

User Manual: Continuous Wave Laser Cleaning Machine

This user manual is intended for the following laser cleaning machine models: NCL-[series redacted]



Company Address
405 Power House St.
Ste. 504
McKinney, TX 75071

Company Phone Number
830-433-1160



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Revision History

Version #	Author	Description of Changes	Approved By / Date
1.0	Nuwave Laser Cleaning	New document to provide users with a detailed manual for the [series redacted]	[Redacted] July 2024



Section A. Product Overview

Nuwave Laser (NWL) guarantees that the laser cleaning machine has been fully tested and inspected before shipment and meets the published specifications. Please verify that the package and accessories were not damaged during transportation or during delivery. Any damages or missing goods must be reported to the company upon receipt / unboxing within five (5) business days.

Continuous Wave (CW) Laser cleaning is a new cleaning method in industrial cleaning. Our company's [redacted] series laser cleaning machine uses a high-power, Class IV laser, a high-speed scanning system, and a high-precision control delivery system to remove contaminants from the substrate.

A variety of scanning patterns are available to provide different cleaning effects. This particular machine has eight (8) different cleaning patterns, each with a unique effect on the substrate. The user will be able to adjust the cleaning patterns on the machine screen to get the desired cleaning effect.

When the laser beam strikes the surface, several processes occur such as the material absorbs the laser energy with varying absorption coefficients, leading to rapid heating and vaporization of surface layers. This thermal effect causes contaminants like rust, paint, or oxides to be ejected as plasma or debris. Laser parameters such as power density and scanning speed are adjusted to control material removal depth and ensure only targeted substances are removed.

Part 1. Uses for Laser Cleaning Machine

NCL series laser cleaning machine can be used to:

- Remove rust, paint and oil on metal and some non-metal surfaces
- Clean black ash, carbon deposition, and oil stain on the surface of parts after welding

Part 2. Laser Cleaning Advantages

Compared with traditional cleaning methods, our NCL series laser cleaning machines have the following advantages:

- No damage to the substrate, unless a profile is required
- Minimal secondary pollution to the environment when removing contaminants
- Precision and control with optimal area cleaning
- High-cost performance due to minimal consumables
- Mobile, can be hand-held or integrated into automation



Part 3. Product Appearance and Arrangement

The appearance of NCL series is as follows:

Figure 1: Multiple Views of the NCL



Section B. Safety

Before using the laser cleaning machine, read this manual carefully to have a detailed understanding of the equipment safety and methods of operation. It is important to have a Laser Safety Officer (LSO) on-site for this machine. There are LSO courses available online, which can assist companies with developing and implementing a successful laser safety program for their organization. Follow the operating procedures and safety specifications in this manual during the operation of the equipment.

Safety Resources:





- *At the present time, Occupational Safety and Health Administration (OSHA) does not have a comprehensive laser standard, though [29 CFR 1926.54](#) (link is subject to be updated) is applicable to the construction industry.*
- *You may also refer to the [OSHA Technical Manual \(OTM\) Section III: Chapter 6](#) (link is subject to be updated) for more information about laser safety.*
- *American National Standard for Laser Safety [ANSI Z136. 1-2007] requires a Laser Safety Officer (LSO) when workers use Class IIIB or Class IV lasers – unless the lasers are enclosed in a Class I enclosure so they don't expose workers to damaging radiation. Training courses for Laser Safety Officer can be found on the website for [The Laser Institute](#).*



Part 1. Safety Signs and Regulations

There are laser warning signs throughout the operation manual, such as the following:

Table 1: Laser Warning Signs

Label Pictures	Label Information
	<p>Laser Safety Warning (located on the equipment's head or located in the upper right corner of the chassis door)</p>
	<p>Chassis Security Warning (located on the front and back of the chassis)</p>
	<p>Please read the manual before use (located on the front and back of the chassis)</p>
	<p>Wear a mask (located in the upper right corner of the chassis door)</p>

Part 2. Laser Protection

Class IV (high power): The most dangerous of all lasers (above class 3B). Direct contact, scattered, or indirect contact can burn the skin or cause devastating and permanent eye damage. It can ignite flammable substances and cause a fire hazard.



