

USER MANUAL

Laser cleaning

LC-CLEAN 1500W CW

MANUFACTURER:

LASERCOMERCIAL ENTERPRISE

B67583120

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INDEX OF CONTENT

LEGAL NOTICES	5
CHAPTER 0 - PREFACE.....	6
RECEPTORS AND GENERAL INFORMATION	6
SYMBOLS, NOTICES, AND CATEGORIZATIONS USED IN THIS MANUAL	7
CHAPTER 1 - SUMMARY	8
1.1 INTRODUCTION	8
1.2 REFERENCES.....	8
1.3 TYPES OF USE.....	9
1.3.1 INTENDED USE.....	9
1.3.2 UNINTENDED USE (FORESEEABLE MISUSE)	10
1.4 CERTIFICATION	11
CHAPTER 2 - LASER SAFETY INFORMATION	13
2.1 SYMBOLS AND WARNINGS IN THIS MANUAL.....	13
2.2 LASER CLASSES	14
2.3 LASER CLASSIFICATION.....	15
2.3.1 LASER PARAMETERS.....	17
2.4 RISKS AND RISK FACTORS AND SAFETY SIGNAGE ON LASER EQUIPMENT	19
2.4.1 HAZARDS DURING THE CLEANING PROCESS: GASES, SMOKE AND DUST ..	24
2.5 PREVENTION AND SAFETY SYSTEMS	25
2.5.1 SAFETY SIGNAGE ON LASER AND PACKAGING EQUIPMENT	26
2.5.2 CREATION OF THE LASER ROOM	28
2.5.3 RISK ASSESSMENT AND DESIGNATION OF RESPONSIBLE PARTIES	29
2.5.4 ADMINISTRATIVE CONTROLS	30
2.5.5 GENERAL	30
2.5.6 RESPONSIBILITIES OF THE PERSONS OPERATING THE MACHINE AND THE USERS OF THE MACHINE	33
2.6 WARNINGS WHEN WORKING WITH LASER CLEANING	34
2.7 PROHIBITIONS	35
2.8 PPE'S	35
2.8.1 SAFETY GLASSES	35
2.8.2 SAFETY MASK.....	38
2.8.3 CLOTHING FOR PPE.....	38
2.9 TECHNICAL DATA OF THE MACHINE	39



2.10 TRAINING	40
2.11 regulations	41
CHAPTER 3 - LASER CLEANING	42
3.1 DESCRIPTION	42
3.2 DIFFERENCES, ADVANTAGES AND DISADVANTAGES WITH RESPECT TO SHOT BLASTING	42
3.2.1 ADVANTAGES OF BLAST CLEANING	42
3.2.2 DISADVANTAGES OF BLAST CLEANING	42
3.3 APPLICATIONS OF LASER CLEANING	43
CHAPTER 4 – MAIN COMPONENTS	44
4.1 LASER RESONATOR	44
4.2 LASER GUN	44
4.3 EXTERNAL AIR CIRCUIT	45
4.4 BACK SIDE CONNECTIONS	46
CHAPTER 5 – USE OF THE EQUIPMENT	48
5.1 ELECTRICAL CONNECTION	48
5.2 ON AND OFF MODE	48
5.2.1 ON MODE	48
5.2.2 SHUTDOWN	48
5.3 CONTROL SCREEN	49
5.3.1 START OF THE SOFTWARE	49
5.4 CLEANING	49
5.4.1 CLEANING MODE	50
5.4.2 OSCILLATION	50
5.4.3 POWER	51
5.5 CONFIGURATION	52
5.5.1 CORRECT	53
5.5.2 I/O	54
5.5.3 TEMPERATURE	55
5.5.4 USERS	55
5.5.5 OTHERS	56
5.5.6 VERSIONS	57
5.5.7 POWER RAMP	58
5.5.8 DYNAMIC PARAMETERS	58



5.9 GUN OPERATION	59
5.9.1 GALVANOMETRIC SYSTEM	60
5.9.2 FOCAL LENS.....	60
5.9.3 PROTECTIVE LENS.....	60
5.9.4 FOCAL LENGTH.....	61
5.9.6 SAFETY.....	61
5.9.7 AIR OUTLET MODES.....	62
5.9.8 PARAMETRY	63
5.10 MAIN FAILURES	64
5.10.1 TEMPERATURE ERROR	64
5.10.2 FAILURE OF ONE OF THE AXES	65
5.10.3 LASER DOES NOT EMIT	65
CHAPTER 6 - EQUIPMENT MAINTENANCE	66
6.1 LENS PROTECTOR REPLACEMENT	66
6.2 GUN CONNECTOR INSPECTION	67
6.3 LASER GUN	67
6.4 AIR CIRCUIT FILTER.....	67
6.5 PERIODIC INSPECTIONS.....	68
CHAPTER 7 - WARRANTY AND CONDITIONS	69
7.1 WARRANTY	69
7.2 CONDITIONS AND LIABILITY	69
7.3 PROCEDURE	70



LEGAL NOTICES

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CHAPTER 0 - PREFACE

This manual is mandatory reading and compliance by anyone who is in the controlled laser zone.

All users must review the user guide in its entirety and receive full training by authorized personnel before using the device

The original language of this manual is Spanish.

RECEPTORS AND GENERAL INFORMATION

This guide is intended for all owners and operators of the LC-CLEAN 1500W CW device, as well as for all persons who work and are in areas near the laser equipment when it is being used.

All users of this product must be trained in laser safety, and must follow all safety instructions and warnings in the user guide, the safety labels on the EQUIPMENT, and all applicable safety rules, laws, and regulations. The following standards and guidelines have been taken into account in the preparation of this manual, which can be consulted for a better understanding of the content:

- UNE-EN 60825-1:2015 Safety of laser products. Part 1: Equipment classification and requirements.
- UNE-EN 60825-4:2006 Safety of laser products. Part 4: Laser radiation protection systems.
- IEC / TR 60825-14:2004 Safety of Laser products – Part 14: A user's guide
- EN ISO 11553-1:2020 Safety of Machinery. Laser processing machines. Part 1: General security requirements.
- UNE-EN 12254:2010 Screens for workstations with lasers. Safety requirements and tests.
- UNE-EN 207:2018 Personal eye protection equipment. Filters and eye protection against laser radiation (laser protection glasses).
- Directive 2006/25/EC of the European Parliament and of the Council of 5 April 2006 on the minimum safety and health requirements concerning the exposure of workers to risks arising from physical agents (artificial optical radiation).
- Royal Decree RD 486/2010, of 23 April, on the protection of the health and safety of workers against risks related to exposure to artificial optical radiation. BOE nº 99 24/04/2010.
- ANSI Z136.9:2013 American National Standard for Safe Use of Lasers in Manufacturing Environments.



SYMBOLS, NOTICES, AND CATEGORIZATIONS USED IN THIS MANUAL

SIGNAGE AND/OR SYMBOL	EXPLANATION
 <u>DANGER</u>	This concept and signage indicates a major hazard to be aware of. If this danger is not avoided, it can lead to deaths, serious injuries.
	This signage indicates 'WARNING', is accompanied by an important explanation for the safety and use of the equipment by the user.
 IMPORTANTE	This signage is accompanied by an explanation that should be paid special attention to since it is highlighted.



CHAPTER 1 - SUMMARY

1.1 INTRODUCTION

This manual contains all the necessary information related to the LC-CLEAN 1500W CW Laser cleaning equipment, and has been produced by LC LASERS. This is a guide compiled with experience and dedication to facilitate the understanding and use of the LC-CLEAN 1500W CW laser cleaning equipment by the end user. In order to make continuous and lasting use of the equipment, the person or persons who are going to operate the LC-CLEAN 1500W CW laser cleaning equipment must be familiar with its installation, operation, maintenance and safety systems.

Very important: Read the manual in its entirety before using the LC-CLEAN 1500W CW laser cleaning equipment. Keep the manual with the machine, in case of sale or transfer of the equipment to third parties, provide the user manual.

Before installation and use, read and follow the instructions in this user manual. Damage to people and/or materials may be the result of not following the instructions set out below.

The operation of the system is only allowed with equipment and spare parts supplied or included in the manufacturer's parts, any type of deliberate modification by the user without consulting the manufacturer may pose a risk to the health of the people who carry out the use of the machine.

The equipment must be handled by personnel trained and authorised by the user company.

The machine complies with all established safety regulations. However, hazards may arise if the machine is operated by untrained personnel, used improperly, or employed for purposes other than those for which it was specifically manufactured. This chapter provides an overview of all the important safety considerations needed to optimize safety and ensure the safe and trouble-free operation of the machine.

Other chapters in this manual also contain specific safety instructions.

Signs, labels and pictograms attached to the machine must be kept visible and must not be removed.

1.2 REFERENCES

The following standards and guidelines have been taken into account in the preparation of this manual, which can be consulted for a better understanding of the content:

- UNE-EN 60825-1:2015 Safety of laser products. Part 1: Equipment classification and requirements.



- UNE-EN 60825-4:2006 Safety of laser products. Part 4: Laser radiation protection systems.
- IEC / TR 60825-14:2004 Safety of Laser products – Part 14: A user's guide
- EN ISO 11553-1:2020 Safety of Machinery. Laser processing machines. Part 1: General security requirements.
- UNE-EN 12254:2010 Screens for workstations with lasers. Safety requirements and tests.
- UNE-EN 207:2018 Personal eye protection equipment. Filters and eye protection against laser radiation (laser protection glasses).
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- ANSI Z136.9:2013 American National Standard for Safe Use of Lasers in Manufacturing Environments.

1.3 TYPES OF USE

1.3.1 INTENDED USE

Laser cleaning is becoming more and more present in different industries and jobs. Some of the applications of laser cleaning are as follows:

- Aircraft and vehicle paint removal
- Cleaning the walls or exteriors of some buildings
- Cleaning in the electronics industry
- Weld cleaning
- Preparation of materials to be welded
- Partial removal of paint layers or coatings
- Cleaning of industrial parts or belts and meshes with accumulated dirt
- Metal oxide removal

This laser equipment is specifically manufactured to work with its built-in software and the uses prepared for this machine, it must be taken into account:

- a) Clean suitable materials with the appropriate parameters that are required
- b) The laser cleaning machine must be used and operated by personnel who are familiar with the equipment, its use and operation.
- c) Failure to comply with or omission of the instructions and warnings contained in this instruction manual excludes any liability to LC LASERS, the manufacturer of the equipment.
- d) All preventive safety measures included in this manual must be used.



To work with other materials or special alloys not specified in the above list, consult LC technical service for their safety.

1.3.2 UNINTENDED USE (FORESEEABLE MISUSE)



Under no circumstances shall the laser cleaning machine be used for any purpose other than cleaning the materials indicated and suitable for laser cleaning.

As indicated in the previous points, you can choose the type of cleaning to be carried out, but not for any other purpose. The user of the laser cleaning machine is obliged to wear the PPE indicated in order to make good intended use of the machine.



Under no circumstances work or be near the laser machine without the appropriate laser protective glasses.

Under no circumstances should the laser cleaning machine be used to work on objects that may injure people or animals or deteriorate buildings and valuables or similar.

Under no circumstances should the laser gun be aimed at living beings, delicate materials, structures, buildings, electrical equipment, electrical appliances, electrical installations, vehicles, cars or any other object that moves away from the cleaning work itself. Serious accidents to people, animals, and valuable facilities can result from these actions. LC is exempt from any guilt and legal, criminal or administrative repercussions derived from the misuse of the laser cleaning machine not provided for in this manual.

Examples of product misuse include:

- i. Working without following the safety measures specifically explained in this guide.
- ii. Use of this product by untrained persons in any area.
- iii. Inadequate protective measures in the workplace. Key protective measures include: (1) Establishing a controlled laser zone with an entry restricted by interlocking; (2) provide PPE to ALL workers within the controlled laser zone (e.g., laser safety glasses, and suitable filters, and appropriate clothing and gloves for cleaning work).
- iv. The unauthorized modification or conversion of the product by the user or other personnel without the express written authorization of LC.
- v. Intentionally disabling or bypassing product safety systems.



- vi. Using parts and consumables (other than PPE that meet safety requirements) from other manufacturers (e.g., protective window, nozzle tips, etc.) that do not meet the minimum requirements.
- vii. Use this product to clean parts containing materials other than those described in section 1.2.1.
- viii. Remove or render illegible safety labeling and hazard warnings.
- ix. Hold the parts by hand or in any way that the cleaning head points in the direction of parts of a person's body.
- x. Use of this product by anyone in a residential area.
- xi. Clean in containers containing flammable, combustible or unknown materials.
- xii. Use laser equipment for non-cleaning work.

1.4 CERTIFICATION

LC Lasers certifies that the LC CLEAN 1500W CW laser cleaning equipment has been inspected and tested by authorized personnel.

LC-CLEAN 1500W CW has passed LC quality control before the shipment of the laser equipment to the customer. This quality control includes the exhaustive review of:

- Internal components of the equipment.
- Conductivity.
- Testing of the equipment and proper operation.
- Exterior aesthetics of the equipment.
- Replacement material.

Below is the declaration of conformity of the LC CLEAN 1500W CW device.



Declaración CE de Conformidad

Nosotros **Laser Comercial Enterprise**
C/ Pere Andorra 5, 08016
08650 - Sallent
(Barcelona)



declaramos, bajo nuestra única responsabilidad, que la instalación:

Denominación genérica: Limpieza láser
Marca: LASER COMERCIAL ENTERPRISE SLU
Modelo: LC-CLEAN CW 1500W
Código de producto: LC-LL1500W
Año de expedición: 2025

clasificada como máquina, según la directiva 2006/42/CE - *Directiva de Máquinas*,

y a la que se refiere esta declaración, se adapta a lo reflejado en las siguientes normas o documentos normativos, entre otros:

EN ISO 12100:2012 - Seguridad de las máquinas. Principios generales para el diseño. Evaluación del riesgo y reducción del riesgo.
EN 60204-1:2007 - Equipo eléctrico de las máquinas. Parte 1: Requisitos. Generales
EN ISO 14120:2016 - Seguridad de las máquinas. Resguardos. Requisitos generales para el diseño y construcción de resguardos fijos y móviles.
EN ISO 14119:2014 - Dispositivos de enclavamiento asociados a resguardos. Principios para el diseño y la selección
EN ISO 13857:2005 - Distancias de seguridad para impedir que se alcancen zonas peligrosas con los miembros superiores e inferiores
EN ISO 13850:2007 - Parada de emergencia. Principios para el diseño.
EN 60081-2:1993 - Compatibilidad electromagnética. Norma Genérica de emisión. Parte 2: Entorno Industrial
EN ISO 13849-1:2009/AC - Seguridad de máquinas. Partes de los sistemas de mando relativos a la seguridad. Parte 1: Principios generales para el diseño.
EN 13849-2:2013 - Seguridad de máquinas. Partes de los sistemas de mando relativos a la seguridad. Parte 2: Validación.
EN 13732-1:2005 - Ergonomía del ambiente térmico. Métodos para evaluación respuesta humana a contacto con superficies. Superficies calientes.
EN 1537:1999+A1 - Seguridad de las máquinas. Iluminación integrada en las máquinas
EN 61310-2:1995 - Seguridad máquinas. Indicación, marcado y maniobra. Requisitos para el marcado.
EN 61310-3:1999 - Seguridad máquinas. Indicación, marcado y maniobra. Requisitos para la localización y funcionamiento de actuadores.
EN 60826-1:2015 - Seguridad de productos láser. Parte 1: Clasificación de los equipos y requisitos.
EN 60826-4:2007 - Seguridad de productos láser. Parte 4: Sistemas de protección frente a la radiación láser.

