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OPERATING AND MAINTENANCE MANUAL

GravoTech Yag100



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Distributor stamp

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Updates

The updating index A0 corresponds to the first edition of this manual.

The alphabetical character (A) represents the major index while the numeric character (0) represents the minor index.

The minor index will change after an isolated update (modification of only some pages in the manual).

Only the modified pages will bear the new updated index.

The major index will change after a complete updating of the manual, giving forth a new edition.

The minor index will then return to zero.

The chart below will provide a record of the various updates since the first edition.

It is recommended that this procedure be taken into account and that you insert the modified pages in your manual as they are sent.

Date of revision	Updating index	Modifications
October 2005	0510A0	First edition in English
October 2005	0510B0	Addition of Chapter 7
November 2005	0511B1	Addition of section 7.4 Addition of photo p.47
January 2006	0601C0	. Update of conformity certificate: - Directive 98/37/CE, - Directive 2002/96/CE.
December 2006	0612D0	Update of paragraphs 2.3 / 2.4 / 2.6 / 3.4 Addition of paragraphs 1.4 / 2.7 / 2.8

1

INTRODUCTION PRESENTATION

1.1) Overview of the equipment

The Gravotech YAG100 is a complete marking station which includes a YAG type Laser source.

This type of Laser provides a very high marking quality on various material, including many metals that cannot be processed with CO2 Lasers.

It is dedicated to surface marking (no deep marking, no deep engraving), with or without color change (depending on the parameters used and the material to mark).



The basic package includes all the elements needed for a good operation of the Laser :

1. Laser module (includes the Nd:YVO₄ Laser source)
2. Scanhead + flat field lens
3. Electronic Control Unit
4. Workstation with Z axis adjustment and slotted marking table
5. A set of cables between the Laser station and the control unit
6. A crossover Ethernet cable for connection to the PC.
7. Engraving software GravoStyle 5 on CD Rom (Graphic level) + dongle
8. A GravoTech YAG driver (CD Rom)

1.2) 1.2.Minimum PC Configuration

For a good use of GravoStyle 5, the recommended configuration for the PC is :

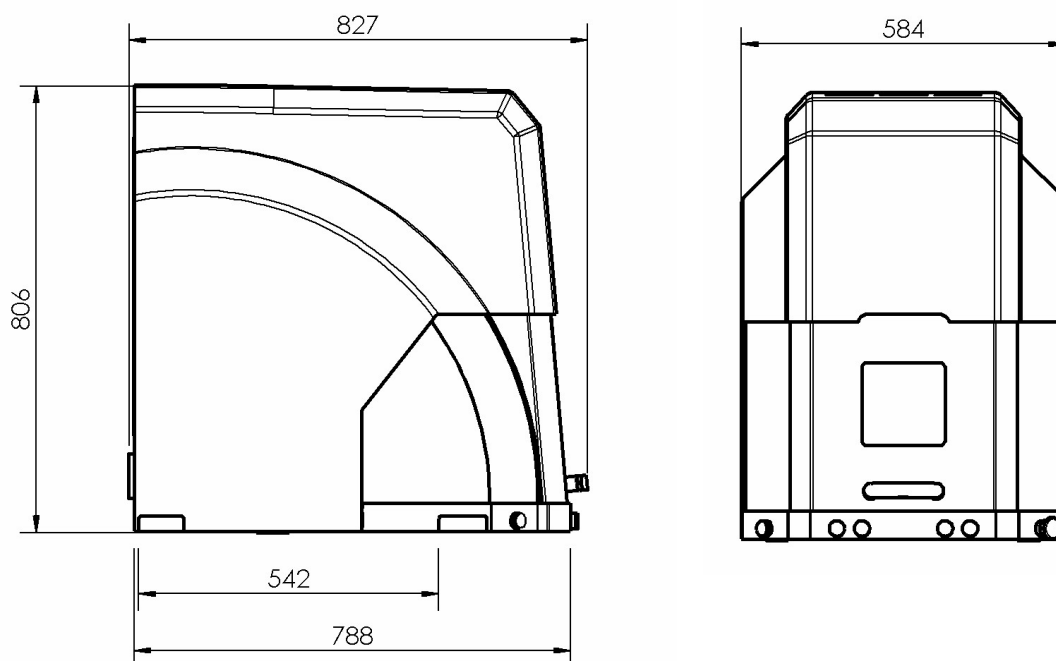
SPECIFICATION	MINIMUM	RECOMMENDED
Processor	Pentium 3, 800 MHz	Pentium 4, 1400 MHz
DRAM	128 MB	256 MB
Hard Drive	10 GB	
Windows	NT, 2000 ou XP	
CD ROM	x24	x40
Ports	Ethernet, Parallel, USB, Serial	Ethernet, USB, Serial, Parallel
Graphic card	32000 colors, 16 bits	
Display	17", 1024 x 768	19", 1400 x 1050
Other	Floppy disk drive	Printer, scanner

1.3) Dimensional drawing of the GravoTech YAG100

1.3.1. Marking station

The marking station is designed to be installed onto a desktop / benchtop.

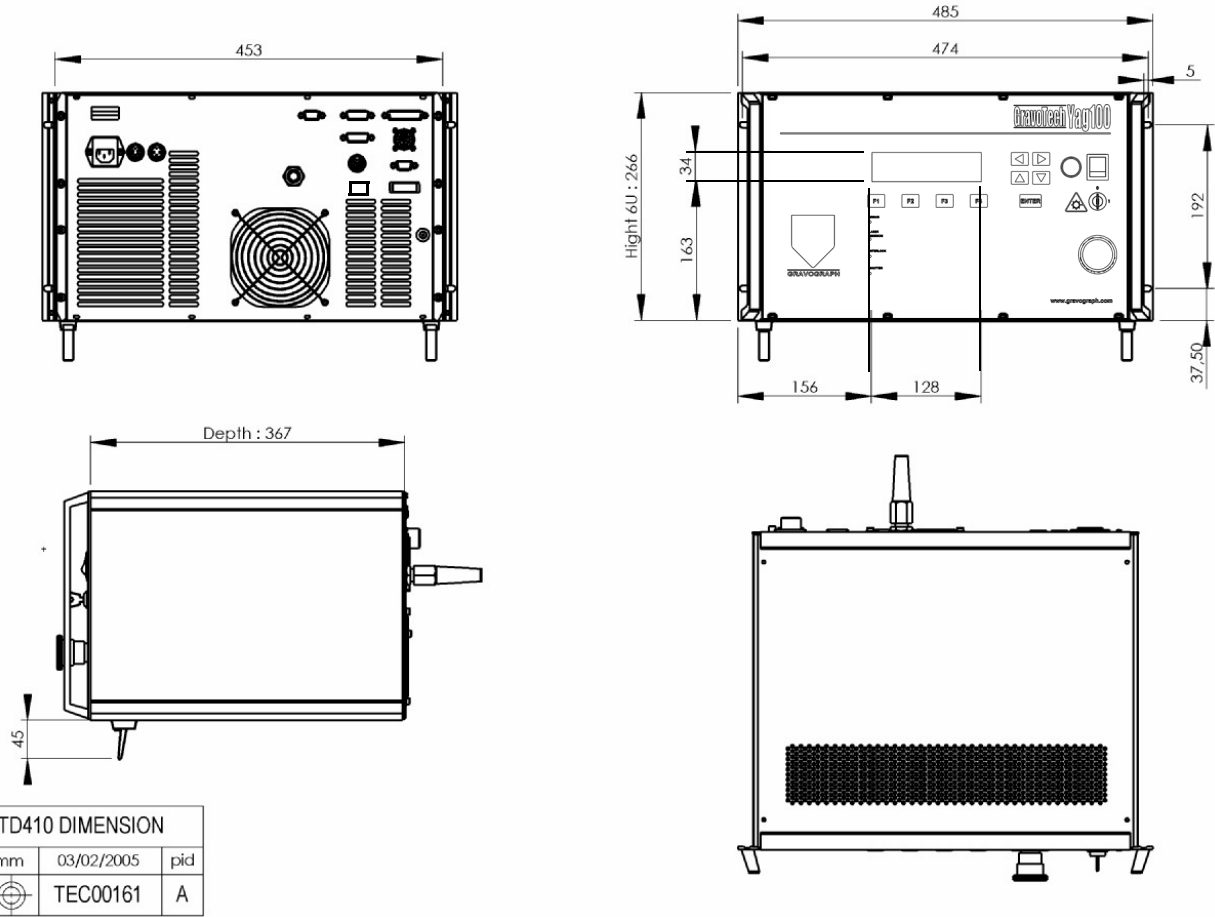
Its weight (including the Laser module inside) is approximately 75 kg.