Figure 2: Class IV Laser Sign



The laser cleaning machine is classified into class IV laser products, and the average power of the product is more than [redacted]. The mid-wavelength of the laser is [redacted], which is beyond the visible light range. However, these beams may cause irreversible damage to the eyes. Therefore, safety glasses must be worn when operating the laser cleaning machine.

Laser safety glasses shall be assigned according to the standard that can shield the laser within the whole wavelength range emitted by the laser. The laser safety glasses provided shall always be worn when operating the equipment. Even if wearing laser protective glasses, do not look directly at the laser output head.

Protective glasses provided with the machine have a protection band of [redacted] and 800-[redacted] (see figure below).

Figure 3: Examples of Provided Safety Glasses





Part 3. Safety Training

Nuwave Laser will conduct the initial training (either in-person, virtually, or via an online video training course). The customer is responsible for all additional training after this event. Please refer to the beginning of this section for Laser Safety Officer (LSO) courses that are available online. This training provides valuable information for all machine operators.

Only authorized, trained and instructed personnel are permitted to operate and maintain the laser cleaning machine. Any operation other than those specified in this instruction is deemed to be out of compliance with the standard operating procedures. The LSO/trainer shall ensure the training of all personnel, and the training contents shall at least include:

- Demonstrate the correct operational process of the laser cleaning device to the LSO/trainer.
- Use and wear laser protective glasses correctly.
- Ensure the work area is clear of all flammable materials or other hazards. Ensure there are no other personnel in the area.
- Show an understanding of the biological effects of laser radiation on the body.



Part 4. Hazardous Areas

The ray direction coverage area, for the equipment's cleaning head, is directly in front of the laser's lens. This area is dangerous and may cause harm to your body if the area is entered. It is prohibited to point the cleaning head lens at another person.

Figure 4: Cleaning Lens Hazardous Area



Part 5. List of Safety Precautions

- Ensure the power is off before cleaning and maintaining the equipment.
- Avoid dust and other pollution. The dust on the surface of the cleaning head may accidentally heat and become damaged. This may weaken the output of power or failure to fire the laser.
- Do not bend the cable beyond one (1) foot. This laser may not fire because of this.
- Do not place flammable and combustible materials near the laser cleaning machine. These items should avoid direct laser or reflective impact of the laser light.
- The laser safety glasses shall always be worn when operating the equipment. Even if wearing laser protective glasses, do not look directly at the laser output head.
- Always open the laser protective cover before using the laser. The equipment cannot work when the laser protective cover is closed. Rotate up to open the protective cover.
- Handle the polished head carefully when using or moving the laser cleaning machine to prevent dust/other pollution from directly coming to contact with the lens.



- Nuwave Laser is not responsible for burnt/damaged focal lenses due to insufficient operator care/ventilation of the cleaning head. Please provide proper airflow and ventilation around the machine such as high-powered fans, air scrubbers, or fume extractors. These will help blow the airborne particulates away from the cleaning head and prevent damage.

Part 6. Emergency Stop Instructions

The emergency stop button is located on the right side of the operation panel below the screen (see figure below). If unknown issues occur, release the light control button (trigger / activation button to emit the laser beam), and press the emergency stop button immediately.

After the emergency state is resolved, the emergency stop button can be turned clockwise to release the emergency stop state. To re-enabled / restart the machine, follow the normal steps to power on the machine.