El producto descrito es conforme con las siguientes Directivas Europeas:

2014/35/UE Directiva de Baja Tensión

2014/30/UE Directiva de Compatibilidad Electromagnética

2006/42/CE Directiva de Máquinas

La propia empresa arriba indicada se encargará de recopilar el Expediente Técnico de Construcción bajo requerimiento motivado de las autoridades nacionales competentes, según se indica en el Anexo II 1.A apartado II de la citada Directiva 2006/42/CE.

Sallent,
10 de ENERO de 2025
(Lugar y fecha de la exposición)

Ferran Sardans,
Director Técnico
(Nombre y firma)





CHAPTER 2 - LASER SAFETY INFORMATION

To ensure safe operation and optimal performance of laser cleaning equipment and associated peripherals, follow all warnings in the product's user guide.

Safety precautions must be observed during all phases of operation, maintenance, and service.

It is essential to read the manual in its entirety before using the LC-CLEAN 1500W CW laser cleaning equipment. Keep the manual with the machine, in case of sale or transfer of the equipment to third parties, provide the user manual.

Before installation and use, read and follow the instructions in this user manual. Damage to people and/or materials may be the result of not following the instructions set out below.

The operation of the system is only allowed with equipment and spare parts supplied or included in the manufacturer's parts, any type of deliberate modification by the user without consulting the manufacturer may pose a risk to the health of the people who carry out the use of the machine.

The equipment must be handled by personnel trained and authorised by the user company.

Users of this equipment should follow these recommendations and apply proper laser safety practices at all times and in all work related to this equipment.

All set-up operations, as well as maintenance, should be carried out only by qualified personnel.

2.1 SYMBOLS AND WARNINGS IN THIS MANUAL

In CHAPTER 0, the symbols and words used in this manual are specified to indicate the importance of concepts and/or explanations. They are designed to draw your attention to any hazards or important information. These standardized signal words will identify important hazards and warnings.

Safety warning messages will appear in this user guide whenever hazards or risky situations may occur. They shall alert the user to the direct and indirect dangers related to the use of the product and associated peripherals, and shall contain general rules of behaviour.



For your safety, it is important to read and fully understand the meaning of these signage words and symbols. Follow all safety warnings and proceed with caution to avoid accidents, personal injury, and property damage.

2.2 LASER CLASSES

The class of a laser is the first piece of information that indicates its dangerousness. This information is easily accessible. It is mentioned on the laser device as well as in its instructions for use. This is a regulatory and normative obligation for the manufacturer.

These classes, which are 8, may be summarized as follows (1; 1M; 1C; 2; 2M; 3R; 3B; 4).

CLASS	RISKS
1	The device is safe to use, including direct viewing for a long period of time, even when using optical observation devices.
1M	Laser-free beam, including direct vision for a long time (with the naked eye); Seeing through an optical instrument can be dangerous (the letter "M" stands for "magnifying optical vision instruments")
1C*	Without ocular risk, the VLE for the skin (or other non-ocular tissues) can be exceeded in case of interactional exposure (the letter "C" derives from the term "contact", deduced from the mode of operation).
2	Safe ** for momentary exposures (0.25 s), valid only for the wavelength range of 400-00 nm.
2M	Safe ** for a short period of time; possible injury if seen with an optical instrument.
3R	Laser that exceeds the maximum allowable exposure (MPE) for direct viewing in the beam (the letter "R" stands for "reduced requirements")
3B	Dangerous if exposed to direct beam, regardless of the duration of exposure. Diffuse reflections are normally safe, but EMP can be overcome when using an optical vision instrument. In addition, there is a risk of fire due to the direct beam (the letter "B" is historical because it comes from the first classification).
4	Dangerous direct vision, dangerous exposure of the skin, dangerous diffuse reflection and high risk of fire, also due to diffuse reflection.



* This class refers to direct applications with intentional radiation exposure to the skin or internal tissues of the body in medical, diagnostic, therapeutic, or cosmetic procedures. The laser radiation emitted can be Class 3R, 3B or 4, but the technical characteristics of the device prevent eye exposure (the beam can be Class 3R or 4, but the technical characteristics of the device prevent eye exposure (the beam can be only if the applicator is in contact with the skin, or very close to the skin or internal tissues of the body), thus reducing the hazard class to Class 1. By extension, the requirements of this class can be applied to laser equipment developed, for example in the biomedical research of the CNRS.

** The concept of "safe" is linked to the absence of injuries. However, these rays can cause intense and painful glare.

2.3 LASER CLASSIFICATION

The laser cleaning equipment is a Class 4 (USA: Class IV) laser system identified according to DIN EN 60825-1.

To avoid eye irritation during operation, the operator should NEVER look directly at the laser source and should wear eye protection goggles.

Class 4 (U.S.) (USA: Class IV)

High-power lasers (visible or invisible) that are considered to pose an acute potential risk to the eyes and skin in both direct (intrabeam) and scattering (diffuse) conditions. Also have potential hazard considerations for fire (ignition) and byproduct emissions from the target or process materials.

It is the responsibility of the machine operator to take appropriate measures to eliminate hazards such as fires or explosions through the laser beam.

When working with Class 4 (US: Class IV) lasers, follow these precautions:

- In accordance with BGV B 2 "Laser Emission", a trained laser safety officer must be appointed to assess potential hazards and ensure that appropriate control measures are in place.
- The laser-controlled area should be marked with appropriate warning signs or warning lights.
- The laser-controlled area will be defined to contain laser radiation.
- It must also be protected from unauthorized access.
- The operator of Class 4 laser systems must always wear appropriate safety glasses.
- An indicator (typically a light) to provide a warning of laser emission before and during the time of issuance.

**DANGER****INVISIBLE LASER RADIATION CLASS 4**

Serious and permanent eye damage from reflected or scattered radiation.

Precautions:

If the system can be active (key switch on), it is necessary to wear laser goggles within the protected laser area.

- Once it stops working and before leaving the controlled laser zone, the laser device operator must: (1) turn the key switch to the OFF position and (2) remove the key to store it in a safe place. This prevents unauthorized and untrained personnel from using the laser device.

The LC CLEAN 1500W CW has a red pointer on the head to help center the beam. This red pointer is a 2M class laser.

All lasers should be rated according to their output power or energy and the wavelength of the laser. This device is classified as a high-power laser instrument with the laser classification for each type of laser specified below.

	Main Fiber Laser (Used for Cleaning)	Laser indicator (pre-job positioning aid)
Laser Classification	Class 4	Class 2M
Wavelength	1070 nm	600 to 700nm
Laser radiation emitted	Invisible (Infrared)	Visible (Red)
Medium power	1500w	20mW
Peak Power	<110kW	20mW

**DANGER****CLASS 4 INVISIBLE LASER RADIATION - HAZARDS TO THE EYES AND SKIN**

This level of light can cause serious damage to the eyes and skin.

Cautions:



- Because of these risks, a qualified laser safety officer must be present to ensure a safe working environment.
- If the system can be turned on, it is necessary to wear laser goggles within the controlled laser zone.



-
- While the laser device is in operation, the appropriate laser guards, guards and safety procedures must be present.
 - The laser operator must wear all recommended PPE, including: (1) specified laser protective goggles. Additional PPE intended to protect the skin includes fire, heat, and arc-flash protective gloves, clothing, and aprons.
-

**DANGER****VISIBLE LASER RADIATION CLASS 3R.**

- Avoid exposing your eyes to this laser.
 - Avoid looking directly at the laser beam directly or with optical instruments.
-

2.3.1 LASER PARAMETERS

A laser is a device that produces a special form of light. A conventional light source, such as a light bulb, produces a diffuse form of light that contains a wide range of wavelengths. A laser produces a much more structured light. Laser radiation is extremely bright (several orders of magnitude greater than the light we receive from the sun), has a high degree of purity (can be thought of as a single wavelength), and is usually emitted in a very narrow beam.

The divergence of a typical laser beam is only 1mrad, i.e. the beam will scatter only 10 cm after traveling 100 m. These properties make laser radiation ideal for cleaning use in various applications:

Restoration, rust removal, grease cleaning, among other options. The purity of the beam allows for the selective removal of unwanted material, while its low divergence and high brightness allow the beam energy to be conducted by a lens and focused to reach the power and energy density needed to remove material impurities from a surface.

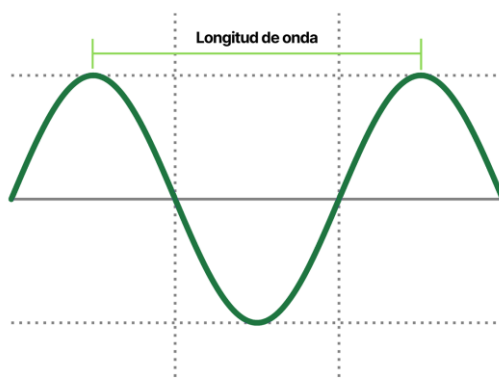
The term LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers are devices that produce a very special form of light, very dense in energy. There is a whole range of lasers that are used in sectors as varied as industry, surgery, telecommunications, construction, etc. Closer to home, there are "scanners" at the grocery store, CD players, etc.

Wavelength: Laser light is a form of energy that behaves, for practical purposes, like a wave. Wavelength is the distance between two peaks.

The wavelengths of laser radiation are usually expressed in nanometers (nm). A nanometer is equivalent to one millionth of a millimeter or 10^{-9} meters or 0.000000001 meters. The wavelengths of light emitted by different types of lasers range from 190 nm to 10,600 nm.



The wavelength of laser radiation from a cleaning equipment is usually 1064nm.



Power: The power of a laser, concentrated in a small area, can be enough to cut metal. In other cases, the potency is so low that there is no risk to the eyes or skin.

In practice:

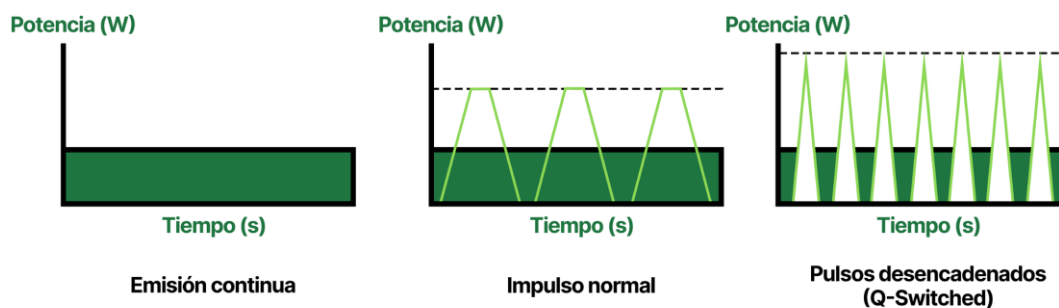
- For a pulsed laser, the amount of energy in joules (J) that it can release per pulse is given. Power can also be quantified by taking into account the duration of a pulse. Power is expressed in watts, which corresponds to 1 J/s.
- For a continuous emission laser, its emission power is given in watts (W). The output power of continuous wave lasers can range from a fraction of a milliwatt to several kilowatts.

However, with the same average power, the maximum power of a single pulse at the output of a Q-switched laser can reach gigawatts or even terawatts in some types of lasers. These high powers correspond to an energy released in a very short time.

Tiempo: Duración de un impulso

Área verde oscuro: Potencia media

Línea discontinua: Nivel de potencia máxima



Type of issue:

Laser radiation can be emitted in the form of a pulse or continuously. A laser can emit light continuously or pulsed, depending on the nature of the pumping source. If the pumping source provides power in a short burst (rather than continuously), the resulting emission is a pulse of light.



- The pulses. The duration of the pulses varies from a few femtoseconds (10-15s) to several tens of milliseconds. These pulses follow one another at highly variable rates, from a few pulses per hour to several hundred per second. They can be of three types: normal, Q-switched, or locked mode.
- Broadcast continues. A laser is said to emit continuously if the duration of emission exceeds 0.25 seconds, which is the time of the eyelid closure reflex (eyelid reflex). When the eye is subjected to intense light, the eyelid has the reflex to close to protect the eye.

2.4 RISKS AND RISK FACTORS AND SAFETY SIGNAGE ON LASER EQUIPMENT

As stated in the previous section, there are several risks and risk factors in the LC LASERS manual laser cleaning system:

EYE HAZARDS

The eye is an extremely sensitive and important part of the body. The eye's great ability to collect and focus light means that it is vulnerable to laser-induced damage.

Damage can occur at all wavelengths, although the area of tissue affected depends on the wavelength. Laser radiation emitted in the visible (400 - 700 nm) and near-infrared spectral regions (700 - 1400 nm) pose the greatest risk, as the light is effectively transmitted through the ocular fluid and is concentrated on a very small point on the retina, at the back point of the eye. This range of wavelengths is known as the risk region of the retina.

This high concentration of energy can be enough to permanently damage the retina. This damage can be especially severe if it occurs in the central region (fovea) of the retina, which contains an especially high concentration of light sensors. Damage can seriously affect the vision in that eye. Unfortunately, most accidents occur with the observer looking in the direction from which the laser beam has traveled, so damage and therefore eye damage is more likely to occur in this critical region.

Short-wavelength (<300 nm) laser radiation in the ultraviolet and long-wavelength in the far-infrared (>3000 nm) is absorbed in the front of the eye, which can damage the cornea. Laser radiation in the mid-infrared (1400 - 3000 nm) and near-ultraviolet (300 - 400 nm) is mainly absorbed by the lens, which can lead to the formation of cataracts.



Even brief exposures to a high-intensity laser beam can cause damage.