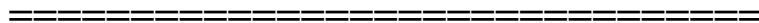


1.3.2. Control unit

The control unit is a 19” rack and must be mounted horizontally, in a well ventilated area.

The maximum distance between the Laser and the control unit is approx 2,5 meters (cable length is 3 meters).



1.4) Safety Instructions***SPECIAL SAFETY INSTRUCTIONS******OPERATOR PROTECTION AGAINST
LASER RADIATION*****INSTALLATION FOR INDUSTRIAL USE**

Use :

Installation :

CONTROL AREA

The area in which the present paper is posted is a LASER CONTROL AREA

*during normal production, (1)

*during maintenance and adjustments, (1)

* (1)

CONTROL AREA REGULATIONS

Access to the **LASER CONTROL AREA** is restricted. Only qualified personnel, trained by the employer in both safety and first aid, may be present during operation.

All persons present in the **LASER CONTROL AREA** must be informed of the present regulations by the employer.

(1) To be filled in or crossed out.

GENERAL SAFETY INSTRUCTIONS

- Avoid all exposure.
- Do not place hands or any object in the trajectory of the laser beam.
- Never look directly into the output head.
- Do not remove the protective covers or short-circuit the security system.
- Electrical interventions on the equipment must only be performed by LT/HT qualified personnel..
- Should an accident, incident, or any doubt as to the proper functioning of the equipment occur, inform the PERSON RESPONSIBLE FOR LASER SAFETY

LASER SAFETY GLASSES

It is mandatory to wear safety glasses which protect against laser radiation at all times when in an area where laser radiation superior to Class 1 is emitted.

When laser operation with the risk of radiation is interrupted, the safety glasses should be placed in their protective case and stored in a designated storage place.

Name and address of the DOCTOR responsible for examining personnel assigned to the LASER CONTROL AREA.

..... Tel.

Name and address of the LASER SAFETY PERSON responsible for making sure that regulations are respected in the laser control area.

..... Tel.

2

SECURITY & LASER PROTECTION

2.1) Conformity certificate

The GravoTech YAG100 Laser marking equipment has been made, assembled and checked in our factory :

TECHNIFOR SAS

114, quai du Rhône

01708 MIRIBEL - FRANCE

The **GravoTech YAG100** conforms with the requirements of the ECC Directive for Laser products, and is certified to comply with United States title 21, Sub-Chapter J of The Code of Federal Regulations. These regulations describe the design and manufacturing requirements for the safe operation of Lasers and Laser products. In the United States these requirements are administered by the Center for Devices and Radiological Health (CDRH), Federal Drug Administration.

The **GravoTech YAG100** is enclosed, interlocked and labelled to insure safe operation. Labels should not be removed. Interlocks should not be defeated by an operator. There is a Class 4 hazardous Laser inside the marker, and operators should not access the interior or defeat interlocks. Only qualified, Service trained personnel should access the interior or operate the Laser with interlocks defeated. Such operation should be conducted under appropriate safeguards for Class 4 operation, including the use of Laser protective eye wear.

This equipment conforms to:

- the European Parliament and Council Directive 98/37/CE of June 22, 1998, concerning the consolidation of the laws of member states relating to the machines.
- the Council Directive (73/23) of February 19, 1973 concerning the consolidation of laws of member states relating to electric material destined to be employed with some limits of voltage.
- the Council Directive (89/336) of May 3, 1989, modified, concerning the consolidation of the laws of member states relating to electromagnetic compatibility.
- the European Parliament Council Directive 2002/96/CE of January 27, 2003 modified, concerning Waste Electronic and Electrical Equipment (WEEE).

However, if you find your equipment to be defective, please contact your dealer.

Waste Electronic and Electrical Equipment



This symbol indicates that once this equipment has reached the end of its useful life, it must not be disposed of with non-sorted municipal waste, in accordance with the European directive 2002/96/CE.

The equipment must be disposed of at an appropriate collection point for processing, sorting, and recycling of Waste Electronic and Electrical Equipment (WEEE).

The elements which compose Waste Electronic and Electrical Equipment (WEEE) may contain substances which have harmful effects on the environment or on human health.

By following these instructions, you are helping the environment, contributing to the preservation of our natural resources, and protecting human health.

2.2) Safety Requirements:

The *GravoTech YAG100* Laser can be installed to operate in Class 1 environment. In this case the YAG100 system safety enclosure is interlocked and sealed against potential Laser radiation emissions when properly operated and secured. Tampering with or purposeful defeat of the interlocking devices, or removing any of the designed safety features or labels could result in exposure to the Laser beam hazards.

2.2.1. Laser Radiation Hazard

During operation, this Technifor Laser marking equipment, functions as a Class 2 Laser Product pursuant to the European Norm 60825-1 A2, 2001 and the United States Code for Federal Regulation, Title 21, Sub-chapter J. Part 1040. During normal operation the Laser beam and its reflections are completely enclosed and there is no Laser hazard to persons in the immediate area. There is, however, a Class 4 Laser inside this product, and caution should be taken whenever the access door or panels are open.



Operating the Laser (or shorting any interlocks) with access doors or panels open will result in increased risk of human exposure to Class 4 Laser radiation (infra-red, Q-switched Nd:YVO4). Chamber enclosure is constructed of a material which does not transmit 1.06 µm infrared. Enclosure door is interlocked to prevent the Laser from firing when opened for normal operation or operator performed maintenance. No tampering, by-passing or defeating of these interlocks by operators is permitted. No operator access to other interior areas of the product is intended on this equipment. Access behind guards or panels which are not interlocked, is for Service functions only.

Never insert fingers hands or other objects into the Laser marking zone. The Laser may be designed to fire when parts are present in the marking zone, and accidental firing could take place, if interlocks have failed or are by-passed. Never insert objects, wires, rods or body parts under or around protective guards/housings. Never allow shiny objects in the Laser beam path. Direct and indirect reflections can be extremely hazardous to eyes and skin.

The performance of **Service Functions** is permitted only by individuals trained and qualified to perform such work; and trained in the avoidance of Laser Radiation and Associated Hazards. Service functions include such tasks as: cleaning / replacing / aligning optical components; alignment of part holding equipment; testing / repairing workstation electrical / electro-mechanical or control equipment. Service personnel may override certain interlocks or safety features to verify performance. Under these conditions it is the responsibility of the service person and the Laser Safety Officer to ensure that proper administrative controls have been implemented (including temporary barriers) which will prevent the accidental exposure of humans to the Laser or reflected radiation.

When operating in Class 1, **Eye Protection** for this Laser marker is not required during Operation. However, protective eyewear is especially necessary during servicing. Protective eyewear must be worn by all personnel in the vicinity of the Laser, during service, or anytime when covers may be opened and interlocks defeated, with the Laser activated.



Standard plastic or glass safety glasses, with side shields DO NOT have Optical Density sufficient enough, and DO NOT PROVIDE PROTECTION for observers. For those engaged in service activity, or those who must continue to work in the area during the time of service, with potential for exposure to Class 4 radiation, it is required that they be provided with protective eye-wear designed specifically to protect against Laser radiation.

Eyewear for this product (Q switched Nd:YVO4 Laser equipped) must be tested and marked safety glasses (with side shields) or goggles. These spectacles or goggles must have a Optical Density (O.D.) factor of greater than that required to attenuate for the appropriate Laser wavelength (1.06 microns = infra-red) below the MPE (Maximum Permissible Exposure) Eyewear is commercially available.

2.2.2. Associated Hazards

The design and construction of this Technifor product is intended to provide worker protection from hazards. However, mis-use or unauthorized access behind panels could result in worker exposure to hazards.