Figure 5: Emergency Stop Button on NCL



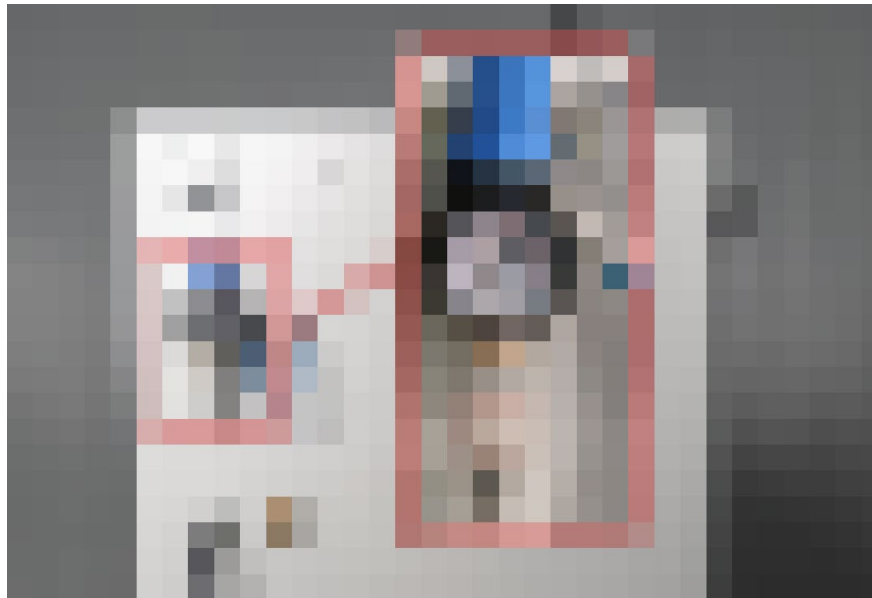


Section C. Before Using Device

Part 1. Requirements

- The power supply of the cleaning equipment uses [redacted].
- There should be a ventilation distance of about two feet (2 ft) around the equipment. The internal laser or water chiller may malfunction or lead to failure if the ventilation distance is not adequate.
- The ambient temperature range of the equipment [redacted], and the normal operating temperature range is [redacted] (water chiller temperature). If the operating temperature is beyond that range (above or below), it may trigger an alarm for the internal laser and fail to emit light.
- An air regulator is positioned at the rear of the machine, which is supplied with [redacted] of compressed air.

Figure 6: Air Hose Connection on the Rear Panel





Part 2. Machine Startup

Follow the steps below to properly start up and operate the machine.

Table 2: Machine Startup Instructions

Step	Action
1	Plug in the machine to an appropriate power source. <ul style="list-style-type: none"> • [redacted] • [redacted]
2	Turn on the breaker at the back of the machine by flipping the switch up <ul style="list-style-type: none"> • Down indicates the off position • Up indicates the on position
3	Navigate to the front of the machine and push the start button. The green light and machine screen will turn on. <ul style="list-style-type: none"> • The green, solid-state light indicates that the machine is at the appropriate operating temperature and is ready for cleaning to begin. • A red or blinking red light indicates the machine is coming up/down to the operating temperature
4	Press the button labeled “Enable” to start the laser on the cleaning head <ul style="list-style-type: none"> • This will allow the laser to begin fire.

Part 3. Cleaning Head Activation and Use

Follow the steps below to properly start up and operate the cleaning head.

Table 3: Cleaning Head Instructions

Step	Action
1	The laser should already be enabled. Follow instructions in Table 2 (Section C Part 2).
2	There are two (2) safety mechanisms on the cleaning head. <p>1st safety – Rotate square protective cover on the cleaning head over until it clicks into place</p> <ul style="list-style-type: none"> • The light on the machine will turn red, which indicates that it is almost ready to use. • The lens on the cleaning head should now be exposed.



Step	Action
3	2 nd safety – Press the secondary safety button on the cleaning head, which will turn red. <ul style="list-style-type: none">• The operating screen should display “Shutter Enable”.
4	Once both safety mechanisms are deactivated, the cleaning head should project a red line from the laser in the direction that the cleaning head is pointing. <ul style="list-style-type: none">• WARNING: Do not aim this cleaning head laser towards any person, and even if wearing laser protective glasses, do not look directly at the laser output head.
5	When ready for cleaning, press the button/trigger at the front of the cleaning head to activate the laser cleaning process.