SKIN HAZARDS

Laser radiation can also cause skin damage, although skin hazards are generally considered less serious than eye hazards. The part of the skin affected will depend on the wavelength of the laser beam. Visible and near-infrared radiation (400 -1400 nm) is able to penetrate the epidermis (50 -150 μm from the surface) and dermis (1 - 4 mm), while far-ultraviolet and far-infrared radiation is strongly absorbed in the stratum corneum (8-20 μm). Potential effects of irradiating the skin by a laser beam are summarized in the table.

Standard: UNE-EN 60825-1:2015

LC CLEAN is a class 4 laser product



ELECTRICAL RISK

This is due to the manipulation of the power supply circuit, which should only be accessed by authorised maintenance personnel using specific safety measures related to electrical risk and/or deficiencies in the insulation of the flexible cables or connections to the machine's network.

To reduce the electrical risk, do not open the door intended for the storage of the electrical circuit, as there are no parts inside that the user must handle, in case of failure disconnect the machine and notify a manager or authorized person to contact the specialized technical service.

To avoid indirect contact, make sure that there is adequate grounding and the housing is in perfect condition. It is necessary to ensure that the chassis of the LC-CLEAN 500W P laser cleaning system is connected to the earthing connection.



Do not use gas, flammable liquid or electrical conduits for earthing connections. Direct electrical contact can occur in the power supply circuit due to insulation deficiencies in flexible cables or connections to the network or machine.

Indirect electrical contact can occur with the machine housing due to a voltage defect or grounding connection defect.

LASER RADIATION

Observation within the class 4 laser beam and exposure of the skin are dangerous, as well as observation of diffuse reflections.



IMPORTANT NOTE: The use of protective glasses is mandatory both for the use of the machine and to remain in the area of use given the risks previously exposed.

PROJECTIONS AND BURNS

Eye projections and burns can be caused by micro-projections of particles of materials detached from very thick layers that are being cleaned. Take the necessary steps to protect your eyes and skin.

Risks of burns or skin lesions. To minimize the risk, it is recommended to wear appropriate clothing of appropriate length for the activity being carried out, being cotton safety clothing that completely covers the operator's arms and torso.

EXPLOSION AND FIRE

It can originate from working in flammable environments or inside containers that have contained flammable liquids or when working with containers that have contained flammable products. To avoid or minimise the risk, the material must be checked before starting the activity with the laser equipment.

INHALATION OF POLLUTANTS

Risk of inhalation of pollutants produced by smoke-producing cleaning. To minimise or avoid the risk, optimal ventilation of the premises is recommended together with a localised extraction or, failing that, a confinement of the process. In the event that the first method is not sufficient and an isolation of the process cannot be carried out, the worker's individual protection must be used in a complementary way for the respiratory tract.

BLOWS OR FALLS

Risk of bumps/cuts against moving and stationary objects of the equipment, such as the housing or other parts of the machine.



Risk of falling objects in handling, good use of the hose and gun is recommended during use.

Risk of falling at the same level, it is recommended to maintain order and cleanliness in the work area to avoid falls caused by the moving parts of the equipment such as the hose.

ACOUSTIC RISKS

There are three sources of noise in laser cleaning workplaces:

- The laser system itself.
- The smoke extraction device.
- The laser cleaning process. The rapid ejection of material from a surface during laser cleaning causes the generation of sound waves, which propagate outside the surface and are heard as a "click".

The long-term effects of joint exposure to the three noise sources have not been investigated by any institution at either European or global level. However, the noise levels of the laser system itself are not very high, and the smoke extraction device will depend on the equipment used.



Risk that can lead to incorrect actions by untrained people!

Improper use of the machine may result in injury and/or damage to the machine and third parties.

It is necessary to inform the personnel and user who will use the equipment about the operation of the machine and any other risks.

Consult the official rules on the operation of machines and the rules for accident prevention.



Risk arising from the fault, failure or error of safety installations and machine components!

Defective or missing safety installations and machine components can result in death, injury, and/or damage to the machine.

Carefully check that the safety systems and machine components are working properly and do not exhibit faults or unusual behavior.

The actions specified for each fault should be taken immediately if the parts are defective or defective.

**Risk derived from incorrect operation (especially at the time of configuration)!**

Setting up and operating the machine with limited knowledge of its function may result in injury and/or damage to the machine and/or third parties.

It is necessary to read the operating and safety instructions carefully before starting the machine and starting any type of work

**Risk of incorrect use of the equipment by unauthorized persons and/or with the appropriate knowledge!**

Setting up and operating the machine with limited knowledge of its function may result in injury and/or damage to the machine and/or third parties.

It is important to never leave the machine unattended while it is in operation.

Turn off the machine with the main switch when not in use and work is finished.

**Risk posed by the lack of machine signalling!**

Making incorrect assumptions can lead to the risk of the machine being operated incorrectly.

Machine and workspace signage must be used correctly.

**Risk derived from irreparable breakdowns!**

Any non-repairable failure can damage the machine. In this case, it is required to turn off the machine properly and call customer service.

**Risk arising from the use of substandard parts or from other manufacturers.**

The use of substandard spare parts or parts from other manufacturers impairs the safety of the machine and invalidates the Declaration of Conformity (CE) supplied with the machine.

Worn parts or damaged mechanical, safety or electrical components should be replaced with original spare parts, consult your supplier.

**Risk due to lack of protective equipment!**



It is mandatory to wear the appropriate work clothes.

It is mandatory to wear high-powered laser protective safety glasses (Class 4 / US: Class IV).

It depends on which materials you are working with, it is required to use a suitable extraction system, there are some materials that when cleaned with lasers emit harmful fumes.



Risk posed by laser marking reaction products!

A suitable extraction system must be used in laser marking due to the possible generation of gases, fumes and any other partially toxic by-products.

In individual cases, reaction products may consist of static powder. If it enters any electrical system, it can cause short circuits that result in personal injury and property damage.



Risk posed by flammable or explosive materials!

Class 4 laser radiation can ignite materials or cause explosions. Among others, it must be ensured that:

The parameters are selected so that the material does not overheat.

The system is monitored if necessary.

Dust is safely extracted.

There is no build-up of flammable residue or remnants in the workspace.

2.4.1 HAZARDS DURING THE CLEANING PROCESS: GASES, SMOKE AND DUST

Laser cleaning can involve the generation of fumes and the emission of other substances into the air caused by the same process of evaporation of impurities from a surface. This waste is mainly composed of substrate material. In addition, small amounts of compounds that were not part of the original material, gases generated by the thermal cracking of organic substances and their combustion caused by the laser. It is known that these laser-generated air pollutants can create unpleasant odors and visible smoke.

Depending on the materials being cleaned and the parameters selected, laser cleaning can generate gases, fumes, aerosols or dust.



The toxicity of such fumes and residues depends on the material or dirt in question.

These potentially harmful fumes should be removed from the breathing area by extraction if there are high concentrations of fumes for a long time.

The operator is responsible for ensuring that an adequate extraction system is in place and for complying with relevant guidelines to protect people and the environment.

The VDI guideline 2262 1... 3 "Air in the workplace" provides, among other things, additional observations.

The operator must also ensure that gases, fumes, or dust do not settle on the laser gun lens. Any dirt that accumulates on the lens can lead to loss of performance, property damage, poor marking results, and damage to the device. Contact your service to get a new one in case of damage.

In a very concrete example, recent research has shown that in a 50m² floor area and 4 m high workshop without any air exchange, 10 minutes of limestone laser cleaning was enough to achieve the maximum permissible workplace concentration (CMPT) of breathable quartz powder.

Another study, also conducted indoors, showed that the waste emitted resulting from the removal of sulfation crusts by laser cleaning included a significant proportion of particles with diameters equal to or less than 3µm. These small particles can penetrate the lungs to the alveoli and are potentially harmful due to the solubilization of their alkaline and metal salt compounds.

It is sometimes difficult to determine the real danger of the fumes generated by the fact that the exact composition of the layer of dirt being removed is often unknown.

In any case, the danger of smoke generation is solved with a properly functioning fume extractor and with the ventilation of the workspace once the day is over. In addition, **the use of a mask during cleaning work is highly recommended**. On some occasions, the use of masks and/or **respiratory protection systems with air supply may be mandatory**.

2.5 PREVENTION AND SAFETY SYSTEMS

There are different prevention and safety systems that will make the handling and operation of the LC-CLEAN 1500W CW Laser cleaning equipment much safer and minimize risks during its use.

The laser cleaning machine has the following safety features:

- Machine on/off key;
- Laser on/off button;
- Emergency stop button;



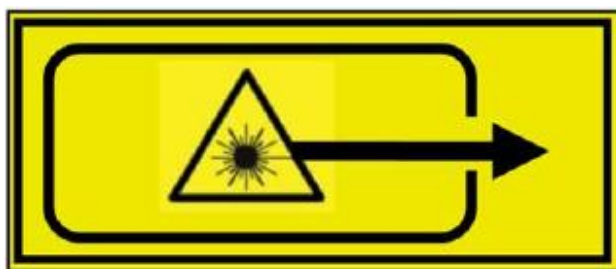
- Emission notification display and notice.
- Proper signage
- Creating a secure workspace

2.5.1 SAFETY SIGNAGE ON LASER AND PACKAGING EQUIPMENT

The UNE-EN 60825-1 standard requires that each laser product must carry labels to warn about the class, the beam emission opening, the characteristics and the dangers of exposure to laser radiation generated by the specific product.

In addition to the identification and laser sorting labels on the LC CLEAN 500W P machine, the following are available:

- A label indicating the output of the laser beam, i.e. on the cleaning torch with an arrow pointing towards the tip:



- A label indicating the characteristics of the laser emission (wavelength and maximum power), the hazard from exposure to visible and invisible Class 4 radiation.



(ejemplo)

On the other hand, the following signs may appear on the equipment or in certain work areas around it. Here's what it means:



SAFETY GLASSES.

Mandatory eye protection.

Pictogram according to EN 61310 standard Indication, marking and manoeuvring.

Part 1: Specifications for Visual, Audible, and Tactile Cues, Section 7.

**GLOVES.**

Mandatory hand protection against burns.

Pictogram according to EN 61310 standard Indication, marking and manoeuvring.

Part 1: Specifications for Visual, Audible, and Tactile Cues, Section 7.

**FACE SHIELDS.**

Mandatory face protection.

Pictogram according to EN 61310 standard Indication, marking and manoeuvring.

Part 1: Specifications for Visual, Audible, and Tactile Cues, Section 7.

**WARNING! RISK OF ELECTRICAL CONTACT.**

Work on the electrical installation must be carried out exclusively by qualified personnel authorised by the company and in compliance with safety regulations.

Pictogram according to EN 61310 standard Indication, marking and manoeuvring.

Part 1: Specifications for Visual, Audible, and Tactile Cues, Section 7.

WARNING! LASER RADIATION RISK

Work with the laser machine must be carried out exclusively by qualified personnel authorized by the company and in compliance with safety regulations.

Pictogram according to the specific standard in laser radiation EN 60825-1.

**WARNING! GENERAL DANGER.**

General indication of caution due to a hazard that will be defined in the area where the sign is placed.

Pictogram according to EN 61310 standard Indication, marking and manoeuvring.

Part 1: Specifications for Visual, Audible, and Tactile Cues, Section 7.

2.5.2 CREATION OF THE LASER ROOM

Most laser cleaning systems produce a divergent laser beam. As the laser beam moves away from the system, it will eventually spread to such an extent that it can be considered safe, i.e. too weak to harm the eye. This distance is called the Nominal Eye Hazard Distance (NOHD). NOHD depends on the characteristics of the laser cleaning system being used, including wavelength, pulse length, pulse energy, and beam divergence.

Laser cleaning should be carried out within a controlled area, within which the laser beam is confined.

- Adequate warning signs must be present and a warning light (activated when the laser is in operation) must be clearly visible in the workspace and when entering the work area.
- It is also optional to incorporate an acoustic signal that is activated when the laser is fired.
- Interlocks must be installed at the access points to the controlled area so that the laser system is turned off when someone enters the area.

When setting up a controlled zone (whether inside a large studio or outdoors), the path of a laser beam escaping from the zone (if a roof has not been included) should always be taken into account: there may be specular reflective surfaces (e.g. shiny metal pipes) above the work area or windows on the upper floors of a neighbouring building directly in the line of sight.

In such cases, there is a possibility that people outside the controlled area may be inadvertently exposed to dangerous radiation, so a roof should be included (of course, it may also be necessary outside to protect from the weather). On scaffolding, any gaps between the scaffold boards must be secured if working above or below the laser cleaning area.

- The particles and fumes generated by the cleaning process must be sucked up at their source.



This room may consist of a room or an area delimited by fixed or movable partitions (cabin, protective enclosure, etc.). It is considered an area with access reserved for personnel authorised by the head of the unit.

Controlled laser room signage:

There should be adequate signage indicating the presence of a laser and its level of risk. This signage must be clearly visible and legible at all entrances to the premises. Includes:

- The "laser risk" pictogram.

A warning light, flashing or not, placed in a visible place, is recommended, which warns of the activation of a laser in the room. It can be supplemented by the emission of an acoustic signal. If a facility has multiple Class 3B or 4 lasers, the warning light should be activated as soon as one of the sources (including the power capacitor) is powered. Whenever possible, it is recommended that the indicator light be linked to the laser power. These lights can also be replaced by light boxes (or light columns). They are made up of several lights and provide more accurate information about the nature of the risk depending on the use of the laser. The meaning of each color in the display panel* should be specified and it is advisable to harmonize it for the entire unit.

In summary, the following should be taken into account to create a safe space:

- a) Illuminated warnings
- b) Access control to the laser cleaning area
- c) Fume and particulate extractor
- d) Good lighting and ventilation in the work area
- e) Cover glass windows and the like
- f) Interlock switch for access to controlled work areas
- g) PPE Needed

2.5.3 RISK ASSESSMENT AND DESIGNATION OF RESPONSIBLE PARTIES

The workplace risk assessment should identify all hazards, establish the conditions under which they may exist and identify the level of risk to which people may be exposed. Appropriate safety controls can then be put in place to reduce the level of risk to an acceptable level. Both risk assessment and security controls must be documented. There should be a formal written framework in which the organization manages laser safety.

To guarantee a safe space area and to be aware of all the dangers and safety measures to be taken, it is useful to assign a **Laser Security Officer (LSO)**. This figure must assume



administrative responsibility for laser safety on behalf of the employer and ensure compliance with safe work procedures.