Electrical Hazard: The Laser power supply contains high voltages and high currents. These electrical sources, present inside the protective housings, are enough to be fatal. Only trained and authorized service technicians should access any area of the power supply.

Environmental Hazard: Laser processing, with this type Laser, causes thermal and photo-electric (molecular) decomposition of the material. Even the micro-quantities of by-product (soot or vapor) created by Laser marking can accumulate over a long period of time. Some of these by-products may prove to be hazardous to humans. Always consult the material manufacturer's Material Safety Data Sheets, (paying close attention to dust and combustion by-products). Because of the possible hazard, unless otherwise permitted by local Industrial Hygienist, workers should treat Laser marking by-product as hazardous. Filters from the exhaust system should only be removed by workers wearing personal-protective-gear, including gloves and respirator filters. These exhaust filters should be handled and disposed of (or recycled) as Hazardous Waste Material under the customer's factory Hazardous Material Management Program. Likewise, workers who periodically clean the inside of the marking chamber should wear protective gear, especially gloves, to prevent skin contact with any built-up hazardous by-product.

2.3) Characteristics

Laser Beam

- Grade (EN60825-1) Class 4 (class 1 with appropriate protection),
- Average power: 8 W maximum,
- Minimum pulse duration: 8 ns,
- Frequency: 10 to 100 KHz,
- Wave length: 1064 nm.

Power Supply

- Electrical supply 115/230 V AC, 50-60 Hz - 1kW maximum,
- Number of phases: 1P+N+PE,
- Electric protection 2 6A, 125V fuses.

Environment

- Operating temperature: 15 - 35° C (59 - 95° F),
- Storage temperature: 0 - 40° C (32 - 104° F).

Pump laser diode

- Power 30W continuous
- Typical current 43A
- Wavelength 808 nm

Positioning diode

- Power 0.6 mW
- Wavelength 650 nm

Anti-laser screen protection level for a wavelength of 1064 nm

- Maximum power density 10^8 W/m^2
- Maximum energy density $5 \cdot 10^4 \text{ J/m}^2$

Noise level emitted by the system

- 68 dbA mesured at 1 meter

2.4) Recommendations and Safety Precautions

For productivity and safety reasons, each user should read this manual before using a Laser machine for the first time or before using a new machine.

For all configurations:



Hazardous Fumes

Laser marking certain materials can cause dangerous gas and particles to be emitted that can be toxic and/or can disturb the machine's functioning.
Should this occur, an extraction system (possibly with filtering) should be installed at the marking station.



The Laser Unit should be kept clean and protected from dust. The external lens should be checked and possibly cleaned (see maintenance paragraph).

The Control Unit should be kept in a well-ventilated place (air enters from the rear and is vented through the upper and lower hoods).

Special protections should be used in polluted environments. Use of specific protections are the responsibility of the operator or the integrator

GRAVOGRAPH is not responsible for injuries that result from disregarding the above rules of operation or other general safety rules applicable to the use of this equipment. Furthermore, disregarding these rules will result in the cancellation of the warranty.

This equipment conforms to current safety standards (at the time of manufacturing).

**The various marking equipment components were designed to function together.
They should not be used separately.**

These components are certified CE and must be used with CE certified components.

2.5) Security Class

The GravoTech YAG100 is a class 1 Laser device.

This means that under normal operating conditions, there is no risk of emission of Laser radiation outside the marking area (fully enclosed).

When the unit is opened, the LaserTop 410 is Class 2 (positioning diode radiation measured at < 1 mW).

Please report to the EN60825 standard for detailed presentation of the security classes of Laser based equipments.

2.6) Identification of the GravoTech YAG100

2.6.1. Identification of the workstation

Before its installation in the workstation, the Laser module is a class IV Laser device (refer to EN60825), and is identified accordingly.

The following labels are applied on the Laser module (they are not visible in normal operating conditions) :

Security labels (black lettering on yellow background)

INVISIBLE LASER RADIATION
LASER RADIATION AVOID EYE
OR SKIN EXPOSURE TO DIRECT
OR SCATTERED RADIATION

LASER RADIATION AVOID EYE
OR SKIN EXPOSURE TO DIRECT
OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT

CAUTION
LASER RADIATION WHEN OPEN
AND INTERLOCKS DEFEATED.

LASER APERTURE

WARNING
THIS LASER SYSTEM CONTAIN A
CLASS 4 LASER IN A CLASS 1 INCLOSURE
IT HAS BEEN CLASSIFIED AS CLASS 2 DUE
TO THE PRESENCE OF A VISIBLE LASER DIODE



OPTICAL FIBER

2.6.2. Identification of the elements

Machine identification labels (white lettering on black background)

Each module (Laser, Control unit and station) is identified with an individual label with its individual serial number, manufacturing date and operating conditions.

2.7) Extraction system

Characteristics of filters used in the recommended extraction system

The system is equipped with 3 filtration stages:

- Prefilter : F6 according to standard EN779 (thin filter)
- Absolute filter HEPA H13 cording to standard EN779 : (99.97% >0.3µm)
- Activated carbon filter (42 liters) : odors and toxic gases

MIL.STD 282	←	95% DOP	...	99.90% DOP	...	99.97% DOP	...	99.99% DOP	...	99.999% DOP
NBN X44-001	←	U95			U99,97			U99,99		
EUROVENT	←	EU10		EU11		EU12		EU13		EU14
EN 779	←	H10 (HEPA)		H11 ... H12 (HEPA)		H13 ... H14 (HEPA)		U15 ... U16 (HEPA)		

2.8) Potential risks related to material processing

ISO 11553-1:205(F)

Appendix A (informational)

Potential risks

A.1 Examples of by-products of the process

A.1.1 General information

The following by-products are some of the most current examples of what laser material processing may produce. These examples are for informational purposes only and are not exhaustive.

A.1.2 Processing ceramics

Aluminum oxide (alumine), magnesium oxide, calcium oxide and silicon oxide;
BeO (Beryllium oxide - very toxic).

A.1.3 Processing silicon

Waste Si and SiO is suspended in the air (breathable and may provoke silicosis).

A.1.4 Machining metals

From a medical standpoint, at a minimum, the following metals and their components are involved:

Mn, Cr, Ni, Co, Al, Zn, Cu, Be, Pb, Sb

Their medical effects are the following:

- toxic: Cr^{6+} , Mn, Co;
- allergens, metal fever: Zn, Cu;
- pulmonary fibrosis: Be;
- cancerogens: Cr^{6+} , NiO

Beryllium is very dangerous. Heavy metal fumes are created, especially when cutting alloys similar to titanium, magnesium, and aluminum, or zinc-based metals.

A.1.5 Cutting plastics

A wide variety of potentially harmful substances may be emitted. Operations performed at low temperature produce hydrocarbon aliphatics, while working at high temperatures produces an increase in aromatic hydrocarbon (such as benzene, PAH) and polynuclear polyhalogen hydrocarbons (dioxins, furans for example). Certain materials may produce cyanide, isocyanates (polyurethane), acrylates (PMMA) and hydrogen chloride (PVC).

ISO 11553-1:2005(F)

Their medical effects are the following:

- toxic: cyanide, CO, benzene derivatives
- allergen, irritant: isocyanates, acrylates;
- irritation of the respiratory tracts: formaldehyde, acrolein, amines;
- cancerogens: benzene, certain PAH.

A.1.6 Soldering metals

Generally speaking, fume emission is low in comparison with metal cutting. Heavy metal vapors are to be expected.

See A.1.4.

A.1.7 Heat treatment

Generally speaking there are no by-products, but there may be heavy metal vapor emissions.

A.1.8 Soldering and brazing

Heavy metal vapors, flux vapors and by-products are to be expected.

A.1.9 Cutting paper and wood

Normal by-products, namely cellulose, esters, acids, alcohols, and benzene.

A.1.10 Accidental deterioration of the material

By-products of a material or substance deteriorated unintentionally by laser radiation (optical for example) which present a risk.

ZN, SE oxides.

A.2 Examples of secondary radiation risks

Secondary radiation risks include optical radiation coming from the soldering area and producing

- deterioration of the polymers and emission of toxic gases and fumes, in particular, ozone;
- risk of fire or explosion of materials or flammable substances;
- X rays from plasmas;
- risk to humans resulting from UV radiation and sharp lighting emitted.