Figure 7: Side-by-side images of the handheld cleaning head with the cover on and off

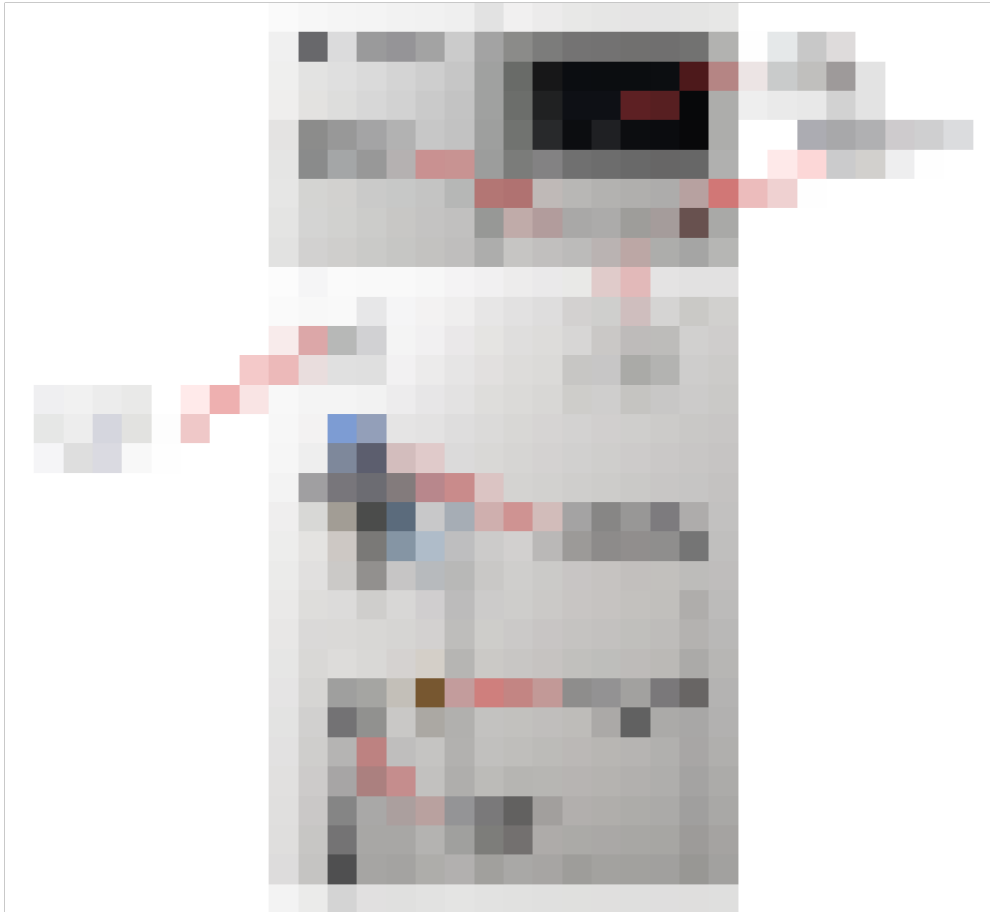




Part 4. Operation Buttons and Panels

The operation buttons of NCL series are as follows:

Figure 8: Operation Buttons and Panels Diagram





Part 5. User Mode Operation Interface

The user mode operation interface of NCL laser cleaning machine are as follows:

Home Screen

Review the home screen figure below along with the corresponding buttons and descriptions in the table below.

NOTE: Please see the *Ultra Wide 2D Cleaning Head Operating Manual (separate from this manual)*.

Figure 9: Home Screen with Corresponding Buttons and Descriptions in the Table Below



Table 4: Buttons and Descriptions for the Corresponding Figure Above

Button	Description
Laser Power (w)	Adjust the power of the laser to adjust the range of 0 Watts to Max Watts
Scanning Length (mm)	Adjust the max line width 0 mm–Max (600 mm)
Scanning Width (mm)	Auto adjusts proportionally to the scanning length parameter
Scanning Speed (mm/s)	Adjust the frequency of the laser in an adjustable range of 20-4000
Graphics	Adjusts which type of scan pattern is being used



Button	Description
Direction	Indicates which direction the pattern traces (up, down, left, right)
Filling	Filling traces the pattern one time or continuously
Shutter Enable	Shows if the safety shutter on the gun is open or closed. The screen setting cannot be adjusted

Part 6. Chiller Operation Specifications

Water Fill Instructions

Follow the steps below for properly observing the water level and refilling the chiller.

