Buying a Laser Welding System: What Changes Between Class 1 and Class 4?

Safety, Compliance, and Facility Requirements for Industrial Environments

Lincoln Electric Automation

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Executive Summary

Industrial laser welding delivers high throughput, precision, and repeatability, but the safety class of the system you buy has major implications for compliance scope, facility modifications, training, and total cost of ownership. In most factories, a laser welder is either externally Class 1, where the high-power source and process are fully enclosed with interlocks; or operated as Class 4, where accessible hazardous radiation can exist during operation or maintenance and the facility must implement full control measures.

Lincoln Electric offers class 1 and class 4 laser systems, with the Flex Lase™ cobot and Flex Lase handheld laser system, respectively. Both systems can be used safely and effectively for various applications. It is important to understand the differences between class 1 and class 4 lasers, so you can make the most informed decisions about what is best for your operations.

1) Regulatory & Standards Landscape

In the United States, the Occupational Safety and Health Administration (OSHA) enforces safe workplaces via the General Duty Clause and Personal Protective Equipment rules (29 CFR 1910). OSHA also references the American National Standard for Safe Use of Lasers (ANSI Z136) for evaluating laser safety programs. The U.S. Food and Drug Administration's Center for Devices and Radiological Health regulates product performance and labeling under 21 CFR 1040.10/.11, requiring features such as remote interlocks, emission indicators, and key controls for higher-class products. The International Electrotechnical Commission's IEC 60825-1 defines classification and manufacturer requirements, while IEC 60825-4:2022 specifies requirements for laser guards (curtains, cabins, windows). The International Organization for Standardization's ISO 11553-1:2020 covers laser processing machines and the safety requirements beyond product classification.

Implication: With an externally Class 1 laser system, much of the regulatory burden for operation is baked into the design and certification. Operating a Class 4 laser shifts responsibility to the user to implement the full Z136.1 program standards, define a Nominal Hazard Zone (NHZ), and maintain formal procedures overseen by a Laser Safety Officer (LSO).

2) Hazard Profiles

Class 1 Lasers: Safe for operators under normal, closed-door operation; hazardous internal sources are rendered inaccessible by engineered enclosures and interlocks. Routine operation outside the enclosure does not exceed the Maximum Permissible Exposure (MPE).

Class 4 Lasers: Immediate eye and skin injury possible from direct and diffused reflections; significant fire hazard; alignment and maintenance tasks introduce elevated risk. NHZs can extend beyond the workstation when beams are unenclosed or when doors/panels are open.

Non-beam hazards, present for both but higher for Class 4 lasers, include electrical energy, laser-generated air contaminants (LGACs) and metal oxides, off-gassing from coatings, hot work/fire, and sometimes compressed gases. For LGACs, ventilation and exposure controls must be verified.

3) Engineering Controls and Facility Requirements

If you operate an externally Class 1 laser system, such as the Flex Lase™ Cobot, it's important to maintain the following safe laser features inherent in the design and best practices in the area surrounding the system:

- Protective housing with interlocks to reduce accessible radiation to Class 1 levels (IEC 60825-1); guards/windows per IEC 60825-4 where applicable.
- Keyed enable, emission indicators, and remote interlock (21 CFR 1040.10).
- Minimal room conversion: area outside the enclosure is not an NHZ in normal use; maintain signage and service procedures.

If you operate a Class 4 laser, such as the Flex Lase handheld laser system, the following requirements are essential during open process or service access:

- Defining the NHZ and confining hazards with guarding or barriers (IEC 60825-4 curtains/cabins/windows) and non-reflective, fire-resistant beam stops.)
- Fail-safe interlocked doors and access panels; key-switch master control; remote interlock terminal that forces emission below maximum permissible exposure (MPE) on open circuit (FDA performance standard).
- Area controls and indicators: warning lights/signage at entry, controlled access, E-stops, and alignment of standard operating procedures (SOPs).
- Ventilation & fume extraction sized to the welding process; verify effectiveness and consider employee exposure monitoring.
- Fire protection: non-combustible beam traps; removing flammables; applying hot-work policies as needed.
- Considering surge protection for safety interlock circuits where required by the National Electrical Code (NEC) / National Fire Protection Association (NFPA) 79 adoptions.
- Rapid egress under all conditions
- Personal Protective Equipment (PPE)
    - Laser safety eyewear: select by wavelength and required optical density (OD) to reduce irradiance below MPE for worst-case exposure times; document calculations and keep specifications at point of use.
    - Other PPE: heat-/flame-resistant apparel, appropriate gloves, and respiratory protection if ventilation cannot keep exposures below limits.