3

UNPACKING & INSTALLING THE MACHINE

3.1) Packaging of the machine

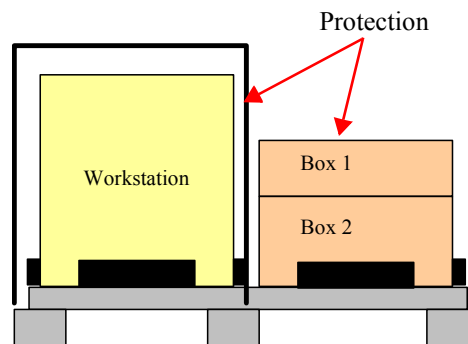


This equipment includes a Laser source and it must be handled carefully to prevent any damage (misalignment) to the equipment that could reduce its efficiency.

3.2) Packaging structure

The machine is packed as follows :

- 1 pallet dimensions 1300x1000x1000, weight 100 kg.
- 1 mechanical structure strapped onto the pallet, with protecting foams to prevent damage.
- 1 set of 2 boxes strapped onto the pallet with the Laser, head, control unit and connection cords.



A shock detector is placed on the box to control that the pallet has not been mishandled (dropped, reversed, etc.). If the shock absorber has turned to red, it must be notified on the delivery documents and reserves must be expressed to the carrier until the equipment has been properly checked.

Content of the packages

Box 1 (on the top): This box includes:

- The Laser module protected by foam blocks on each end
- The scanhead protected by 2 foam blocks
- The set of connection cords
- Set of mounting screws in a plastic bag
- Software and manuals on CD Rom

Box 2 (on the bottom): This box includes:

- The control unit

**It is strongly advised to keep and store the boxes after unpacking as they may be used in the event part of the equipment had to be returned for inspection / servicing.
They can be strapped (individually or together) onto a standard 800x600 pallet.**

3.3) Unpacking specification

3.3.1. Warning / Sensitivity to shocks

The equipment contained in the package is highly sensitive equipment and can be damaged by improper packing or shipping.

The pallet is equipped with shockwatch detectors that are triggered when the pallett has been mishandled, and when there is a risk for the equipment.

Pleas inspect the detectors carefully:

- White detector : Shockwatch not triggered, no shipping / handling issue.
- Red detector : Shockwatch triggered, meaning mishandling occurred (shock, drop, etc.).

3.3.2. Unpacking procedure

Before installing the equipment, it must be properly unpacked to optimize the installation and operation of the equi-
pment.

Take the different elements out of the pallett and check that they are in proper condition.

3.4) Installation procedure



Part of the equipment is heavy and shall be handled/carried only by 2 persons.

The installation includes several steps that must be conducted properly to ensure safe installation of the equipment.

Tools to use :

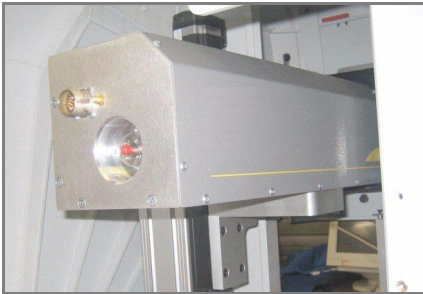
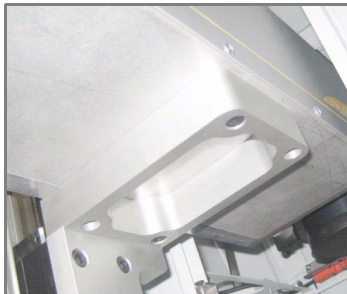
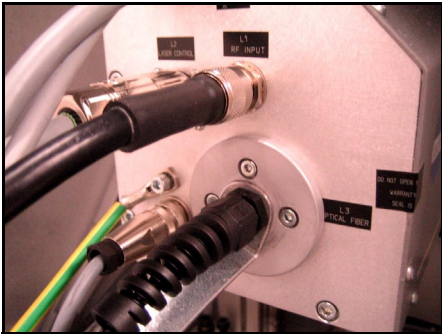
Allen key: 

Flat screw driver: 

Cross screw driver: 

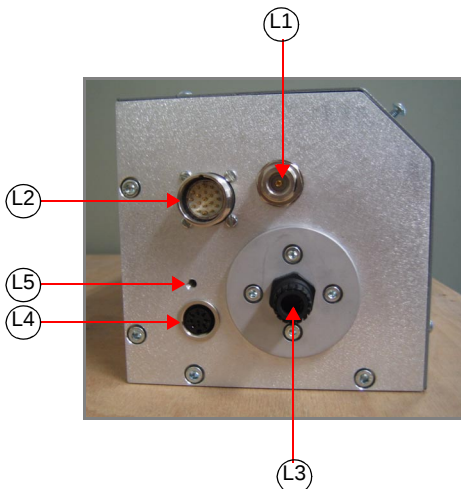
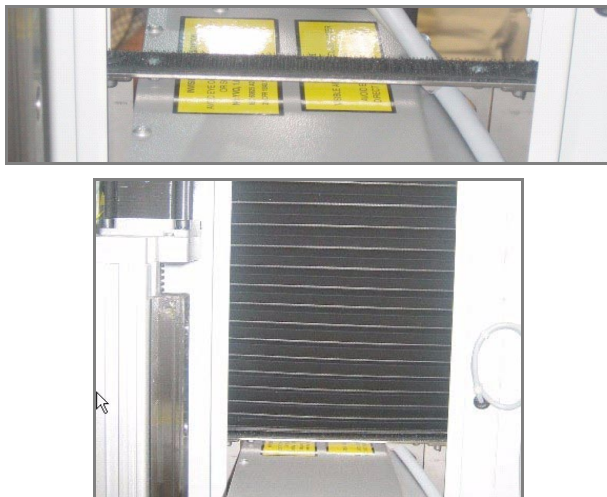
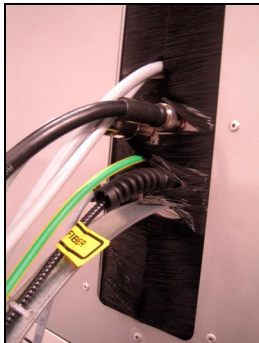
Step	Description	Tool & size
1	Remove the rear cover of the workstation structure. This enables access to the internal part and to install the Laser module + head in the machine. 	 3 .../...

.../...

Step	Description	Tool & size
2	Attach the scanhead on the Laser module. Check position by aligning the edges of the module and of the scanhead. 	 4
3	Remove the upper bellows (attached by the velcro band). Remove the 2 screws to take off the top of the metalframe. See photo Step 6	 2.5
4	Install the Laser inside the station. The Laser is mounted from the bottom face using 4 screws.  	 5
5	Connect the cords onto the Laser module and the scanhead. Connect L2 connector (round 19 pins) Connect H4 and H5 onto the scanhead (DB9 + DB25) Connect the L1 connector (RF) Connect the optical fiber : • Remove the metal housing (3 M4x16 + nylon washers + o-ring) to access the SMA connector on the Laser module • Insert the fiber through the strain relief and the end plate without removing the fiber end protection • Remove the protections and connect the fiber to the SMA connector. Tighten by hand, DO NOT USE TOOLS • Replace the metal housing and attach the strain relief   Keep the fiber end and SMA protection caps in the event you are required to return part of the equipment for inspection or servicing.	 3 

