

TECH NOTE

LRS-9550 Laser Eye Safety Features

PURPOSE

This technical note describes the laser eye safety features of the LRS-9550 High Power Laser Diode Test System.

BACKGROUND

The LRS-9550 system houses up to 32 removable laser diode fixtures. The fixtures are inserted into modular shelves, each of which can hold four fixtures. Figure 1 shows a single shelf with four fixtures.

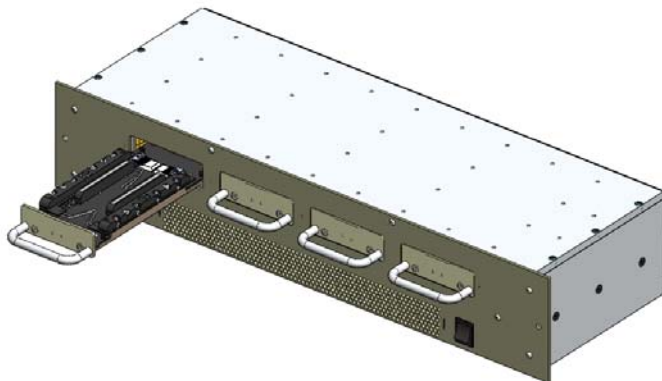


Figure 1: A single LRS-9550 shelf and four fixtures; one fixture partially removed

The LRS-9550 provides laser drive currents up to 30A. With optical power outputs characteristic of Class IV lasers, it is critical to ensure operator eye safety. The LRS-9550 has been designed and verified to be laser eye safe under all operating conditions.

OVERVIEW OF DESIGN

Each fixture holds between 2 and 16 devices. The outputs of the devices are arranged along the edge of the fixture and are directed into integrating

sphere ports located in the shelf. Aside from the fixture opening, each fixture slot is isolated from the environment by structural metal components. In order to make connection to the drive circuitry, the fixture must be fully inserted into the slot. The risk of light escaping exists in three locations: the perimeter of the fixture face plate where a ~ 0.031 in gap exists, the LED holes on the face plate, and the opening of an adjacent slot if a fixture is not installed. Figure 2 illustrates these three locations. Note that the perforated air intake shown below the fixture positions is mechanically isolated from the rest of the shelf with a continuous sheet metal duct which prevents any light escaping here. Due to the geometry of the shelf and multiple bounces that must occur, any light escaping the locations shown in figure 2 is highly attenuated. To verify that no hazard exists, a laser hazard analysis was performed by a third party certified laser safety officer.

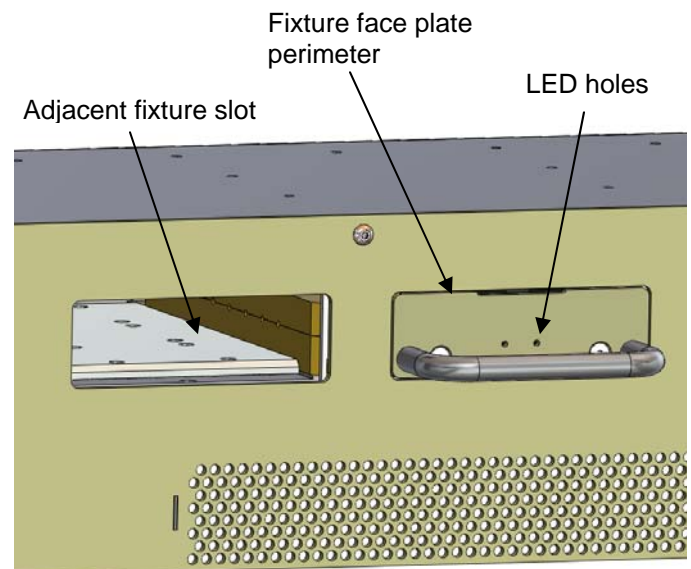


Figure 2: Potential locations for escaping light

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LASER HAZARD ANALYSIS

The maximal permissible exposure (MPE) for a system loaded with 940nm devices was calculated per ANSI standard Z136.1. The Class I accessible emission limit (AEL) was calculated based on the beam being concentrated to the aperture of a dilated eye (7mm diameter).

An optical power meter was fitted with a 7mm aperture and used to take measurements in all locations around the fixture and shelf, including an adjacent empty fixture slot. The maximum reading observed resulted in a value a factor of 29 less than the AEL.

FIBER-COUPLED FIXTURES

With fixtures for fiber-coupled devices there is the additional risk of fiber breakage, in which the broken end of the fiber could emit light in a random direction. The two areas where this could present an eye safety hazard in the standard shelf/fixture interface are the LED holes on the fixture front panel and the perimeter of the fixture face plate.

All fiber-coupled fixtures utilize a special face plate with a flange that overlaps the shelf front panel. An o-ring seal ensures a light-tight interface between the fixture and shelf. To prevent harmful light from exiting the LED holes, but to still allow visibility of the green LEDs, a special filter glass is used between the LEDs and the holes. The filter glass is Schott KG5, which allows transmittance of ~90% in the green wavelength range, but less than 1% transmittance at wavelengths of 850nm and above, the operating range of typical high power fiber-coupled devices.

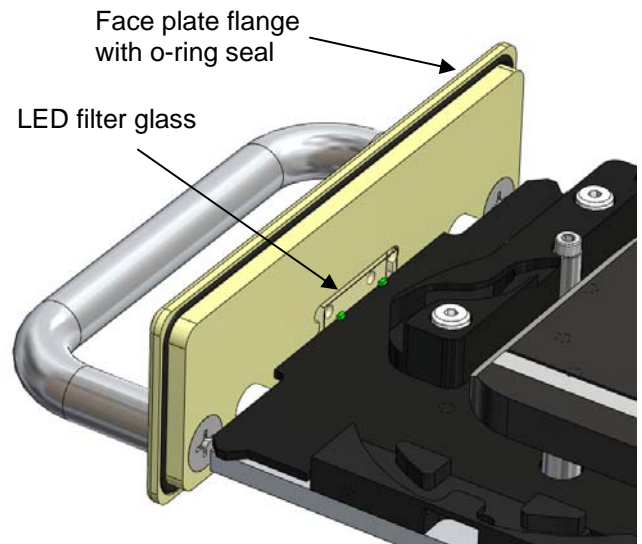


Figure 3: Additional safety features on fixtures for fiber coupled devices.

SUMMARY

The LRS-9550 High Power Laser Diode Test System has been designed to be laser eye safe under all operating conditions. By design the fixture and shelf interface protects the user from escaping light. Light emissions from the system were measured by a certified third party laser safety officer and found to be a factor of 29 less than allowable limits. Fixtures for fiber-coupled lasers employ additional safety features to protect the user in the event of a broken fiber.