The role of the laser safety officer is to:

- Ensure appropriate control measures.
- Regular monitoring of laser hazards.
- The effectiveness of the control measures applied.
- Maintenance of workspace and equipment.

The employer retains overall responsibility for laser safety. The employer must ensure that the LSO has the knowledge and ability to perform their role effectively.

The LSO may need to use a Laser Protection Advisor (LPA) in certain situations. The Laser Protection Assessor, for example, must establish appropriate safety controls when working conditions differ in any way from the normal situation.

The role of the LSO should also include the specific approval of control measures. This is especially important in the case of outdoors, where the security installation will be temporary and conditions can be very different from ideal conditions. The LSO must inspect and approve (or, if necessary, require changes and additions) such facilities before they can be used. This approval must be documented so that it is reflected what conditions are being met when working with a laser cleaning equipment.

2.5.4 ADMINISTRATIVE CONTROLS

Administrative controls involve keeping track and controlling who uses the laser cleaning system and how it is used.

The procedural aspects of administrative controls, i.e. "local rules", are extremely important, as they establish the organisational framework in which the laser will be used. A vital part of laser safety is awareness of hazards and understanding the procedures in place to reduce the risk of injury to an acceptably low level.

It is critical to restrict the use of a laser cleaning system to personnel who have been trained in the safe use of lasers.

2.5.5 GENERAL

Power supply circuit

The power cords must be of the right cross-section so as not to lead to overheating.

Its insulation shall be sufficient for a nominal voltage < 1000 V.



The connection terminals of the LC-CLEAN laser cleaning device and the plug pins must be properly insulated.

Light radiation

Class 4 laser devices should not be used without first carrying out a risk assessment to identify dangerous situations and assess the foreseeable level of exposure to the laser, as referred to in paragraph 4 of Directive 2006/25/EC on the minimum safety and health requirements concerning the exposure of workers to risks arising from physical agents (artificial optical radiation). In addition, it will serve as a basis for determining the control and protection measures necessary to ensure safe operation.

The following factors will be taken into account in this assessment:

- Characteristics of the area(s) intended for laser cleaning.
- Process control.
- Manual operations.
- Fastening and positioning of the parts.
- Beam output considerations: structural integrity of components, means of maintaining the condition of optical components, means of maintaining beam alignment, etc.
- Situation and location of workers during laser cleaning.
- Environmental factors.
- Geometry, composition and surface finish of the piece or pieces to be worked.



IMPORTANT INFORMATIVE NOTE: When working with highly reflective materials, the bounce light can conserve a lot of energy in the first section of said bounce, it is recommended to take extreme precautions in the hands to avoid burns on the skin and not to touch the worked parts just after cleaning them with laser, wait a prudent time.

Trained and specialised LC LASERS personnel will inform the user of this risk assessment.

As a general rule, safe workspaces must be delimited. Depending on the risk assessment carried out, one or a combination of the following options will be chosen:

- i. Install the cleaning equipment inside a controlled area, i.e. an enclosure with fixed walls and ceiling and an access door with safety switches to prevent access by third parties. Access will be restricted to authorized personnel.
- ii. Use workstation separation screens to protect other operators from direct and indirect laser light radiation. The material should be opaque, preferably solid sheet metal and non-reflective surfaces. The use of robust translucent material is also possible, which must be selected according to the optical protection properties suitable for the wavelength and power of the laser source. The bottom should be at least 50 cm off the ground to facilitate ventilation. It should be marked with the words: DANGER, RISK OF LASER RADIATION.



Regardless of the solution adopted, the use of approved laser protective glasses is mandatory for the operator operating the laser cleaning equipment and any other person who is observing the work.

There are two types of radiation generated during laser cleaning:

- Direct radiation is the radiation emitted by the gun or torch and that cleans the material. Such radiation can cause severe burns in direct contact with the skin and eyes.
- Indirect radiation is that produced by the bounce and/or reflection of the light emitted by the gun or torch. This light has a specific wavelength, between 1060-nm and 1080nm. This wavelength is covered with the special glass that the protective glasses have.

Projections and burns

It is recommended to wear cotton safety clothing that completely covers the operator's arms and torso to protect the skin properly. The user must use protective glasses, and face shields, which in addition to protecting from radiation, do so from the micro projections from the cleaning process.

Protection against toxic fumes and vapours resulting from the cleaning process

Use a fume and vapour extraction system, duly located near the cleaning area, and must evacuate such fumes and vapours outside the work area, ensuring a renewal of clean air.

Ventilate the workspace on a recurring basis when laser cleaning equipment is not being used.



If the material to be cleaned generates a lot of fumes due to its composition (galvanized, aluminized or other treatments), it will be mandatory to incorporate a smoke and vapor extraction system or, failing that, respiratory protection equipment with air supply.

Grounding

Installation of grounding jacks must be done according to the manufacturer's instructions.

It is necessary to ensure that the chassis of the laser cleaning equipment is connected to the ground.

Do not use gas, flammable liquid or electrical conduits for earthing connections.



2.5.6 RESPONSIBILITIES OF THE PERSONS OPERATING THE MACHINE AND THE USERS OF THE MACHINE

Store this manual close to the machine's workstation so that it is accessible at all times to all persons working on the machine.

The user must ensure that the machine is only operated in perfect safety and maintenance conditions.

You should always have a fire extinguisher handy, as the laser beam can ignite flammable materials.

Do not store any flammable materials inside the device or in the vicinity of the device. In particular, the remains of materials produced must be removed to avoid the risk of fire.

The operator must ensure cleanliness and accessibility in and around the machine by means of appropriate instructions and controls.

The machine should only be operated by trained and authorized personnel.

For all activities related to installation, assembly, commissioning, operation, modifications of conditions and methods of operation, maintenance, inspection and repair, the shutdown procedures that may be provided for in the Operation Manual must be observed or the specialized technical service must be contacted.

It is the operator's duty to check the machine before starting work for externally visible damage and defects, and to immediately report any changes (including behavior during operation) that affect safety.

Preparation, retooling, workpiece change, maintenance and repair activities should only be carried out with the equipment turned off, by trained personnel.

Mainly, no safety components can be removed or deactivated (we already emphasize imminent dangers, e.g. severe burns, loss of sight). If safety components need to be removed during repair and service, replacement of safety components should be performed immediately after completion of service and repair activities.

No working methods that affect the safety of the machine are permitted.

It is absolutely forbidden for anyone who is under the influence of drugs, alcohol, or medications that alter a person's reaction to work or work with the machine.

The scope of competence for the different activities in the scope of operating the machine must be clearly defined and observed, so that unclear competence issues do not arise under the safety aspect. This applies in particular to activities on electrical equipment, which should only be carried out by special experts.

- a) Follow safety instructions to avoid bodily injury and property damage while working on and with the machine.



- b) Failure to follow these instructions may result in bodily injury and damage to or destruction of the machine.
- c) Failure to disregard the safety advice and instructions given in this manual will release the manufacturer and its authorized representatives from any liability and claims.

2.6 WARNINGS WHEN WORKING WITH LASER CLEANING



The laser beam should never be aimed at people or animals!

Never attempt to modify or remove the safety devices or the laser head cover!

Never attempt to modify or disassemble the laser and do not attempt to start up a system that has been modified or disassembled

The use of this machine for any purpose other than that for which it was manufactured: cleaning materials by means of a laser is prohibited.

Exposure to hazardous radiation may result from the use of operating equipment or settings different from that described herein, and if different operating methods are performed.

- The workplace must be well lit. This allows the conservator to see the work correctly (especially if they are wearing tinted eye protection), move freely around the work area and see other hazards, such as trailing cables. Ideally, the walls surrounding the workplace should be light in colour and reflect light diffusely.
- The work area must be well ventilated.
- Specularly reflective surfaces should be removed from the workplace to reduce the possibility of reflections. Tools around the workspace that may have shiny surfaces; They must be covered with anti-reflective tape.
- Care should be taken when wearing jewelry during laser cleaning operations.
- If the boundaries of the controlled area contain windows, they should be covered with a material that is opaque to the laser radiation being used (glass transmits most of the wavelengths used in laser cleaning very well).
- Attention should also be paid to the number of people present in the controlled area. Ideally, only one laser should be used at a time and no other work should be done while using the laser.
- If more than one laser cleaning system needs to be used simultaneously, a controlled zone must be created for each laser.



2.7 PROHIBITIONS



Cleaning work should not be carried out with the LC-CLEAN 1500W CW laser cleaning equipment near places where degreasing operations are being carried out, as hazardous gases may be produced.



Nor will it be allowed to work inside containers, tanks or barrels until they have been completely cleaned and degassed with steam.



It is forbidden to carry out any type of cleaning without the necessary protective equipment.



Never use the LC-CLEAN 1500W CW laser cleaning equipment outside the materials to be cleaned.



It is forbidden to store or operate near corrosive or flammable materials.

2.8 PPE'S

2.8.1 SAFETY GLASSES

Laser protection glasses, as PPE, must be CE certified in accordance with European standard EN207: Personal protective equipment for the eyes. Filters and eye protectors against laser radiation must also meet the following requirements:

- Provide a level of protection appropriate to the characteristics of the laser used (wavelength, power, mode of operation, etc.),

According to the characteristics of the source integrated into the cleaning equipment and the measurements studied, the minimum protection level required is DLB6 at the wavelength of 1060-1070 nm.

Selecting the appropriate laser safety eyewear requires the end user to accurately identify the range of wavelengths emitted by this product and the expected exposure limits (EOLs). All laser safety eyewear contains energy absorbing filters. Laser safety eyewear is typically thicker.

The protection level of the glasses must ensure that, in the worst case, what the filter can transmit must be less than the EMP value. The glasses must be suitable for the wavelength of the laser we are working with.

Review the product safety labeling and verify that the personal protective equipment (i.e., goggles, enclosures, viewing windows or peepholes, etc.) being used is appropriate for



the output power and wavelength ranges. Decisions regarding safety eyewear should also take into account potential secondary radiation risks due to radiation from the welding process and UV radiation.

Protective eyewear is based on the use of filters that can transmit or attenuate a certain wavelength of light, partially or totally. The optical density (OD) of a filter is a measure of this attenuation of the energy passing through the filter.

The higher the OD value, the higher the attenuation and protection value. (More light of a given wavelength is filtered out.) In addition, the protective eyewear must offer sufficient resistance against LEP. (i.e. they must withstand a direct laser impact for at least 5 seconds according to EN 207).

Below are the glasses delivered with the equipment:



STARLIGHT X2 Laser Safety Glasses, Filter: 0206

Below is the CE certificate:



EU-Konformitätserklärung



Der Hersteller

PROTECT-Laserschutz GmbH
Mühlhofer Hauptstraße 7
90453 Nürnberg

erklärt in seiner alleinigen Verantwortung hiermit, dass die nachstehenden Produkte

Artikel-Nr.	Filter	Gestell	Gestellfarbe
000-K0206-GLAD-20	0206	GLADIATOR	silber
000-K0206-OVSP-02	0206	OVERSPEC II	weiß
000-K0206-OVSP-20	0206	OVERSPEC II	silber
000-K0206-RETR-21	0206	RETRO	titan
000-K0206-SPEC-02	0206	SPECTOR	weiß
000-K0206-SPEC-20	0206	SPECTOR	silber
000-K0206-STAR-X-01	0206	STARLIGHT-EXTRA	schwarz

im Einklang mit der Verordnung (EU) 2016/425 des Europäischen Parlaments über persönliche Schutzausrüstungen und zur Aufhebung der Richtlinie 89/686/EWG und entsprechen der nationalen Norm, mit der die harmonisierte Norm EN 207: 20 09 + AC: 2011 + EN 207:2017 umgesetzt wird, sowie der Richtlinie über die allgemeine Produktsicherheit: 2001/95/EG stehen.

Die notifizierte Stelle DIN CERTCO Gesellschaft für Konformitätsbewertung mbH, Notified Body 0196, hat die EU-Baumusterprüfungen durchgeführt und die EU-Baumusterprüfbescheinigungen C5083PF/RO (Tragekörper OVERSPEC II)); C5822PF/RO (Tragekörper SPECTOR)) ausgestellt.

Die notifizierte Stelle ECS GmbH – European Certification Service, Notified Body 1883, hat die EU-Baumusterprüfungen durchgeführt und die EU-Baumusterprüfbescheinigungen (C1548.5PF (Filter 0206)); (C863.5PF (Tragekörper GLADIATOR)); (C7002.5PF (Tragekörper RETRO)); (C2334.1PF (Tragekörper STARLIGHT-Extra)); (C1168.4PF (Tragekörper UNIVERSAL unkaschiert)) ausgestellt.

Petra Fröbel
Geschäftsleitung PROTECT-Laserschutz GmbH
Nürnberg, 05.12.2019

Rüdiger Fröbel
Geschäftsleitung PROTECT-Laserschutz GmbH
Nürnberg, 05.12.2019



LC provides laser safety glasses with the LC-CLEAN equipment.

- All persons present in the controlled laser area, whether working with the machine or present as observers, must wear appropriate laser protection glasses and mandatory PPE.
- It is recommended to minimize the number of people present in the controlled laser area.
- Before entering the controlled laser area, all persons must properly put on PPE.
- Do not use with laser safety glasses other than those indicated in this guide.



shutterstock.com - 54879487947

DANGER

INCORRECT OR DAMAGED LASER PROTECTION GLASSES

Serious and permanent eye damage and vision impairment may occur.

Precautions:

- Before using laser safety glasses, all personnel must check the labeling on the glasses and confirm that they comply with the OD or LB classification (depending on the user's country), previously identified in this section.
- Glasses must protect for the wavelength used in the laser equipment.
- Prior to use, laser safety glasses should be inspected for cracks, discoloration, coating damage, marks or fissures.
- Under no circumstances should damaged glasses be used.

Also check the mechanical integrity of the mount.

- If the condition of the laser safety glasses is suspect, that pair should be discarded and replaced.

2.8.2 SAFETY MASK

To adequately protect against UV light produced during the welding process, a suitable safety mask must be used.

UV protection screen, with a grade 3 according to regulations:

- *EN 166: Personal eye protection.*
- *EN 169 Personal eye protection - Filters for welding and related techniques - Permeation properties and recommended use.*

It is **MANDATORY** to use an autogenous or oxycut type protective screen.

2.8.3 CLOTHING FOR PPE

Please refer to section 2.7.6 for information regarding skin risks. Unprotected personnel skin may be exposed to extremely dangerous levels of laser radiation, UV radiation and blue light associated with the cleaning process itself, as well as burns from hot parts.

To protect against skin hazards, the operator of the handheld laser device must wear flame-, heat-, and arc-resistant gloves, clothing, hats, and aprons while the device is in operation.