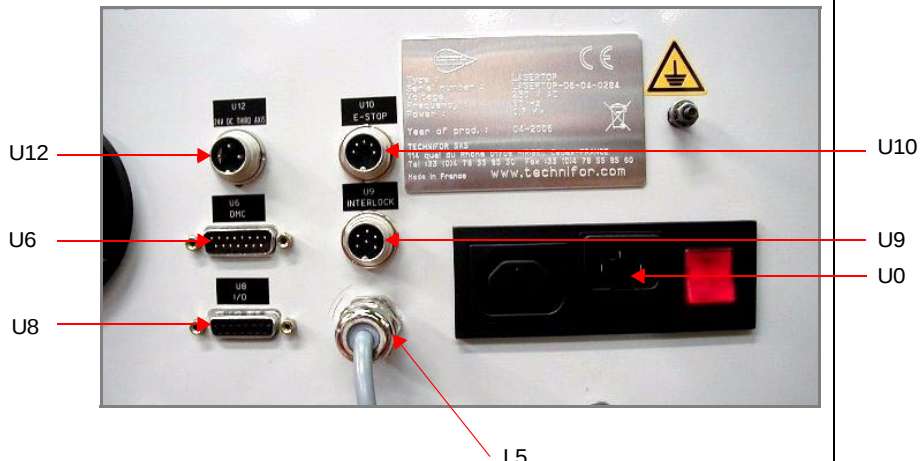
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Step	Description	Tool & size												
5	<table><tr><th>REF.</th><th>DESCRIPTION</th></tr><tr><td>L1</td><td>RF Laser module connection</td></tr><tr><td>L2</td><td>Parallel connection Laser module</td></tr><tr><td>L3</td><td>Optical fiber Laser module connection</td></tr><tr><td>L4</td><td>Shutter key</td></tr><tr><td>L5</td><td>Ground connection</td></tr></table>	REF.	DESCRIPTION	L1	RF Laser module connection	L2	Parallel connection Laser module	L3	Optical fiber Laser module connection	L4	Shutter key	L5	Ground connection	
REF.	DESCRIPTION													
L1	RF Laser module connection													
L2	Parallel connection Laser module													
L3	Optical fiber Laser module connection													
L4	Shutter key													
L5	Ground connection													
6	Mount the metal frame and the bellows around the Laser module. Slide the scanhead cables through the metal frame. 	 2.5 												
7	Replace the rear plate of the station, sliding the cables through the protection brushes. 	 3												
8	Install the control unit. Make sure that it is laying flat and that cooling grids are not obstructed (top, bottom and rear).													

.../...

.../...

Step	Description	Tool & size
9	Connect the permanent cables between the Laser and the control unit : Connect U2 (Laser) Connect U5 and U4 (scanhead) Connect U1 (RF) Connect the fiber : • Open the top cover of the control unit. Take care to remove the ground connector. • Insert the fiber through the plastic protector and the end plate without removing the fiber end protection • Remove the protections and connect the fiber to the SMA connector onto the diode module. Tighten by hand, DO NOT USE TOOLS • Attach the plastic protector to the rear plate. • Close the top cover of the control unit, reconnecting the ground connection  Keep the fiber end and SMA protection caps in the event you are required to return part of the equipment for inspection or servicing.	 3  
10	Connect the station cables to the control unit : • DB15: Input/Output parallel cable (U8) • DIN 3: Connection Z axis power supply (U12) • DIN 5: E-stop connection (U10) • DIN 6: Interlock connection (U9) • Power cord (U0) • Interlock safety shutter (L5) • DMC Option (U6) 	
11	Connect the control unit to the PC with the ethernet cable supplied.	
12	Connect the station to the single phase AC network with power cord provided.	

4

PRESENTATION OF THE ELEMENTS

4.1) Marking workstation

The Laser module and the scanhead are mounted in this station. They are installed on a motorized Z-axis in order to properly focus the Laser beam onto the part.

External view



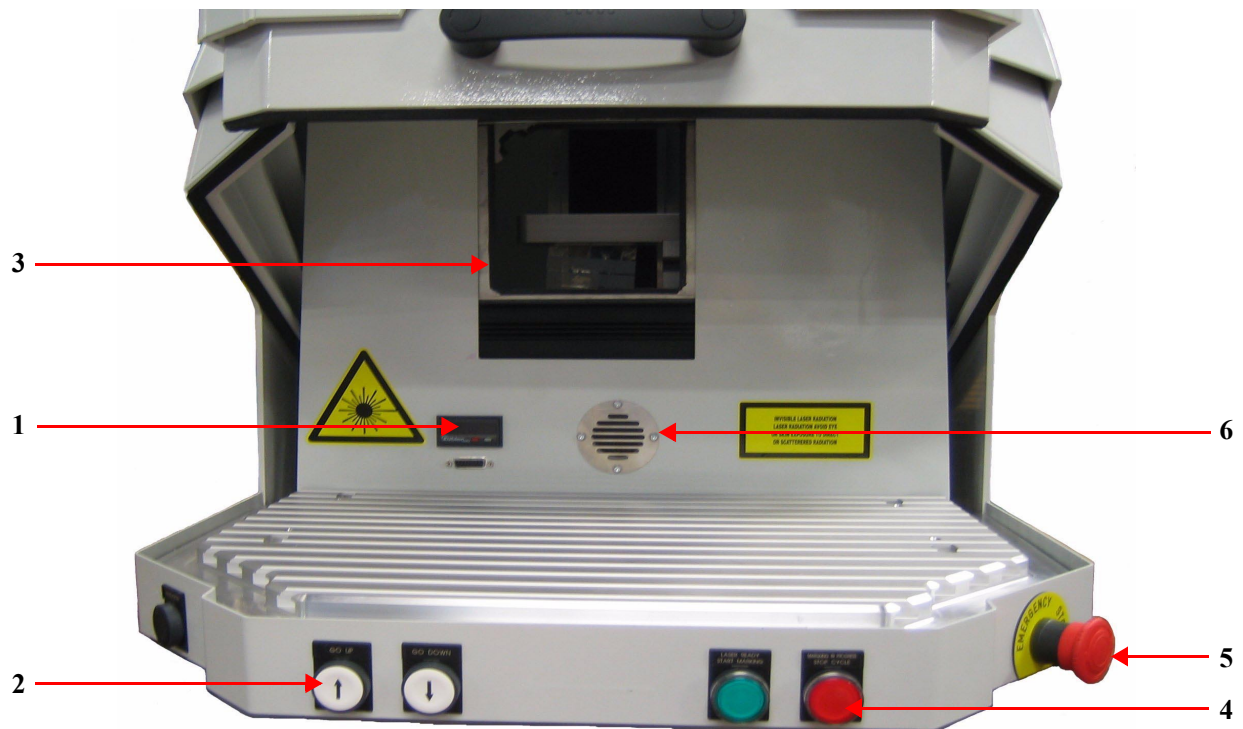
A large slotted table enables positioning of fixturing tools and parts under the scanhead.

Front and side panels are removed when opening the marking area to easily load / un load parts to mark. They slide when the front handle is pushed up, using 2 pneumatic slides to assist opening / closing of the doors.

On the front panel, a protective window enables safe visualization of marking.

View of the marking area

The door is lifted using the front handle, and it gives access to the marking area.



- A **digital display** (1) indicates the Z position of the Laser. It can be reset to 0 depending on the fixturing used.
- **Up and Down buttons** (2) can be used to move the Laser and scanhead (3) to the correct focus position.
- **Buttons + LEDs** (4) are available on the front panel for the following actions:
 - . Green : Start cycle (+ Laser ready information),
 - . Red : Stop cycle (+ marking in progress information),
- An **E-stop button** (5) is also available on the right side of the machine.
- **Exhaust port** (6) is mounted on the back plate of the structure.