Table 5: Water Fill Instructions

Step	Action
1	These machines use a 16L combination of distilled water and anti-freeze (1 gallon) and it is added through the water supply inlet as depicted in the diagram below (Figure 12 and 13).
2	Add the water and antifreeze then turn on the machine.
3	After the new machine is turned on and the air in the water pipe is emptied, the water level of the water tank will drop slightly.
4	After the chiller has been running for a period of time (i.e., 1 to 5 minutes), observe the water level gauge again (Figure 10, below). <ul style="list-style-type: none"> ● If the water level drops significantly, check to see if there is leakage in the water lines within the machine case. ● If there is a leakage, locate the leak and either fix the issue by reinstalling any loose connections or contact Nuwave Laser.



Figure 10: Water Level Gauge

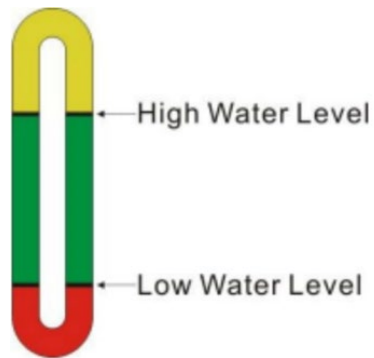


Figure 11: Water Level Indicator on the Machine





Preliminary Chiller Inspection

Review the following list when performing a preliminary inspection of the chiller.

Table 7: Preliminary Chiller Inspection Descriptions

ID	Preliminary Inspection Descriptions
1	Check whether the appearance of the equipment is abnormal and whether the output cable is bent or damaged.
2	Check to ensure all items are configured according to the list.
3	Check whether the lens of the hand-held head is broken and whether the emergency stop switch is lifted.
4	Check the water level of the chiller to ensure it meets the normal working requirements. Green areas are normal water levels, as shown below.

Figure 12: Water Supply Diagram Part 1





Figure 13: Water Supply Diagram Part 2



Section D. Technical Specifications

The laser machine weights are listed in the table below, and the cleaning head weighs [redacted], which is lightweight and convenient.

Table 6: Laser Weights for Each Series

Laser Series	Laser Weight (kg)	Laser Weight (lbs)	Laser Dimensions
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]



Part 1. Optical Characteristic Parameters

Review the table below for the optical characteristic parameters of the NCL Series Laser Cleaning Machine.

NOTE: The parameters in the table below are for reference only.

Table 7: Optical Characteristic Parameters

Equipment Model	NCL [redacted]
Average laser power	[redacted]
Central wavelength	[redacted]
Maximum single pulse energy	[redacted]
Fiber length	[redacted]
Power regulation range	[redacted]
Laser pulse frequency	[redacted]
Laser scan dimensions	[redacted]
Field mirror model	[redacted]
Minimum bending radius or optical fiber	[redacted]
Instability of laser output	[redacted]
Cooling mode	[redacted]
Polarization direction	[redacted]
Guided laser function	[redacted]
Anti-hyper reflexes	[redacted]



Part 2. General Characteristic Parameters

Review the table below for the general characteristic parameters of the NCL-[redacted] Series Laser Cleaning Machine.

NOTE: The parameters in the table below are for reference only.

Table 8: General Characteristic Parameters

Equipment Model	NCL-[redacted]
Net weight	[redacted]
Laser head weight	[redacted]
Crate size	[redacted]
Operation type	[redacted]
Supply voltage	[redacted]
Electrical frequency	[redacted]
Operating temperature range	[redacted]
Storage temperature range (when machine is not in use)	[redacted]
Power consumption at 25°C	[redacted]
Supply air pressure	[redacted]