  Note: OD is logarithmic attenuation (OD = –log10 T). Eyewear must list OD at the laser's wavelength(s); OD at 1064 nm does not imply protection at 532 nm.

4) Integration & Maintenance Modes

Even if the enclosure doors are open for setup, alignment, or service, the Flex Lase Cobot Cart does not expose Class 4 laser hazards. The system disables the laser whenever the doors are open, and the laser is unable to emit when this happens. Only

when the enclosure is closed, along with the front doors, and the safety is reset can the laser be armed and emit beams. Therefore, there should be no laser hazard to the operator or surrounding people in integration and maintenance modes.

5) Facility Planning Checklist

Class 1 Laser

- Verify guard/window specifications (IEC 60825-4) and interlocks/E-stops
- Install local exhaust at the enclosure; confirm emissions control for your materials.
- Establish service-mode SOPs and designate an LSO to approve them.

Class 4 Laser

- Appoint an LSO; perform a Z136.1 hazard evaluation and define the NHZ.
- Engineer guards per IEC 60825-4 (curtains, windows, beam blocks) and interlocked entry.
- Specify eyewear OD and policies; deploy area indicators and signage.
- Implement ventilation and fire controls; integrate surge protective devices (SPDs) where required for safety circuits.
- Train operators/maintenance; publish SOPs for alignment and emergency response.

6) Cost & Schedule Considerations

Compared to an enclosed Class 1 laser system, Class 4 laser operation typically increases total installed cost and schedule due to room conversion/guarding, ventilation, LSO program overhead, eyewear inventory, and compliance documentation. Enclosed Class 1 laser systems shift much of this into the machine bill of materials and vendor validation, often reducing installation workstreams and accelerating time-to-production.

7) Due-Diligence Qualifications

If you are looking for a laser welding system that takes these items into consideration in its design, look no further than the Flex Lase Cobot. The Flex Lase handheld laser system is helpful for manual applications, but it requires these additional steps to produce a safe working environment:

- Delivered classification at the machine boundary (IEC 60825-1 report; FDA certification).
- Guard/window ratings (IEC 60825-4 certificates; transmission/ablation data at welding wavelength).
- Service-mode controls (reduced-power modes, temporary guards, alignment procedures).
- Ventilation & fume recommendations (capture velocity/hood design; test data).

- Interlocks & safety circuits (fail-safe design; remote interlock terminal per 21 CFR 1040.10).
- Eyewear OD/NHZ recommendations for open-door scenarios.

8) Quick Decision Matrix

If you're ready to choose a laser system for your application, use the following table to help decide. Request a quote online at lincolnelectric.com/flexlase.

Consideration	Class 1-Safe Enclosed Welding Cell	Class 4 Open/Service-Accessible System
Lincoln Electric Product	Flex Lase™ Cobot Cart	Flex Lase™ Handheld Laser System
Operator Exposure in Normal Use	≤ MPE outside enclosure; no NHZ in room	Hazardous; define NHZ and restrict access
Primary Standards (Burden on User)	Enclosure/interlocks satisfy classification; user manages service procedures	Full Z136.1 program: NHZ, eyewear, SOPs, training, audits
Guarding	Built-in; vendor validated	User specifies/installs IEC 60825-4 guards/curtains/windows
Ventilation/Fume	Still required for process, but easier to capture inside enclosure	Often bespoke capture; may require industrial hygiene (IH) assessment
Fire Risk Controls	Mostly internal to machine (beam dumps, non-combustibles)	Room-level mitigation and hot-work policies
Schedule & Cost Impact	Lower facility change; faster start-up	Higher installation cost/time due to room controls

Note: Regulation of laser use in the workplace is subject to change. Information provided in this article is accurate to the best of our knowledge at the time it was written. Always check applicable regulations and laws prior to purchase or use of a laser.

CUSTOMER ASSISTANCE POLICY

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