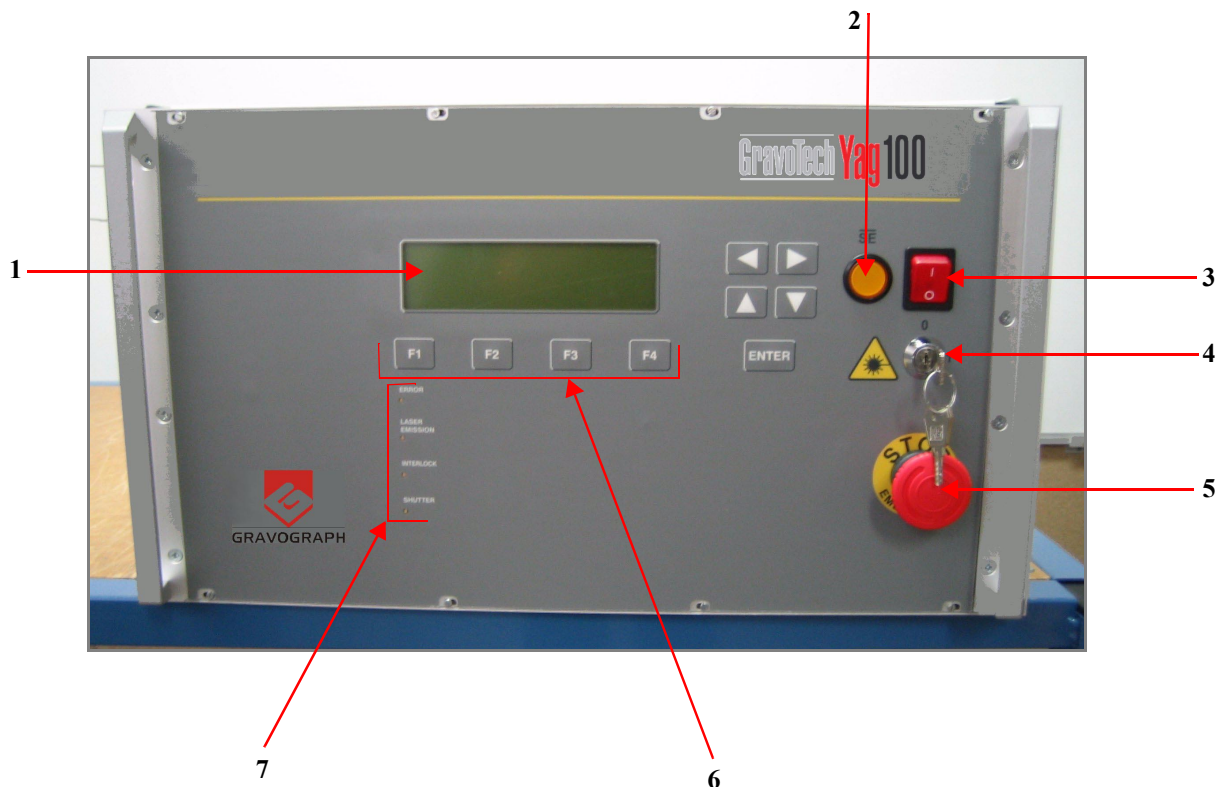
The workstation complies with the European regulation EN60825, and is a Class 2 Laser device. This means that :

- Marking can only be performed when the marking area is closed and there is no risk of Laser emission.
- The door is interlocked, which means that as soon as the door is open, the safety shutter is closed inside the Laser module to eliminate any risk of emission. The Laser cannot be turned on when the door is open (error 14 / interlock).

4.2) Control unit of the machine

The control unit is supplied with the station and includes all the components needed for an efficient operation of the Laser marking systems :

- Laser diode, cooling system (TEC) and controlling electronics.
- Marking control electronics.
- Power supply and connecting rail.
- Display and front panel.



The front panel includes:

- 1 - LCD screen to display information concerning the functioning of the Laser source (temperature, diode current, etc...)
- 2 - Reset after emergency stop.
- 3 - Main switch.
- 4 - Key-switch to start the Laser diode.
- 5 - Emergency stop button.
- 6 - Flat keyboard with different navigation keys (F1-F4, toggle keys, etc.).
- 7 - LEDs to indicate the status of the Laser.

5

SOFTWARE INSTALLATION AND CONFIGURATION

5.1) Connection to the PC

The YAG100 marking systems is connected to the PC using ethernet TCP/IP connection.

There are 2 ways of connecting the machines:

- **Direct connection to the PC**

Ethernet connection with crossover cable. Connect the ethernet cable supplied with the machine between the RJ45 / PC ethernet connector and the RJ45 connector on the control unit (U13).

In this case, the PC is attached to the machine, and marking can only be performed from this station.

- **Connection through a Local Area Network (LAN)**

The PC is already connected to the network.

Connect the machine (U13) to the network. The type of cable to use (straight or crossover cable) depends on the nature of the network. Consult your local network administrator.

In this case, several PCs can access one or several machines which are installed on the LAN.



The cable delivered with the machine is a crossover ethernet cable (5 meters), with an optional inverter (that converts the straight cable into a crossover ethernet cable).

In all cases the YAG100 machine is identified as a network component, to which an IP address is assigned for its unique identification on the network.

All rules related to local IP identification (in your network) will apply. Contact your administrator.

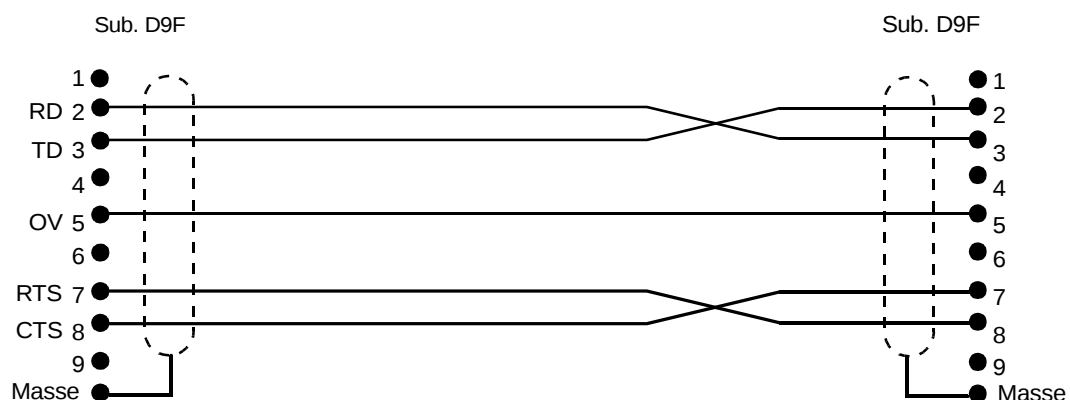
5.2) Configuration of the communication

5.2.1. Equipment configuration

The modification of the communication parameters between the machine and the PC is performed using a RS232 serial connection in order to change the IP address of the machine.

Connect a RS232 serial cable between the PC serial port and the U7 RS232 port of the YAG100 control unit.

Wiring diagram of the RS232 cable



5.2.2. IP address / Default values

The IP address of the control unit must be configured on site depending on the range of IP address that can be used in your LAN.

The default factory value are:

- **IP address** **172.16.0.1**
- **Communication mask** **255.255.0.0**



This configuration will be performed by the qualified technician when the machine is installed, and its IP address will be selected according to your LAN properties.

5.2.3. Modify the IP address of the YAG100 control unit

Contact your dealer.

5.2.3.1 - Installation of the GravoTech YAG Driver

The YAG100 is controlled by the PC like a standard printer, using a driver that is accessible through the configuration panel in Windows.

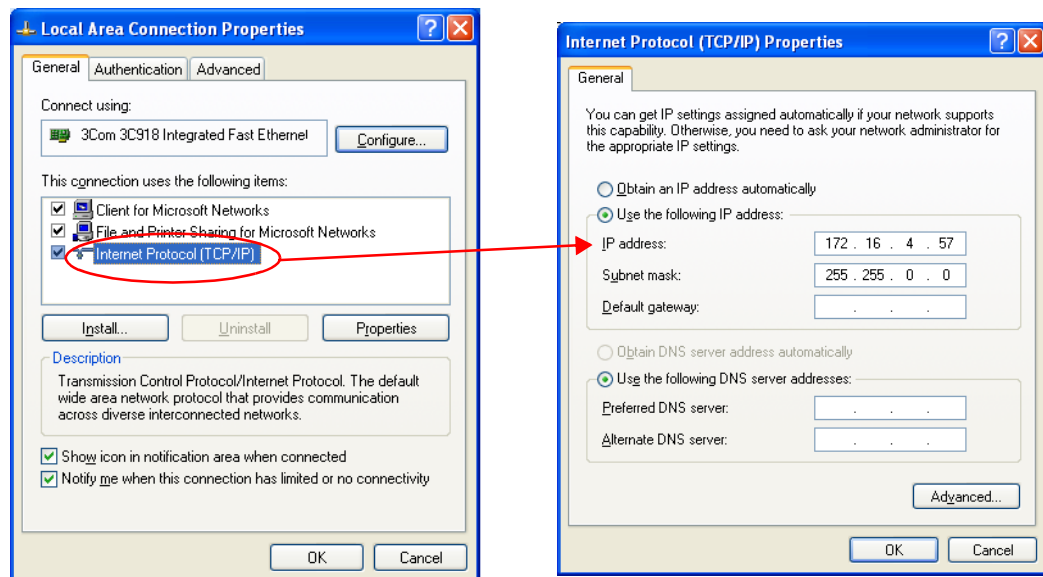
Installation is performed through the “Add Printer” process, using specific features linked to TCP/IP communication.