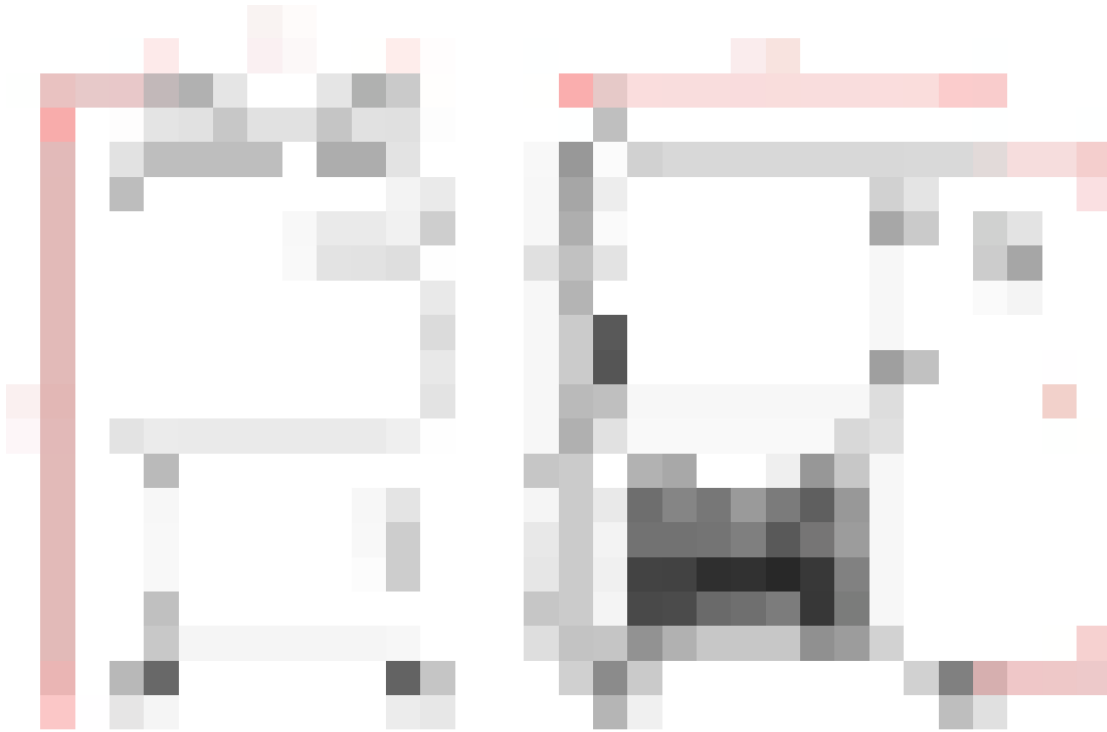


Part 3. Equipment Composition and Specification

Laser Cleaning Equipment Diagram

A diagram of NCL is shown in the figure below.

Figure 14: Diagram of the NCL





Laser Cleaning Head

The laser cleaning head is located in the laser machine compartment on the side of the machine.

Figure 15: Laser Cleaning Head Storage



Section E. Troubleshooting

Follow the troubleshooting solutions in the table below for each of the potential equipment issues. If equipment issues are not listed, please contact the manufacturer for troubleshooting assistance.

Table 9: Example Issues and Troubleshooting Solutions

Issue	Troubleshooting Solutions
The device does not power on after start-up	<ul style="list-style-type: none"> ● Verify the emergency stop switch has been reset. ● Validate that the input power supply is not abnormal, that the connecting plug is not loose, and the start button is self-locking in the on position. ● Confirm that the air switch of the equipment has not been tripped.
The equipment does not give out a red light	<ul style="list-style-type: none"> ● Check that the protective cover of the field mirror is removed. ● Remove the front lens of the hand-held head and check for



Issue	Troubleshooting Solutions
	breakage.
No laser output from the device	<ul style="list-style-type: none"> ● Check if the device is powered up, the key switch is on, and the laser enable key is turned on. ● Confirm that the water chiller has reached the set temperature, and the equipment does not have an alarm. ● Validate the laser focus position to ensure there is not a significant variance. Focus distance too large may result in you not being able to see the laser. ● If the above items are not out of line after visual inspection, confirming no optical problems, you can contact us to help solve.
Weak output from the laser	<ul style="list-style-type: none"> ● Wipe the hand-held head field lens to ensure that the field lens is clean and dust-free, and then test again. ● Check the laser focal distance to see whether there is a large variance from the target distance. Variance that is too large may result in you not being able to see the laser.
All other equipment issues	<ul style="list-style-type: none"> ● Contact Nuwave Laser.

Section F. Packing, Transportation, and Storage

Part 1. Packing

Exercise caution when transporting the laser cleaning machine for mobile cleaning. Nuwave Laser is not liable for damage to machine parts or machine breakage during transportation. Follow the steps below for properly packing the equipment for transportation if repair and/or replacement has been approved by Nuwave Laser.