In addition to eye protection, there are different Personal Protective Equipment (PPE) for the operator of the LC-CLEAN 1500W laser cleaning equipment:

Skin protection(clothing): a special fireproof cotton upper piece for laser cleaning.



Class 1 protective clothing, corresponds to protection against cleaning techniques and less dangerous situations, which produce lower levels of molten metal splashes and radiant heat.

- *UNE-EN ISO 13668:2013 Protective clothing - General requirements.*
- *UNE-EN ISO 11611:2015: "Protective clothing used during welding and related processes"*

These garments are designed to protect the wearer's body, including hoods, aprons, sleeves, and gaiters and excluding the hands. This standard does not cover requirements for foot, hand, face, and eye protectors. For adequate protection against the hazards to which laser cleaning operators may be exposed, additional PPE covered by other standards should be used to protect the head, face, hands, and feet.

If a suit is required, it will consist of:

- A single garment (robe or jumpsuit).
- A two-piece suit, consisting of a jacket and trousers. The jacket should be long enough to overlap the top of the trousers.

Fireproof gloves: It is important to use laser cleaning gloves when working with the LC-CLEAN 1500W machine. They should be a type B welding glove, recommended for TIG.

Features: Category II PPE, according to Standards:

- *EN 388:2016 (Gloves for protection against mechanical risks)*
- *EN 420:2003+A1:2009 (General requirements for protective gloves)*
- *EN 407:2004 (Gloves for protection against thermal risks)*
- *EN 12477:2001+A1:2005 (Protective gloves for welders)*



The gloves have good resistance to heat generated by welding and laser cleaning activities, with a comfortable inner lining for the user. They also have to be comfortable and flexible for easy work.

IMPORTANT

2.9 TECHNICAL DATA OF THE MACHINE

Main information

Model	LC-CLEAN 1500W
Product reference	LC-LL1500W
Electricity consumption	<5500 W



Voltage	230VAC
Power stability (2 hours)	<1.5%
Power stability (24 hours)	<2%
Dimensions approx.	250x400x700 mm
Approx. weight	<40kg
Hose length	6m approx.

Laser Data

Model	L1500W-V.1
Product reference	CL2-L1500W-CW
Laser power	Pm 1500W
Laser type	Continuous fiber laser
Consumption	<5300W
Voltage	48VAC
Maximum power consumption	<110A
Wavelength	1064nm
Power instability	<3%
Power range	1-100%
Frequency range	1-10kHz
Laser efficiency	34%
Start time	10 µs
Gun connection type	QBH
Fiber length	10 m
Core diameter	20um
Anti-glare protection	Yes
Weight	27 kg
Dimensions	424x406x160 mm
Working temperature	10~35°C
Ambient humidity	10-80%
Refrigeration system	Air cooling
Storage temperature	-10-60°C
Laser Class	4 (IEC 60825-1)
Pointer power	2mW
Pointer class	2M (IEC 60825-1)

2.10 TRAINING

Article 6 of Directive 2006/25/EC on the minimum safety and health requirements concerning the exposure of workers to risks arising from physical agents (artificial optical



radiation) requires that workers exposed to risks of artificial optical radiation receive information and training, especially workers using class 3B and class 4 laser products. Training will include:

- The measures adopted.
- The exposure limit values and the associated potential risks.
- The results of the assessments, measurements and/or calculations of the levels of exposure to artificial optical radiation carried out, as well as explanations of their meaning and potential risks.
- How to detect harmful health effects due to exposure and how to report them.
- The circumstances in which workers have the right to health surveillance.
- Safe work practices to minimize risks from exposure.
- The correct use of appropriate personal protective equipment.

2.11 REGULATIONS

The aforementioned provisions are subject to the obligations laid down in Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery and amending Directive 95/16/EC and Directive 2006/25/EC on the minimum safety and health requirements concerning the exposure of workers to risks arising from physical agents (artificial optical radiation).

In addition to the European regulations UNE EN 60825-1 and UNE EN 60825-4 regarding the safety and classification of laser types, UNE-EN 208 of 2010 and UNE-EN 207 of 2018 regarding the essential eye protection for the use of the equipment.



CHAPTER 3 - LASER CLEANING

3.1 DESCRIPTION

LC LASERS manual laser cleaning is a revolutionary and innovative technology in the world of metal cleaning.

The LC-CLEAN 1500W laser cleaning equipment allows for very fine cleaning without excessive heating and without any deformation of the materials.

The operation of the LC-CLEAN 1500W laser cleaning equipment is extremely simple: it does not require a high technical level on the part of the operator, and it cleans a wide variety of materials using the same technique, simply by changing the equipment parameters.

The power and precision offered by the LC LASERS manual laser cleaning system allows us to clean at high speeds, depending on the power of the equipment and the coating to be removed.

3.2 DIFFERENCES, ADVANTAGES AND DISADVANTAGES WITH RESPECT TO SHOT BLASTING

Shot blast cleaning is a cleaning technique that removes dirt by impacting abrasive particles propelled onto metal and non-metal surfaces. Through this process, visible dirt such as rust, corrosion, paint, dust, carbon and other residues can be removed.

3.2.1 ADVANTAGES OF BLAST CLEANING

- It requires a relatively inexpensive upfront cost.
- A technique that does not involve chemical substances.
- Technology well known by the market.

3.2.2 DISADVANTAGES OF BLAST CLEANING

- It is not effective for removing dirt on a large scale.
- High consumption of abrasive products.
- High operator fatigue as the equipment can be annoying.
- Need for a safety suit and cabin.
- High energy consumption.
- Exterior cleaning not recommended.
- Noisy.



However, in recent years, a new technique has burst onto the scene with a vengeance, laser cleaning. This is the most innovative technology in terms of cleaning rust and other substances and has many advantages over other more traditional techniques such as shot blasting.

Currently, the cleaning market has evolved, but many of the techniques used are still backward, since they use manual processes combined with aggressive chemicals that damage the material to be cleaned. In addition, some techniques such as blast cleaning have some drawbacks, such as the need for a large workforce in the different stages of the manual process. With laser equipment we achieve great advantages such as a very fast preparation of the cleaning process.

Some research has shown that the time is reduced by up to 20 times compared to other cleaning systems. The laser cleaning equipment has a high speed, dry cleaning and is also environmentally friendly.

3.3 APPLICATIONS OF LASER CLEANING

Laser cleaning is the latest development in laser technology for deep, effective and successful cleaning. Traditional industrial cleaning methods often require tedious processes, present hazards and limitations, and are polluting to the environment. Laser cleaning machines allow you to clean paint, large dirt, remove rust and corrosion, among other processes. Let's learn about applications of laser cleaning and how laser cleaning equipment works.

Laser cleaning is becoming more and more present in different industries and jobs. Let's highlight some applications of laser cleaning:

- Aircraft and vehicle paint removal
- Cleaning the walls or exteriors of some buildings
- Cleaning in the electronics industry
- Weld cleaning
- Preparation of materials to be welded
- Partial removal of paint layers or coatings
- Cleaning of industrial parts or belts and meshes with accumulated dirt
- Metal rust removal



CHAPTER 4 – MAIN COMPONENTS

4.1 LASER RESONATOR

The laser resonator is the key component that produces the laser light beam. This beam of light is then directed towards the cleaning gun by means of a hose containing a fiber optic cable, which transports the laser energy efficiently.

This resonator is pulsed-type, which means that the laser is emitted in rapid pulses rather than a constant flow of energy. The equipment is designed to offer an average power of 1500W, which ensures constant and effective performance during use



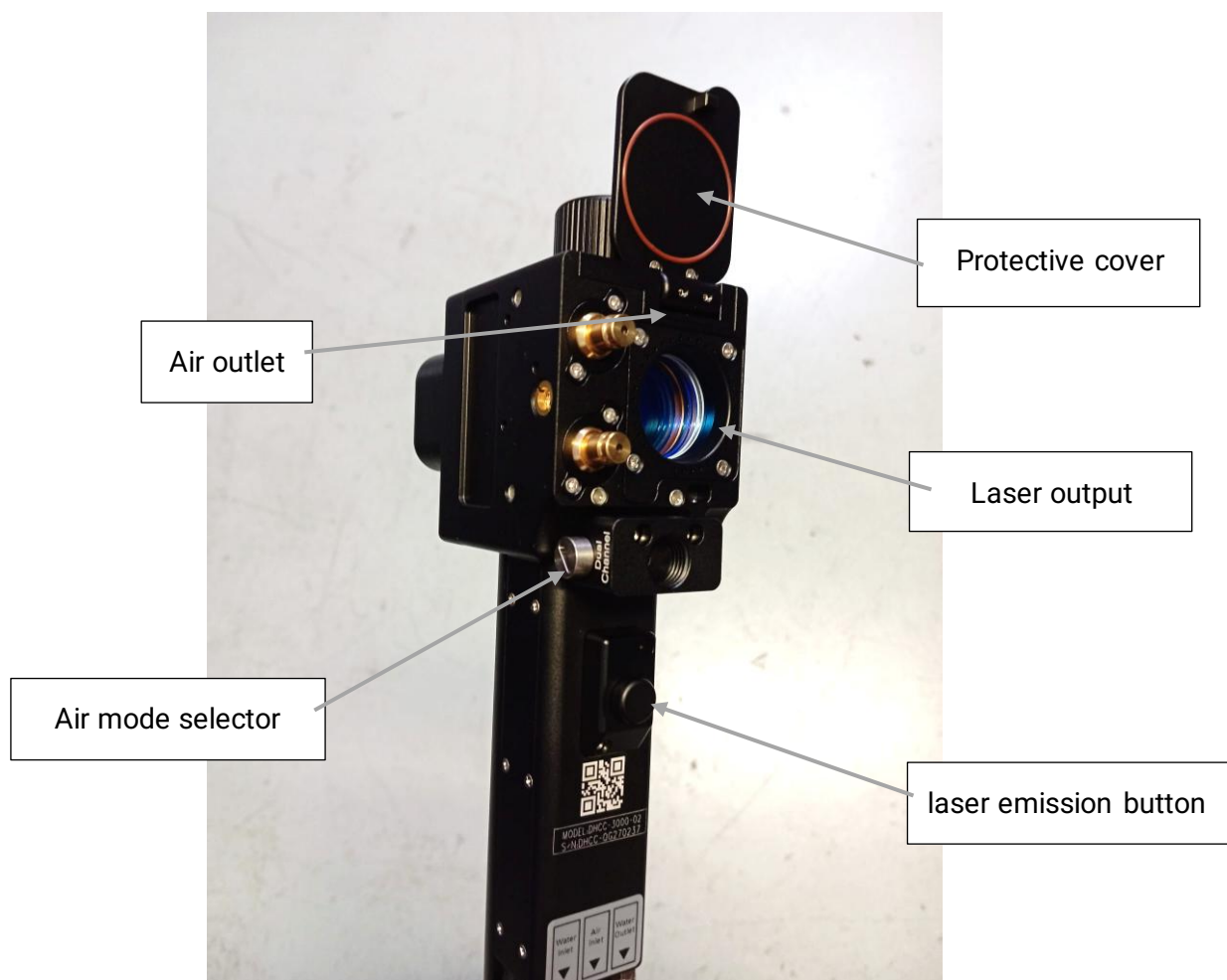
4.2 LASER GUN

The laser gun functions as the main head of the cleaning system, being the work tool that the operator uses to direct and operate the laser towards the surface to be cleaned. This gun allows precise and effective control of the laser beam, making it easier to execute cleaning on specific materials or surfaces.

The laser cleaning gun has some essential consumables, such as lenses, which are key components to focus the laser beam correctly. To ensure optimal performance, it is critical that the gun is kept in good condition and cleaned regularly. This is especially



important to prevent dust, dirt, or other contaminants from affecting the gun's internal components, which could lead to lens damage or affect the accuracy of the laser beam.



4.3 EXTERNAL AIR CIRCUIT

The laser cleaning machine is equipped with an internal air circuit intended for cooling the cleaning torch. For its correct operation, it is essential to connect the machine's air inlet to an external compressor supplied by the customer.

The machine's air circuit incorporates the following elements:

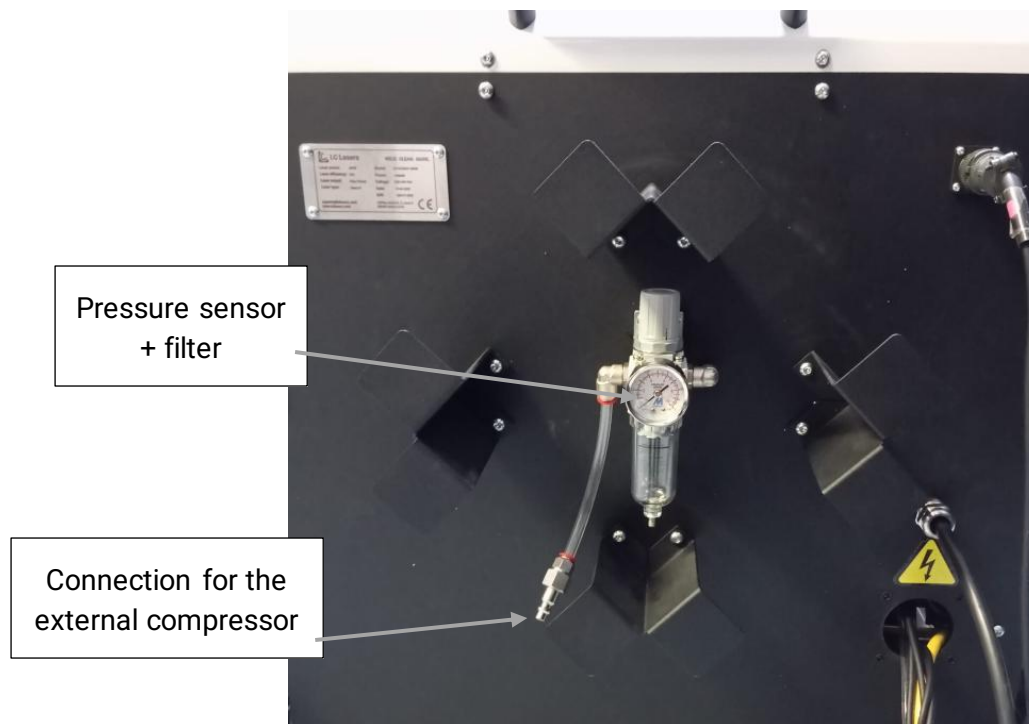
- Pressure Sensor: Continuously monitors the inlet pressure to ensure that the airflow is kept within the set operating values.
- Particulate filter: prevents the entry of impurities or solid debris from the external compressor, thus protecting the internal ducts and the cleaning torch.