5.2.3.2 - Control of configuration and connections

1. Check the software configuration of the TCP/IP protocol on the PC

Configuration panel / Network connections

Display properties of the Local Network Connection



- Check that the TCP/IP protocol is valid and select it.
- Check the IP address and the mask of the PC.

To be able to connect to the YAG100 machine, the IP addresses of both elements (Machine and PC) must be compatible.

Example:

IP of the PC **172.16.4.57** with mask 255.255.0.0

IP of the YAG100 **172.16.0.1** with mask 255.255.0.0

The mask indicates that the systems will only “see” devices with IP addresses starting with 172.16. (*255 means : fixed value, 0 means : open value*).

2. Check the connection between the YAG100 control unit and the PC

This test controls that the equipments can connect properly.

Open a DOS session using the Command function.

Type a ping command to trigger a reply from the machine : **C:\>ping 172.16.0.1** (*IP address of the YAG100*).

*In this example,
the YAG100 has
the following
IP address: 172.16.0.1*

```

C:\>ping 172.16.0.1

Pinging 172.16.0.1 with 32 bytes of data:

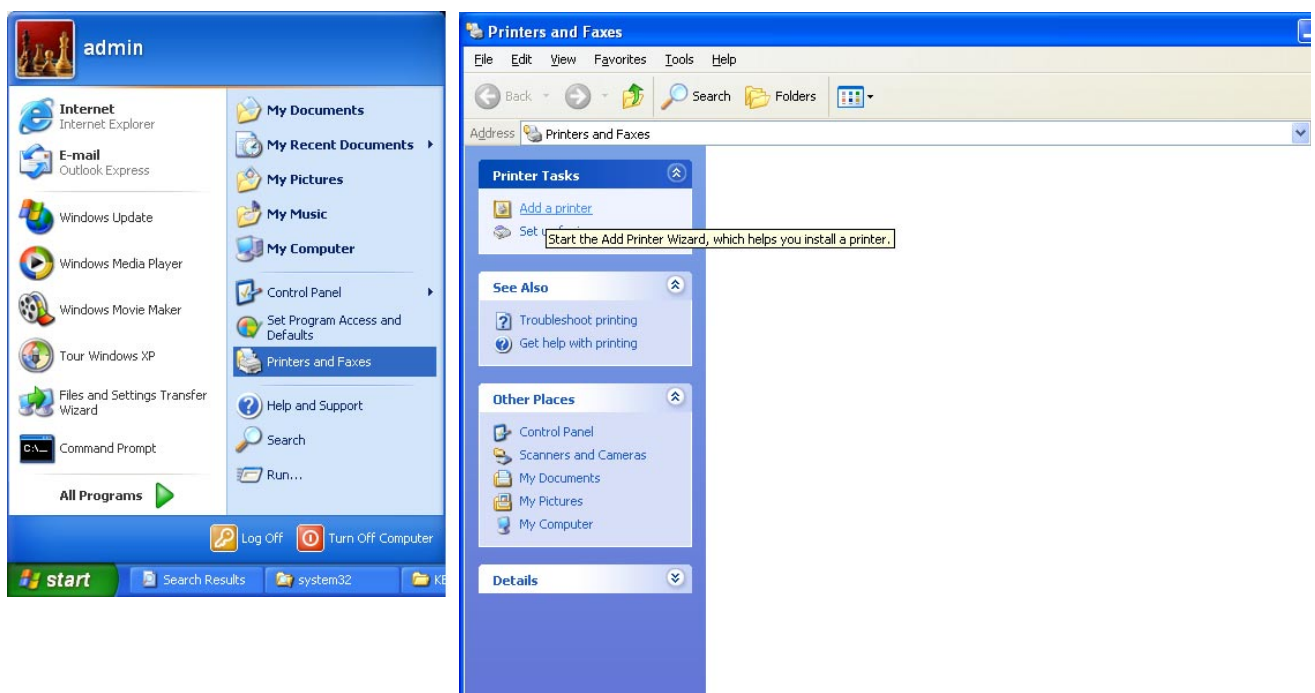
Reply from 172.16.0.1: bytes=32 time<1ms TTL=128
Reply from 172.16.0.1: bytes=32 time<1ms TTL=128
Reply from 172.16.0.1: bytes=32 time<1ms TTL=128
Reply from 172.16.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
  
```

5.2.3.3 - Driver installation

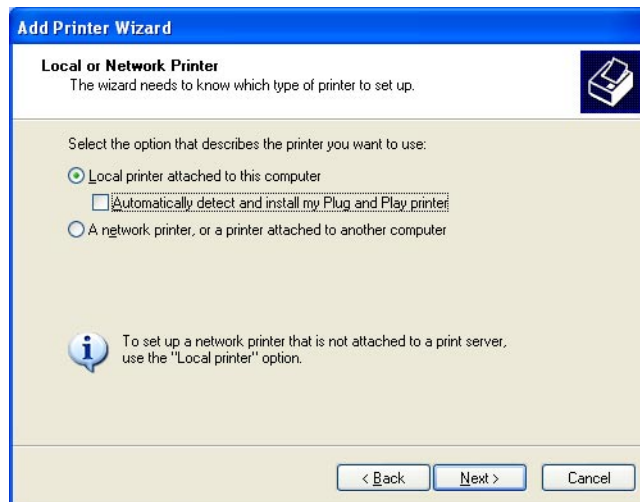
Open the printer control window, and select « Add a printer »



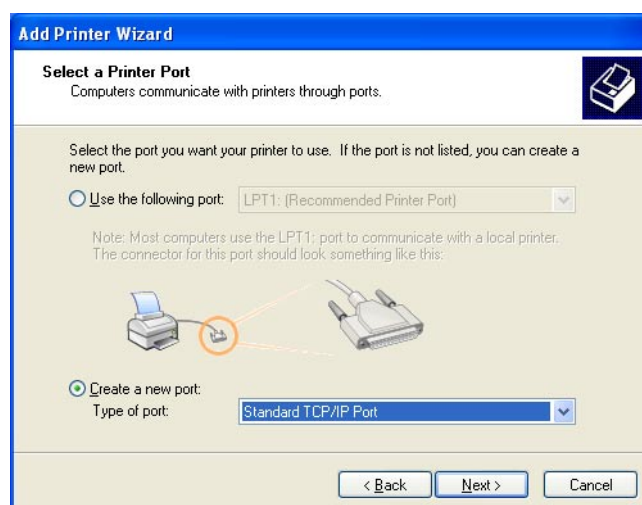
This starts the printer installation wizard.



Select the printer as a local printer connected to the PC (see below)



Create the connection port for the printer (standard TCP/IP port).



Enter the IP address of the YAG100 machine, and the name of the port (default = IP address).

In this example, the YAG100 has the following IP address 172.16.0.1

Add Standard TCP/IP Printer Port Wizard

Add Port
For which device do you want to add a port?

Enter the Printer Name or IP address, and a port name for the desired device.

Printer Name or IP Address: 172.16.0.1

Port Name: IP_172.16.0.1

< Back Next > Cancel

For the peripheral control select **standard type** and **Generic Network Card** driver.

Add Standard TCP/IP Printer Port Wizard

Additional Port Information Required
The device could not be identified.

The device is not found on the network. Be sure that:

1. The device is turned on.
2. The network is connected.
3. The device is properly configured.
4. The address on the previous page is correct.

If you think the address is not correct, click Back to return to the previous page. Then correct the address and perform another search on the network. If you are sure the address is correct, select the device type below.

Device Type

☒ Standard Generic Network Card

☐ Custom Settings...

< Back Next > Cancel

The communication port has now been created. Check the specifications on the end-of-creation report :

Add Standard TCP/IP Printer Port Wizard

Completing the Add Standard TCP/IP Printer Port Wizard

You have selected a port with the following characteristics.

