Chapter 19

Safety with Lasers Used in Manufacturing

19.1 INTRODUCTION

The first industrial applications of the laser were in the field of material processing. Pulsed ruby lasers were used for drilling small holes in the diamond dies used for pulling thin wire at the Western Electric Company as early as 1965 (Charschan, 1972). Since then many more industrial production line applications have evolved. The laser is now used for microwelding, microdrilling, scribing ceramic materials, surface treating, high-speed marking, precision wire stripping, resistor trimming, and integrated circuit manufacture. These types of industrial material processing laser systems now generally make use of a CO₂ laser or a neodymium YAG laser, operating CW or repetitively pulsed. Dependent upon whether the material is to be drilled or welded, a short or longer pulse duration will be employed. The highest CW powers are available from CO₂ lasers; therefore, CO₂ lasers are used for the heavy-duty applications. In any event, all of these laser applications present similar hazards. These include viewing the heated material, or exposure to the airborne contaminates produced in this material processing. The amount of toxic material produced by very small units is normally not significant enough to warrant local ventilation. However, in larger units, where significant amounts of material are released, local exhaust ventilation is often needed. Chapter 26 considers these ancillary hazards of laser material processing. The present chapter concentrates on the hazards from the laser radiation itself.

For most equipment now used on production lines, either the manufacturer or the user of the laser system normally encloses the target area to prevent direct viewing of the laser beam impact on the material. In research laboratories, no such precautions are formally required, and it is not uncommon to find a laser welder or driller apparatus without an enclosure.

Lasers such as He-Ne and Argon CW are used for nondestructive testing and
Figure 19-1. Viewing Optics. Fail-safe procedure for assuring that target reflections do not reach the operator’s eye. The use of a flip mirror which blocked direct eye exposure was often used in early ruby laser microdrilling systems.

measurement. Some, but not all, non-destructive testing techniques make use of holography. The hazards associated with these applications are for the most part somewhat different than for material processing applications.

19.2 NEODYMIUM:YAG LASER MATERIAL PROCESSING

The most commonly used laser for small scale material processing (e.g., in the electronics industry) is the neodymium:YAG laser which operates at 1064 nm. Output energy typically ranges from 50 to 500 mJ per pulse for pulsed lasers and from 10 W to 100 W for CW lasers. Because the 1064-nm wavelength is in the retinal hazard region, relatively low-power reflections can be a serious hazard if they are from a specular (glass or polished metal) surface.