Both elements work together to ensure a stable and clean airflow during cleaning operations.

External compressor requirements

The customer must have a compatible air compressor, capable of delivering a flow rate within the range specified by the machine. The required working pressure range is from **1 to 2.5 MPa**.

It is the user's responsibility to verify that the compressor meets these requirements prior to connection. An inadequate air supply can affect the performance and safety of the equipment.



Back side of the machine

4.4 BACK SIDE CONNECTIONS

On the back of the machine are the connection points necessary for safe operation. Before starting the machine, make sure that all connections are properly installed and in good condition.

Power Cord

The machine has a power connector located in the rear area. This cable supplies the electrical power necessary for the operation of the laser system and its internal components.

- Connect the power cord only to a suitable outlet and to the electrical specifications indicated on the machine's nameplate.
- Make sure that the cable is not visibly damaged and is not under mechanical stress or at risk of crushing.
- Do not use adapters or extension cords that do not meet applicable safety standards.



Important: The machine must be connected to a grounded outlet to ensure user safety and equipment protection.

Safety connection – Interlock system

The machine incorporates a specific connector for the safety cable (interlock), which is also located on the back.

This system is part of the mandatory safety circuit for the operation of the laser.

The interlock cable allows communication between the machine and the cab or work area, ensuring that the laser can only be activated when the safety conditions are correct.

- Connect the interlock cable between the machine and the work cab following the settings indicated.
- The system communicates with the cab locking system: the laser will not emit if the door is open or if the circuit is interrupted.
- In the event of opening the door during operation, the interlock will immediately stop the laser emission.

Note: The machine will not start the broadcast if the interlock circuit is not closed properly. Check this connection in case the equipment does not allow the laser to start.



CHAPTER 5 – USE OF THE EQUIPMENT

This chapter details the first steps to take when you receive your new LC-CLEAN 500W P laser cleaning equipment and for its use. Follow these instructions carefully to start up the equipment for the first time and have this manual handy for future reference related to the maintenance and operation of the equipment.

5.1 ELECTRICAL CONNECTION

All LC-CLEAN laser cleaning equipment has a power cord that comes out of the back side.

The 1500W CW equipment works with a single-phase 32A socket. A power cord is included with the device, with a head that fits into the socket on the back of the LC-CLEAN 1500W CW laser cleaning device.

5.2 ON AND OFF MODE

5.2.1 ON MODE

To properly operate the LC-CLEAN 1500W CW laser cleaning equipment, you must follow the following steps:

- a) Properly connect the equipment to power by plugging the cable into a compatible outlet.
- b) Turn the emergency switch clockwise to deactivate it (mushroom).
- c) Turn the ignition switch key clockwise.

5.2.2 SHUTDOWN

To proceed with the shutdown of the LC-CLEAN 1500W CW laser cleaning equipment, we must follow the previous steps in reverse:

- a) Turn the key counterclockwise.
- b) Press the emergency switch.



5.3 CONTROL SCREEN

The LC-CLEAN 1500W CW laser cleaning equipment is controlled by means of a touch screen located on the front of the equipment, so that it does not require any computer or external complement for its control.

5.3.1 START OF THE SOFTWARE

Once the equipment has been successfully turned on, the following access screen will appear:

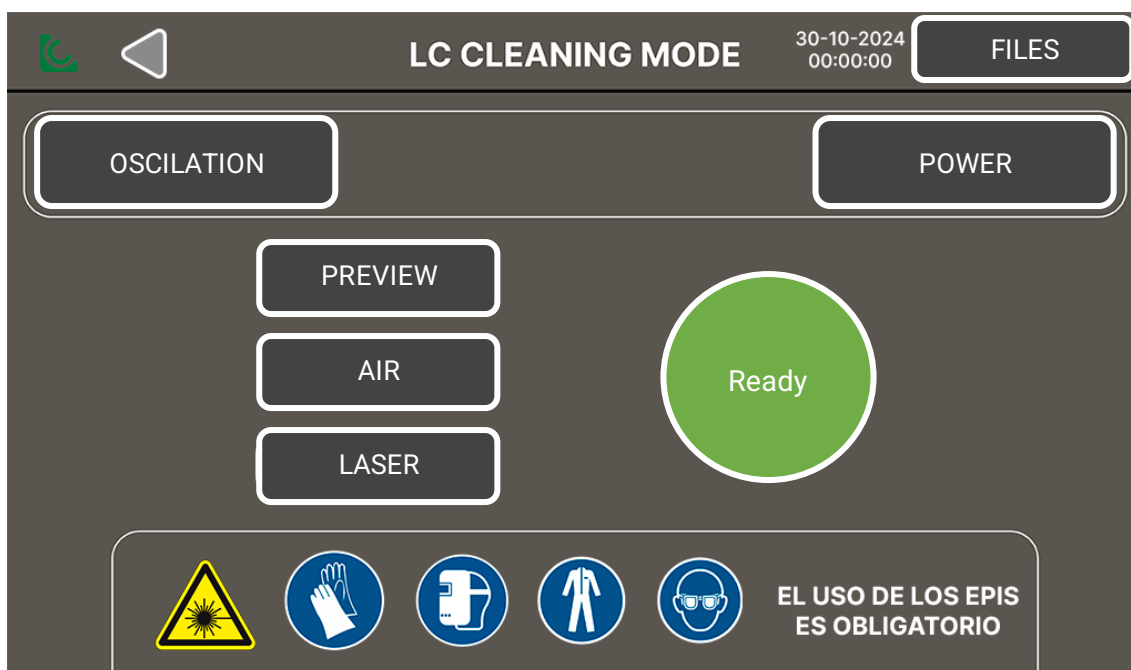


Two boxes can be chosen:

- **Cleaning:** Start the screen to allow laser cleaning (Default password – 1)
- **Configuration:** Allows internal configurations (Default Password – 6)

5.4 CLEANING

In this menu we can access to perform the cleaning



5.4.1 CLEANING MODE

To perform the computer cleaning process, follow these steps:

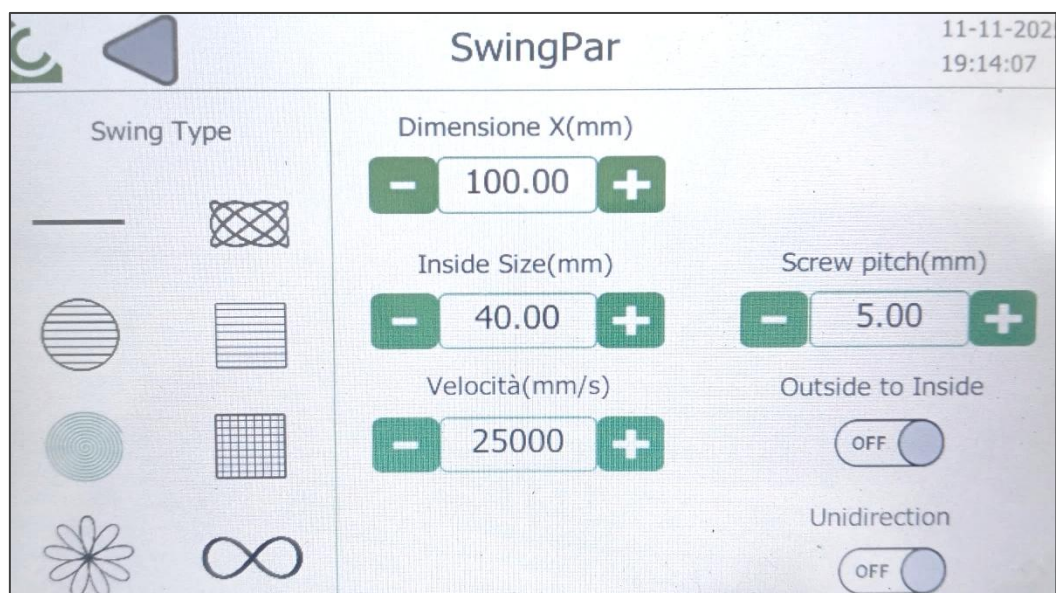
- Click Preview:** Start the preview to check the status of the system.
- Laser Tighten:** Activate the laser to prepare the equipment.
- Ready Indicator:** Confirm that the equipment is ready to operate.
- Remove the lens cover from the gun:** Make sure the lens is uncovered and ready for firing.
- Put on personal protective equipment (PPE):** Verify that you are wearing all the necessary safety elements to operate the equipment safely.
- Press the fire button on the gun twice:** Do this with a 1-second interval between each press to start cleaning.

Optional Note:

- You can press the **AIR** button to activate a digital output that would turn on the external compressor. However, this feature is currently disabled.

5.4.2 OSCILLATION

Here we find different forms of cleaning. Each of these shapes has different configurations depending on the typology.



Shape Configuration

Each figure has particular characteristics that can be adjusted according to its typology. Configurable parameters include:

- **X-axis size:** Modify the horizontal dimension of the figure.
- **Y-axis size:** Adjust the vertical dimension of the figure.
- **Movement Speed:** Regulate how fast the system travels.
- **Rotation angles:** Set the angular orientation of the figure.
- **Fills:** Customize the fill level as needed.
- **Fill Types:** Choose from different fill styles available.
- **Other additional parameters:** According to the specific needs of each figure.

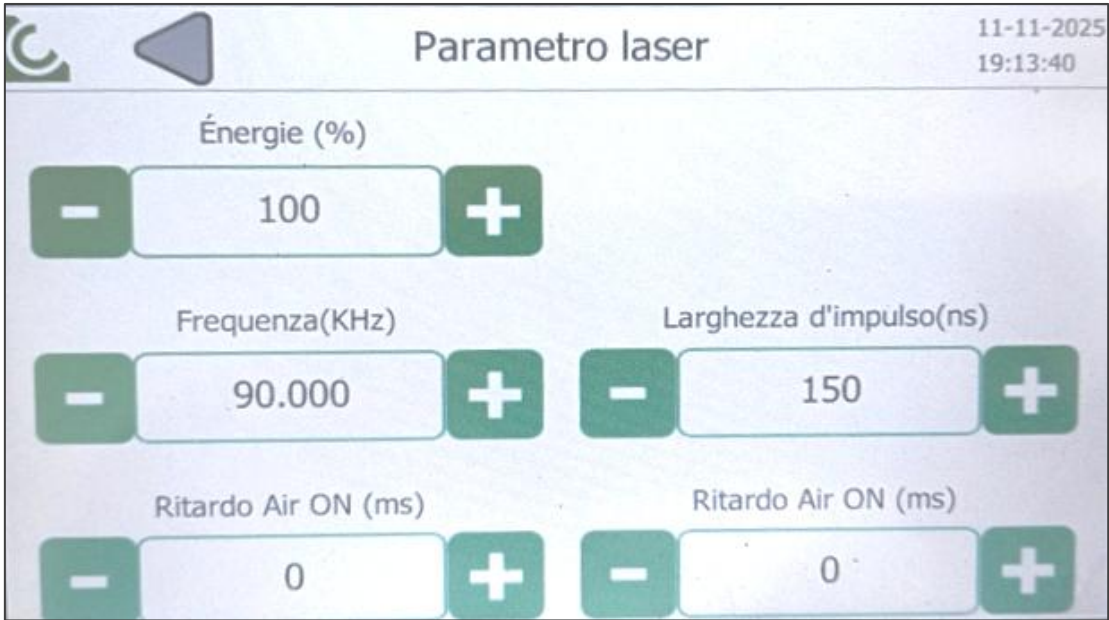
To view the settings made or check the settings, go back to the previous menu and press the **Preview option**.

5.4.3 POWER

Laser Configuration Items

The following adjustable parameters are available to customize the operation of the laser cleaning equipment:

- **Power (0-100%):** Regulates the output power of the laser.
- **Frequency (0-250 kHz):** Adjusts the output frequency of the laser.
- **Pulse width (10-500 ns):** Defines the pulse width according to needs.
- **Pre-air (ms):** Sets the air exit time before firing.
- **Post Air (ms):** Sets the air exit time after shooting.



5.5 CONFIGURATION



The laser cleaning equipment has various adjustable parameters to customize its operation. However, **some functions are restricted** and require the supervision of a specialized technician for adjustment.

- **Point Position Correction:** Adjusts the position of the point to make sure it is as centered as possible (**IMPORTANT**).

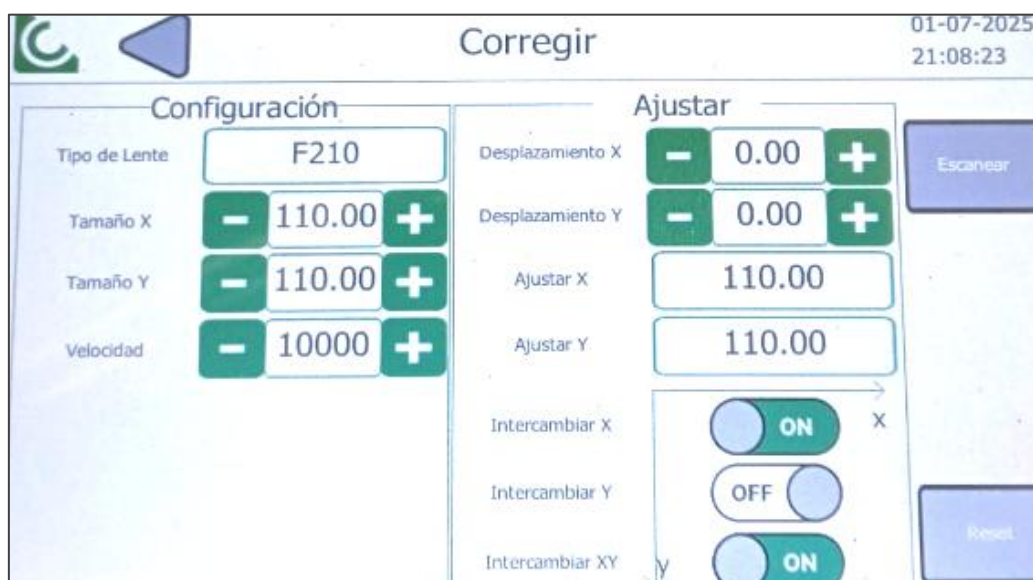


- **Digital inputs and outputs (I/O):** Configure digital inputs and outputs for specific integrations.
- **Temperature:** Monitors the temperature status of both the gun and the laser.
- **User Control:** Manage user permissions and access.
- **Other settings:** Additional device-specific settings.
- **Versions:** Check the version of the installed software.
- **Power ramp:** Allows power ramps to be generated for specific applications.
- **Dynamic parameters:** Adjusts advanced parameters to optimize performance.

