam as it travels. IR viewers are very useful when there is a strong chance a beam is escaping a controlled area. For example, a research lab may have an open table with a variety of optics, multiple beam splitters and other devices. The technician should be able to account for all of the laser radiation, whether it is directed at an experiment or captured by a beam dump. An IR viewer may help solve those occasional puzzles.

### **Power Measurement Tools**

A simple, pocket-sized power meter is an excellent addition to the LSO’s toolbox. The power meter will enable the LSO to ascertain operating power levels of his equipment.

There is no substitute for an actual power measurement, including statements of power ratings in product manuals.

### **Laser Protective Eyewear**

It is obvious that the LSO should have laser safety eyewear. We suggest however, several variations on this theme that will benefit all organizations. First, if your operation includes multiple wavelengths operating at different wavelengths, consider purchasing eyewear with a “broad band” filter that encompasses many wavelengths. Carrying these in your shirt pocket will make it easier to drop in on your laboratories or production cells. Second, at larger facilities in particular, ensure you keep multiple units of laser protective eyewear in inventory – you should be able to demonstrate frame styles, product fit, and filter options to your staff. You will inevitably require eyewear for new personnel, occasional visitors, and replacements for worn or damaged units.

### **Laser Census**

During training, the LSO learns about “administrative controls” in laser safety. We suggest that the LSO create his own pocket-sized laser census which shows 1) laser location and type, 2) minimum protective eyewear requirement for the laser, 3) list of personnel authorized to operate the laser, and 4) a brief checklist of laser safety protocols to enable impromptu audits.

### **Laser Bibliography**

There are several published resources the LSO should keep on his bookshelf, starting with the important laser safety standards. In the U.S., we use the ANSI Z136 standards. In the European Union, directives in the IEC 60825 domain apply. Consider not only the main standard, but also the sub-standards like ANSI Z136.3 concerning medical institutions or IEC 60825-4 covering laser guards.

### **Concluding Thoughts – Budget!**

The Laser Safety Officer is easily equipped with tools that will help ensure the safe operation and maintenance of the laser in his facility. Smaller organization such as a job shop or medical clinic should plan to spend \$1500 to \$2000 to outfit the LSO. Larger organizations including research installations and universities should budget up to \$3,000 or more to ensure the LSO can perform his job effectively. The technicians operating the lasers will also find these tools useful. That said, the cost to fill the toolbox for the LSO is small when compared to the cost of an accident.

<b>Types of Tools</b>	<b>Examples</b>	<b>Typical Budget, LSO in Small Organization</b>	<b>Typical Budget, LSO in Large Organization</b>
Beam Location	IR Viewers, ceramic disks, phosphor cards, burn paper	\$50 to \$300	\$250 to \$2500
Beam Measurement	Power Meter	\$400 to \$600	\$500 to \$5000
Books and Software	ANSI Standards, hazard analysis software	\$150 to \$300	\$150 to \$700
Personal Protection	Eyewear	\$200 to \$700	\$500 to \$1500