Table 10: Packing Instructions

Step	Action
1	After the handheld head and the optical fiber bellows are coiled evenly, the foam is placed on the optical fiber outlet and the handheld head to ensure that the chassis will not damage the optical fiber due to bumpy transportation, and the turning radius of the corrugated pipe is more than [redacted].
2	Foam cotton is used to wrap the equipment, outer wrapping film to make the equipment get buffer protection.



Step	Action
3	When the equipment is placed in the packing box, the box must be fixed around the equipment to ensure that there is no moving space for the equipment to be placed in the packing box.

Part 2. Transportation

When transporting the machine, utilize the built-in tie down points in the machine case to secure the machine. The machine should be cushioned, covered, and packaged with care to limit vibrations, collisions, and unplanned impact. Do not include other equipment or materials in the vehicle that may affect or damage the machine. Nuwave Lasers is not liable for any damages that occur during or due to transportation.

Part 3. Storage

- Avoid water splashing onto the equipment, rain, and direct sunlight.
- Avoid strong electric or magnetic fields.
- Avoid corrosive gas or salty air.
- Storage should be in a climate-controlled environment, and the storage site has no strong vibration and impact.

Section G. Service and Maintenance

For the safety, equipment parts, operation, or maintenance of our company products please read this product manual carefully, and strictly follow the operation instructions. If you have any questions, please call our production and after-sales department, and we will serve you wholeheartedly.

Part 1. Maintenance Instructions

Users are not allowed to disassemble and repair the laser cleaning machine by themselves, and all maintenance work needs to be completed by our company professionals. If maintenance is necessary, follow the list of actions below.

- When any damage is found after receiving the products, customers must keep supporting documents to claim the rights to the person transporting the equipment.
- In order to protect your rights and interests, please contact the production and after-sales department of our company as soon as possible after finding the breakdown and apply for product repair or replacement service.



- After the company authorizes the repair or replacement service, please send the product back to our company according to the packaging and transportation method in this manual.
- In case of secondary damage caused by improper packaging and transportation, the customer shall be responsible for the consequences.
- Please do not send any products back to our company without communication and confirmation.

Part 2. Warranty Statement

Manufacturer's Warranty Statement

Thank you for choosing Nuwave Laser for your laser cleaning machine purchase. We are committed to providing high-quality products and exceptional service. Each laser cleaning machine purchased from Nuwave Laser is covered by our 1-year comprehensive warranty, ensuring your peace of mind.

Comprehensive Warranty Coverage: We offer a 1-year manufacturer's warranty on all laser cleaning machines sold by Nuwave Laser. This warranty covers defects in materials and workmanship under normal use and maintenance. During the warranty period, Nuwave Laser will repair or replace, at our discretion, any defective parts or components free of charge.

Laser Generator Warranty: In addition to the comprehensive warranty, the laser generator itself is covered by a 2-year warranty. This warranty specifically covers the laser generator for defects in materials and workmanship under normal use. During the 2-year warranty period, Nuwave Laser will repair or replace, at our discretion, any defective laser generator components free of charge.

Exclusions:

- Damage caused by misuse, neglect, operator error, accidents, or unauthorized repair/modification.
- Normal wear and tear, including consumable parts.
- Damage caused by failure to follow the product instructions included in the user operator manual.
- Damage caused by an insufficient power source such as a generator that has malfunctioned or is not supplying the correct power requirements to the machine as outlined in the operator manual.

Procedure: If you believe your laser cleaning machine requires warranty service, please contact our Customer Service team at Nuwave Laser. Our knowledgeable representatives will assist you in troubleshooting the issue. If necessary, we will provide instructions for returning the product for evaluation and repair.



Limitation of Liability: To the extent permitted by law, Nuwave Laser shall not be liable for any direct, indirect, incidental, or consequential damages arising out of the use of or inability to use our products.

How to Obtain Warranty Service: To obtain a warranty service, please retain your proof of purchase and contact us directly. Our team will guide you through the necessary steps to resolve any issues covered under the warranty.

This warranty statement is effective for all laser cleaning machines purchased from Nuwave Laser and supersedes any previous warranties or representations.

Thank you again for choosing Nuwave Laser. We are committed to your satisfaction and look forward to serving you.