5.5.1 CORRECT

Pointer and Lens Settings

This screen allows you to adjust the centering of the red pointer and select the lens type. Depending on the lens used, the model (e.g. F210) needs to be changed. You can check the lens model on the lens contour.



The "Adjust" section on the right side of the screen allows you to correct the following parameters of the red pointer for correct centering:

- **X and Y position:** Allow you to move the pointer horizontally and vertically until it is centered with respect to the real laser beam.
- **X and Y width:** They adjust the dimension of the pointer in each axis, being able to enlarge or reduce it to improve its visibility or adapt it to the marking area.
- **Axis swapping:** This option reverses the correspondence between the X and Y axes of the pointer, useful when the orientation of the optical system requires adapting the visual reference.



Make these adjustments with the machine at rest and following established safety procedures, making sure that the pointer is correctly centered before starting any laser operation.



The "**ADJUST**" section is restricted and should only be modified under the supervision of a qualified technician. Incorrect settings could cause the laser to fire inside the gun, which could result in irreparable damage.

5.5.2 I/O

Configuring Digital Inputs and Outputs

In this section, you can configure digital inputs and outputs for various system applications. These configurations allow integration with other devices or systems, optimizing the use of the equipment for specific tasks.

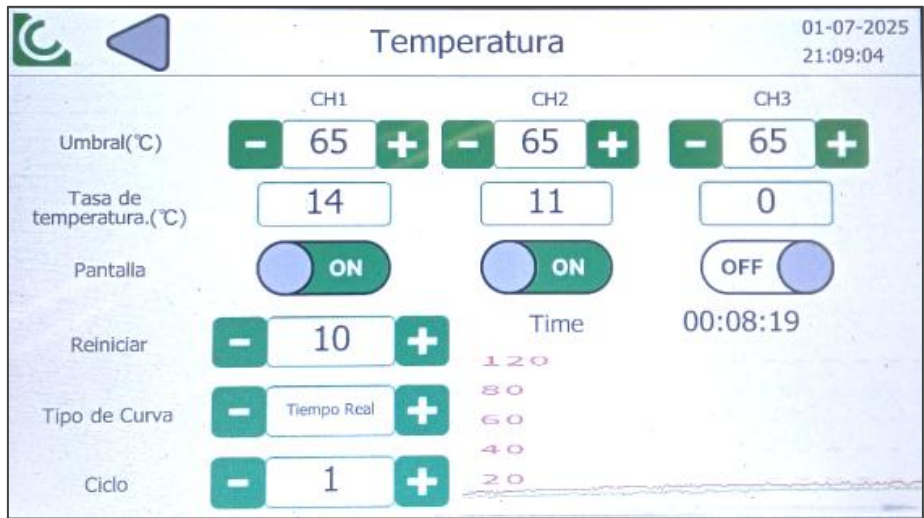
Función DI			Función DO		
Estado	Función	Nivel	Estado	Función	Nivel
1	Ninguno	OFF	1	Ninguno	ON
2	Ninguno	OFF	2	Ninguno	OFF
3	Llave de encendido láser	OFF	3	Aire	ON
4	Ninguno	OFF	4	Error de Motor	OFF

It is important to note that incorrect settings could affect the performance of the equipment or even cause damage to the components. Therefore, it is recommended **not to modify** these settings without the supervision and advice of a qualified technician. Improper adjustment could alter the interaction between the equipment and other connected systems, which could compromise the safety and proper operation of the laser.

If you are unsure how to make these adjustments, always consult with a specialized technician to avoid problems and ensure maximum performance of the equipment.



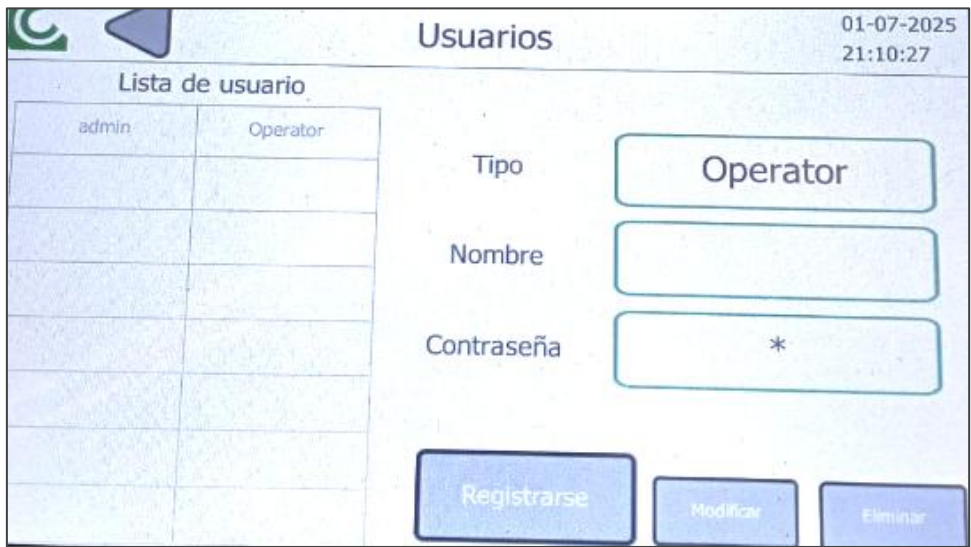
5.5.3 TEMPERATURE



On this screen, it is possible **to monitor the temperature** of the gun and other critical components of the equipment. This feature allows you to check the thermal status of the elements and ensure that they operate within safe ranges, avoiding overheating that could damage the system or affect its performance.

 **Important note:** The parameters and functions of the Temperature display are already defined by default according to the specifications of the machine. Do not make any modifications unless under the supervision of a specialized technician.

5.5.4 USERS





User Management

In this section, you can **change and assign permissions** to different users of the system. There are two types of users with different levels of access:

- **Operator:** Basic user, with limited permissions, suitable only for cleaning tasks.
- **Administrator:** Advanced user, with access to settings and the ability to modify system parameters.

In addition, the following action buttons are available:

- **Register:** To save a new user with the corresponding permissions.
- **Modify:** To update the settings of an existing user.
- **Delete:** To remove a user from the system.

5.5.5 OTHERS

System Configuration

In this section, you can adjust various settings of the control system, such as:

- **Language:** Allows you to change the language of the control system to suit the user's needs.
- **Volume:** Adjusts the volume of the screen or system notifications.
- **Remote Alarm:** Enables external alarms for out-of-system alerts.
- **Alarm Temperature:** Set an alert in case the temperature of the equipment exceeds the safe limit. **It is recommended to leave this option ON by default.**
- **Hazard Alarm:** Activates an internal alarm that warns of possible failures or dangerous conditions of the equipment. **It is recommended to leave this option ON by default.**




Important note: It is recommended **not to modify** the other elements, as they can alter internal configurations of the system and affect its proper functioning.

5.5.6 VERSIONS

Software and Gun Version

In this section, you can check the **software version** and the **pistol version**. In addition, the system indicates whether these versions are valid or if they require any updates.

- **Software Version:** Displays the current version of the software installed on the system.
- **Gun Version:** Reports the firmware version of the connected gun.
- **Validity status:** The author or system indicates whether the version is valid and up to date. Otherwise, an update is recommended.

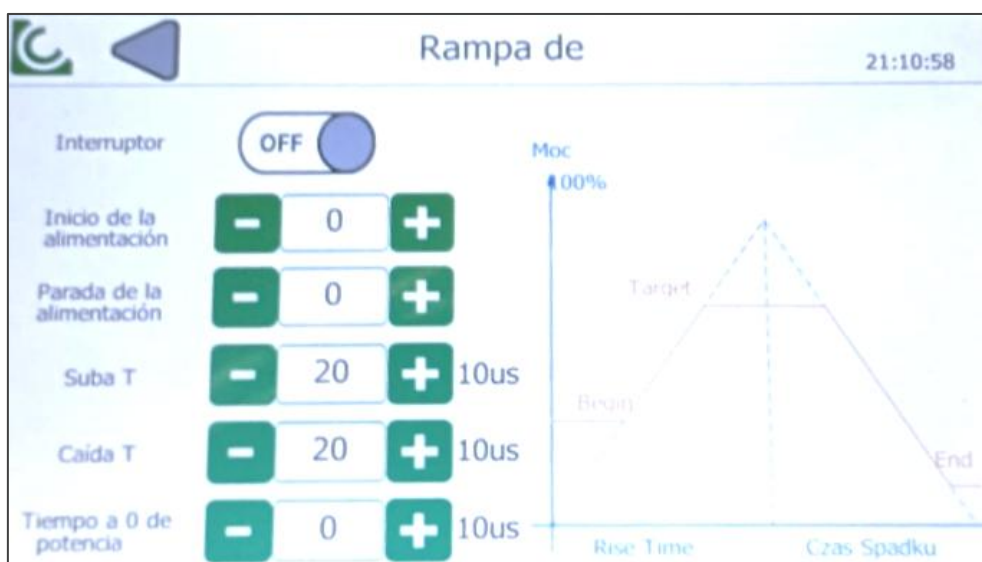


5.5.7 POWER RAMP

On/Off Ramps

In this section, **entry and exit ramps** can be configured to gradually adjust the laser parameters. These ramps allow for a smooth transition in values, improving control and accuracy during the cleaning process.

- **On-ramp:** Adjusts the progressive acceleration of parameters at the start of the process.
- **Off-ramp:** Controls the gradual deceleration at the end of the process, avoiding abrupt changes that can affect performance.



5.5.8 DYNAMIC PARAMETERS

Advanced Features

In this section, you will find more advanced configurations that allow you to adjust critical parameters of the laser system. These options are designed to provide more precise control over the performance of the equipment and to protect it from potential failures.



Available features include:

- **Power limitation:** Allows you to set a maximum power limit to avoid overloading or damaging the laser.
- **Power Step Cycles:** Sets the cycles of gradual increase or decrease of power during the cleaning process. This helps optimize efficiency and protect equipment.
- **Laser beam emission on or off:** Allows you to control when laser emission is turned on or off, which can be useful for safety operations or when the laser needs to be temporarily disabled.

5.9 GUN OPERATION

The gun incorporated in the **LC-CLEAN laser cleaning equipment** is one of the most advanced in its sector, standing out for several advantages over its competitors.

Among the most outstanding features are:

- **Ergonomic Design:** Allows comfortable use for long periods, reducing operator fatigue.
- **Ease of use:** Its intuitive interface makes it easy to use, even for inexperienced users.
- **Robustness of the components:** Made with high-quality materials, which guarantees its durability and resistance in demanding conditions.
- **Convenience of adjustment:** Controls and adjustments are quick and easy to make, optimizing operation time.



- **Versatility:** Adaptable to a variety of applications and work environments, increasing its effectiveness in different cleaning tasks.

5.9.1 GALVANOMETRIC SYSTEM

Inside the gun outlet is the **Galvanometer**, a motorized mirror system that allows the laser beam to be redirected according to the shape selected on the control screen. Depending on the configuration chosen, the mirrors will move in one way or another to meet the desired specifications in the cleaning process.

NOTE:



Access to the galvanometer is restricted and covered by the pistol's warranty. **It should not be tampered with under any circumstances** to avoid invalidating the warranty or damaging the internal components.

5.9.2 FOCAL LENS

Located just after the lens protector, the focusing lens is responsible for concentrating the light beam coming from the resonator. This lens, of the F-Theta type, has the ability to focus the beam on a specific plane, which optimizes the cleaning process.

There are different types of lenses with different focal lengths. In general, **the shorter the focal length, the higher the beam concentration**, allowing for greater accuracy. However, it is important to note that higher concentration does not always translate into faster cleaning, as other process factors also influence efficiency.

5.9.3 PROTECTIVE LENS

The lens protector is the only consumable of the LC-CLEAN 1500W CW laser cleaning equipment. As the name suggests, it is specifically designed to allow the laser beam to pass outwards, protecting the lens from potential damage.

This protector acts as a barrier against pitting and damage caused by laser bounce or refraction, as well as to prevent micro-projections from settling on the lens, which could affect its performance.

It is essential to always keep the lens protector clean and in good condition. It is recommended to check it periodically and replace it when necessary to ensure optimal operation and avoid damage to internal components.

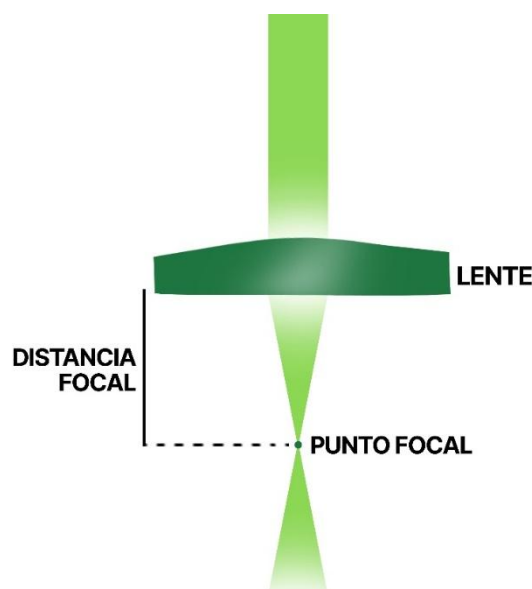


5.9.4 FOCAL LENGTH

As mentioned above, the laser light beam exits the optical fiber evenly and parallelly. The function of the lens is to concentrate that beam in a very small spot, shaped like an "hourglass".

The central point of this "hourglass" is where most of the laser beam energy is concentrated. To ensure maximum efficiency, the focal length must be manually adjusted while the laser is in operation, so that the center point of the beam is located on the surface of the material to be treated.

To facilitate this adjustment, the equipment has two red pointers, specifically designed to help triangulate the distance and ensure that the point of concentration is correctly located in the material during work.



The **focal length** is fixed and varies depending on the type of lens used. Fortunately, finding it is a simple process. To do this, simply pull the trigger of the laser gun and gradually move it to different distances from the material to be cleaned. The objective is to locate the point of greatest intensity, which corresponds to the area of maximum concentration of energy of the laser beam.

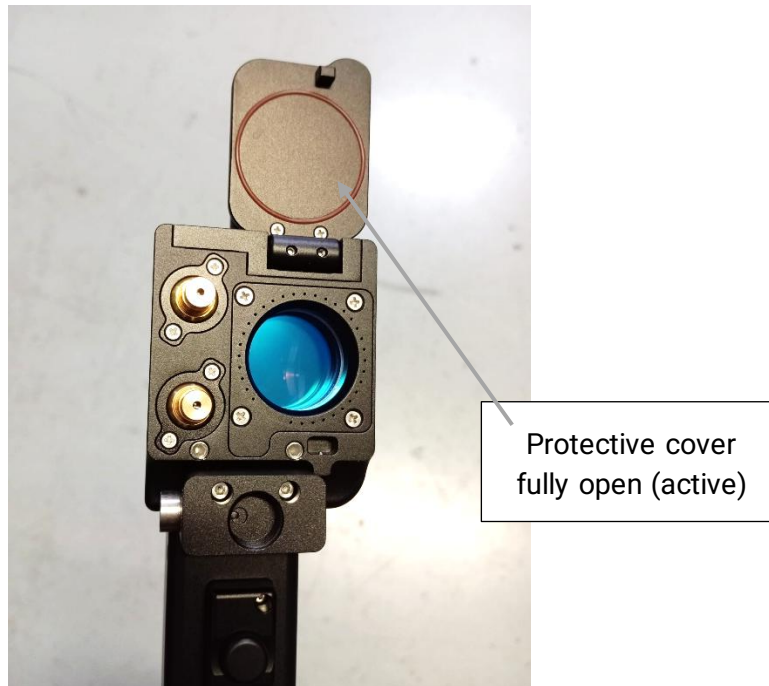
This setting is key to getting the best results during the cleaning process, as it ensures that energy is applied efficiently and accurately.

5.9.6 SAFETY

The LC-CLEAN 1500W CW laser gun features a safety system to prevent accidental laser activation. To activate the beam, the protective cover must be fully open (as shown in the photo).



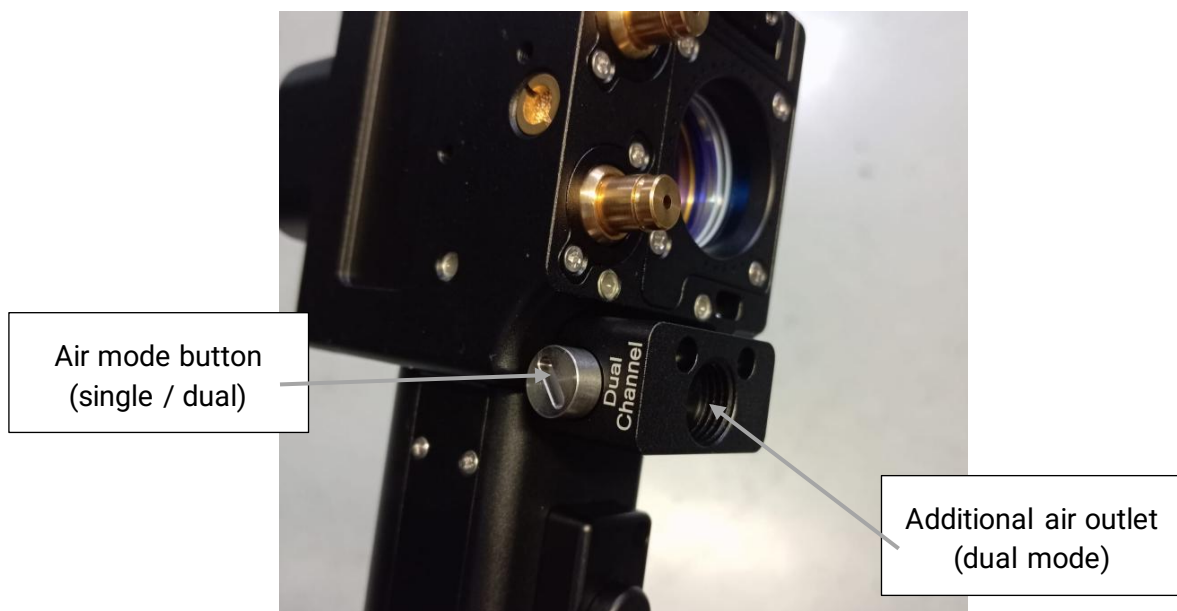
Additionally, the activation button must be pressed in two quick sequences with a 1-second interval between presses.



5.9.7 AIR OUTLET MODES

The gun has two air output modes, activated by the button located below the laser output.

- Single mode: Air output only through the slots around the lens.
- Dual mode: Additional air output through the outlet located in the center of the button.





5.9.8 PARAMETRY

1. Power:

Recommendation: It will depend on the type of material to be cleaned and the layer of contaminant to be removed.

- For harder materials or resistant contaminants (rust, thick paint), higher power (70-100%) is recommended.
- For delicate materials or lighter contaminants (dirt, dust), lower power (30-60%) is recommended.

Recommended value: Starts with **50-60%** for standard cleaning, adjusting according to the type of material and cleaning efficiency.

2. Frequency:

- The frequency is related to the number of pulses per second.
- For tough materials (such as rust or thick layers of paint), a lower frequency is ideal, as the laser energy is concentrated in less time.
- For more fragile materials or to obtain faster cleaning, a higher frequency is recommended, to provide more pulses per second and a higher work rate.

Recommended value: Between 0-5 kHz for harder materials, and between 5-10 kHz for softer materials or more efficient cleaning.

3. Duty cycle:

- Determines the % of the laser wave.
- For cleaning hard surfaces, it is recommended to use a higher duty cycle, which allows for faster and more effective action.
- For softer surfaces or more delicate work, using a smaller pulse width can be helpful to avoid overloading the material with energy.

Recommended value: Start with a range of 50-100% for efficient cleaning, adjusting according to the material.

4. Line Width:

- The line width defines the width of the area that is cleaned in each pass of the laser.
- For quick cleaning of large surfaces, it is ideal to have a larger line width.
- For more detailed work or cleaning small areas, a narrower line width is better as it allows you to be more precise.

Recommended value: Between 60-100 mm for standard jobs, adjusting according to the type of material and the area you need to cover.



5. Movement Speed:

- The speed of movement must be adjusted according to the power, frequency and type of material.
- For harder materials or thicker contaminants, a lower movement speed is recommended to ensure that the laser has enough time to act on the material.
- For softer materials or light cleaning, a higher speed is suitable, as it reduces working time without compromising effectiveness.

Recommended value: For **hard or thick** materials, start with a speed of **10,000-20,000 mm/s**, and for **softer** materials or faster cleaning, use speeds of **20,000-30,000 mm/s**.

Summary of Recommended Initial Values:

- **Power:** 50-60%
- **Frequency:** 0-5 kHz (harder materials) / 5-10 kHz (softer materials)
- **Pulse width:** 50-100%
- **Line width:** 60-100 mm
- **Movement speed:** 10,000-20,000 mm/s (harder materials) / 20,000-30,000 mm/s (softer materials)

Additional Tips:

- Always perform initial tests on a small section of the material to adjust parameters as needed.
- Keep in mind that the type of material (metal, paint, rust, etc.) will greatly influence how the parameters will affect cleaning.
- The temperature of the material is also relevant, as a hot material can react differently than a cold material.

5.10 MAIN FAILURES

5.10.1 TEMPERATURE ERROR

This error occurs when the machine detects an excessive temperature in the cleaning torch.

Possible causes:

- Use of the gun at 90° with respect to the surface, which makes it difficult to dissipate heat correctly.
- Failure or malfunction of the pistol's cooling system.
- Clogged or dirty air filters inside the cooling circuit.

**Recommended action:**

Stop the use of the machine and check the working conditions and condition of the filters. If the error persists, contact Technical Service.

5.10.2 FAILURE OF ONE OF THE AXES

The user may notice that the pointer or scan does not respond on one of the axes (X or Y).

- Possible causes:
- Disconnection or misconnection in the electrical circuit associated with the shaft.
- Failure of the 15 V power supply, which powers the actuators or controllers of the affected shaft.

Recommended action:

Turn off the machine and visually check for loose or damaged cables. If you have any questions, contact Technical Service.

5.10.3 LASER DOES NOT EMIT

Situation in which the machine turns on, but the laser does not initiate the emission.

Possible causes:

- Lente focal defectuosa o dañada.
- Interruption of the interlock system, preventing activation for safety reasons.
- Breakage or damage to the optical fiber transmitting the laser.

Recommended action:

Do not attempt to repair or tamper with the optical system. Check the status of the interlock connection and, if the problem persists, contact Technical Service.



CHAPTER 6 - EQUIPMENT MAINTENANCE

The LC-CLEAN 1500W CW laser cleaning equipment requires regular and periodic maintenance to ensure its correct operation and extend its service life.

If you need to perform maintenance, repair, or inspection, follow these steps:

- a) **Turn off the equipment** and be sure to remove the key.
- b) **Press the emergency switch** to disable any system function.
- c) **Turn off the main switch**, located at the rear of the machine, to completely disconnect the power.

Once maintenance is complete, before putting the equipment back into operation, make sure to:

- **Properly tighten all screws** to ensure that the parts are securely fastened.
- **Verify that security systems** are operational and functioning correctly.

6.1 LENS PROTECTOR REPLACEMENT

To replace the pistol lens guard, follow these steps:

- a) Loosen the circular thread on the protective window and remove the lens protector drawer. The lens protector is located right where the lens is located, being the first layer of protection of the lens.
- b) Remove the damaged or dirty lens protector and replace it with a new one. Make sure not to touch the surface of the protector with your fingers to prevent it from getting dirty.
- c) Once the new lens protector is attached to the pressure frame, place it in its correct position and tighten the circular thread that holds it firmly.
- d) Reinstall the lens drawer in place inside the gun.

Risks associated with lens protector replacement

During the replacement of the torch lens protector, the optical circuit is partially exposed. In this operation there is a risk of dust, moisture or particles entering the interior of the optical system. The presence of dirt in this area can cause:

- Loss of laser beam quality.
- Localized overheating due to beam scattering.
- Permanent damage to the torch's internal optical components, including the focal lens.



- Reduced cleaning gun life.

To minimize these risks:

- Replace **only in a clean environment**, free of dust and drafts.
- Keep the exposure time of the optical system **as short as possible**.
- Avoid touching any optical surface with your hands or with unauthorized materials.
- Make sure the new guard is clean and handle it carefully.

If internal dirt is detected during the operation or there is doubt about the optical condition, **stop the operation and contact the authorized Service Centre**.

6.2 GUN CONNECTOR INSPECTION

It is essential to regularly check that the fiber connector is securely fastened. Make sure it is not loose or mispositioned, as this could affect system performance. In addition, avoid excessive bending of the fiber cable, maintaining a **bending radius greater than 60°** to prevent damage to the optical fiber.

6.3 LASER GUN

The cleaning gun must always be kept clean to avoid possible damage to its optical components. It is important to ensure its correct handling, avoiding falls and blows that may affect its operation.

Also, the connection hose between the gun and the body of the equipment must be treated with care. It should never be stepped on by people or, especially, by itinerant machinery, as this could cause damage to the optical fiber and affect the performance of the equipment.

6.4 AIR CIRCUIT FILTER

The machine incorporates a filter in the external air circuit intended to protect the cooling system of the cleaning gun. Since this circuit is powered by an external compressor, there is a risk that the air supplied may contain dirt, moisture or particles, which can clog the circuit and reduce the cooling capacity of the gun.

To ensure safe operation and avoid overheating, it is recommended to perform the following periodic maintenance tasks:

1. Visual inspection of the filter (weekly)

- Check the overall condition of the filter and its housing.



- Check for any visible accumulation of dust, oil, or particles.
- Make sure the connections are firm and leak-free.

2. Filter purge (weekly or depending on usage)

- If the filter has a manual or automatic purge, remove any moisture or debris accumulated in the tank.
- Always perform this operation with the machine stopped and the circuit without pressure.

3. Cleaning the filter element (monthly)

- Remove the filter element according to the manufacturer's safety instructions.
- Clean the cartridge with clean, dry compressed air, blowing from the inside out to dislodge trapped particles.
- Replace the element if damage, warping or stubborn dirt is observed.

4. Filter replacement (every 6–12 months or depending on the work environment)

- Replace the complete filter if working in environments with high dust or moisture loads, or if flow loss is detected in the air circuit.
- Use only spare parts recommended by the manufacturer to ensure the watertightness and effectiveness of the system.

5. Air flow check (periodic)

- Check that the air flow supplied by the compressor is stable and sufficient for proper cooling.
- A reduction in flow may indicate a clogged filter or a problem in the pneumatic network.

6.5 PERIODIC INSPECTIONS

To ensure the proper functioning of the LC-CLEAN 1500W CW laser cleaning equipment, it is essential to carry out regular inspections. The recommended tasks are as follows:

- Daily Inspection of the Lens Protector: Check that the protector is free of contamination or marks. If it is dirty or contaminated, please make timely replacement.
- Weekly Gun Connector Inspection: Make sure the gun connector is properly connected and shows no signs of wear or damage.
- Gun or torch check: Check for water leaks at any joints. If you detect any leaks, take the necessary steps to correct them and prevent damage.



CHAPTER 7 - WARRANTY AND CONDITIONS

7.1 WARRANTY

The LC-CLEAN 1500W CW laser cleaning equipment is covered by a warranty. The conditions of the warranty are as follows:

- **2-year warranty** for the equipment in general and its main components (resonator, mechanical parts and connections).
- **1-year warranty** for the electrical cleaning gun (optical consumables are not included), the control system and the entire electrical section.
- **Consumables** such as lenses, lens protectors, among others, **are not subject to warranty**.

7.2 CONDITIONS AND LIABILITY

The warranty of the components is subject to proper use and correct operation of the equipment. Any indication of misuse will result in a breach of warranty conditions, and repair or replacement of components will be at the customer's expense.

Specific conditions:

a) During the warranty period, we will provide the defective components free of charge, provided that they meet the warranty conditions. However, the cost of transporting out-of-warranty products is not covered.

b) Users must use the equipment in accordance with the instructions for use to ensure its integrity. The company will not be responsible for the warranty in the following cases, and may exercise legal rights as appropriate:

- Use of the equipment in inappropriate conditions of place, temperature or environment, despite the manufacturer's recommendations.
- Modification of equipment without prior authorization, or the use of spare parts, components or peripherals that are not supplied by our company.
- Failure to comply with established operational and maintenance requirements.
- Damage caused during the transport of the equipment.

c) Without affecting the characteristics of the product, we reserve the right to change the specifications or shape of the products without prior notice.



d) Our only legal obligation is related to the sale of the product itself, its quality and performance, as well as the warranty. We do not assume any additional liability, whether direct or indirect, or for misuse or damage to third parties.

7.3 PROCEDURE

If your equipment has any error or breakdown, please contact your official distributor directly. A technician will be called to carry out the relevant checks and the guarantee will be activated if necessary.