SNMP: No

Protocol: RAW, Port 9100

Device: 172.16.0.1

Port Name: IP_172.16.0.1

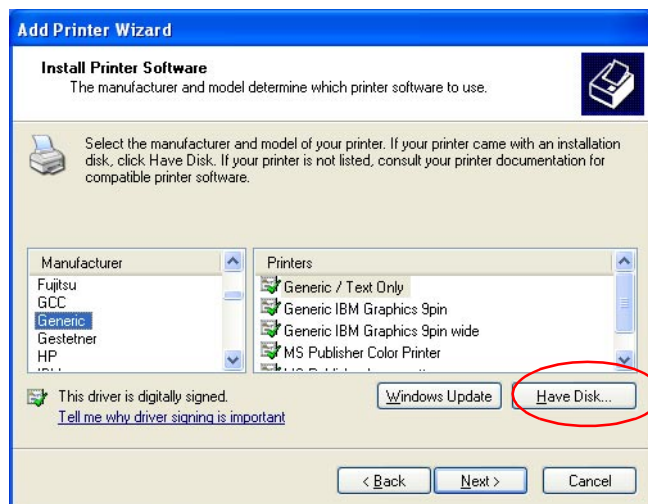
Adapter Type: Generic Network Card

To complete this wizard, click Finish.

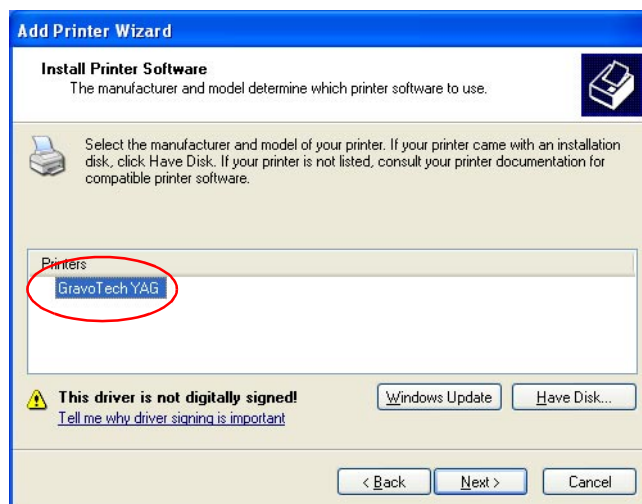
< Back Finish Cancel

If the protocol is not “RAW, Port 9100”, check the communication section for the driver.

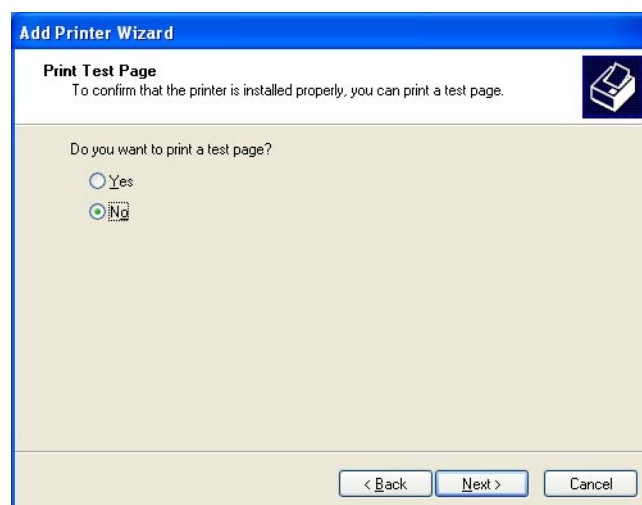
Proceed with the installation of the driver: select « Have Disk ».



Browse the disk (CD Rom) to find the GravoTechYAG.inf file needed for the installation to proceed.

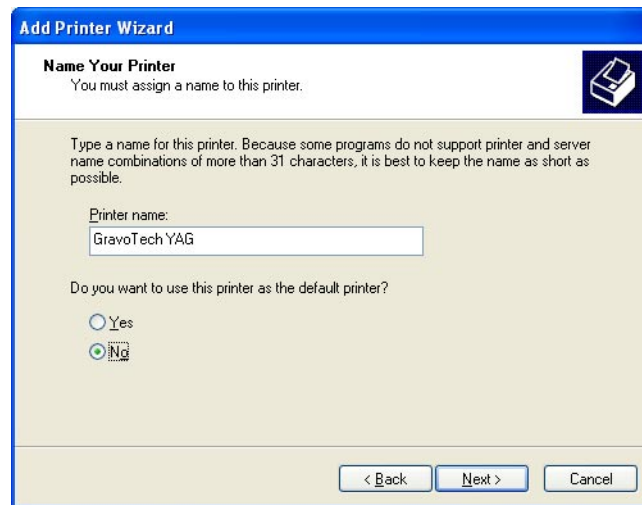


If an older version of the driver is already installed, it is recommended to uninstall it before proceeding.

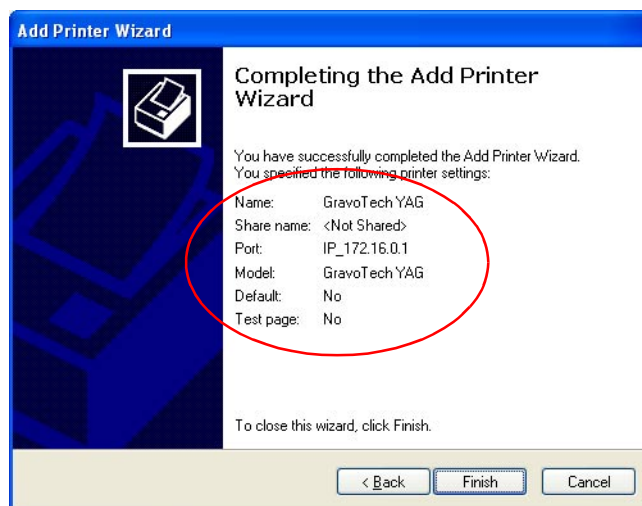


It is advised to keep the *GravoTech YAG* Name as the name of the printer.

Do not select it as the default driver, and do not define it as a shared printer.



A recap of the installation is now displayed:



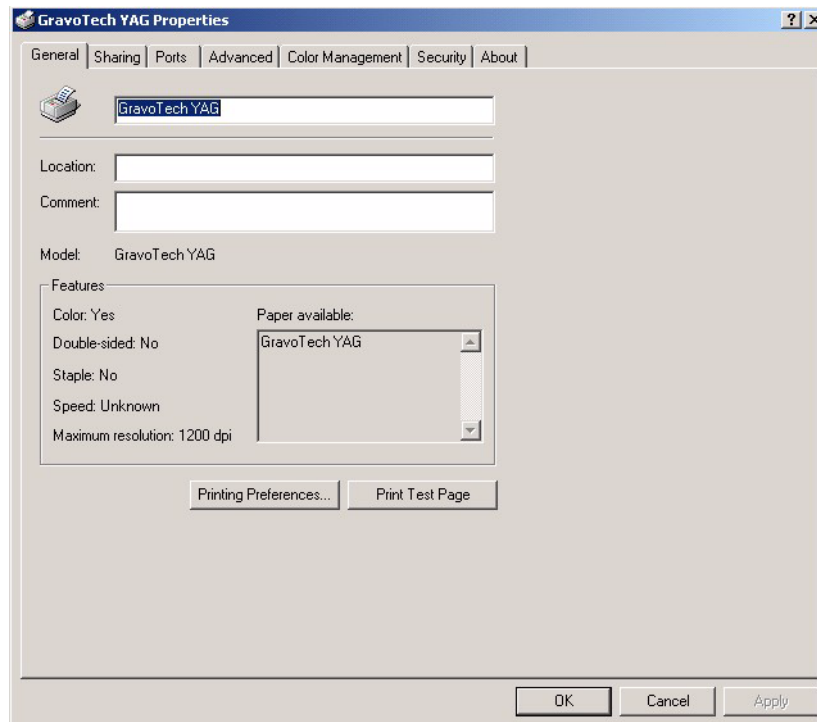
If you get a window alert about the Windows XP compatibility, ignore this message and select "Continue Anyway".

From this point on, the GravoTech YAG appears in the list of available printers:



5.2.3.4 - Communication features of the driver

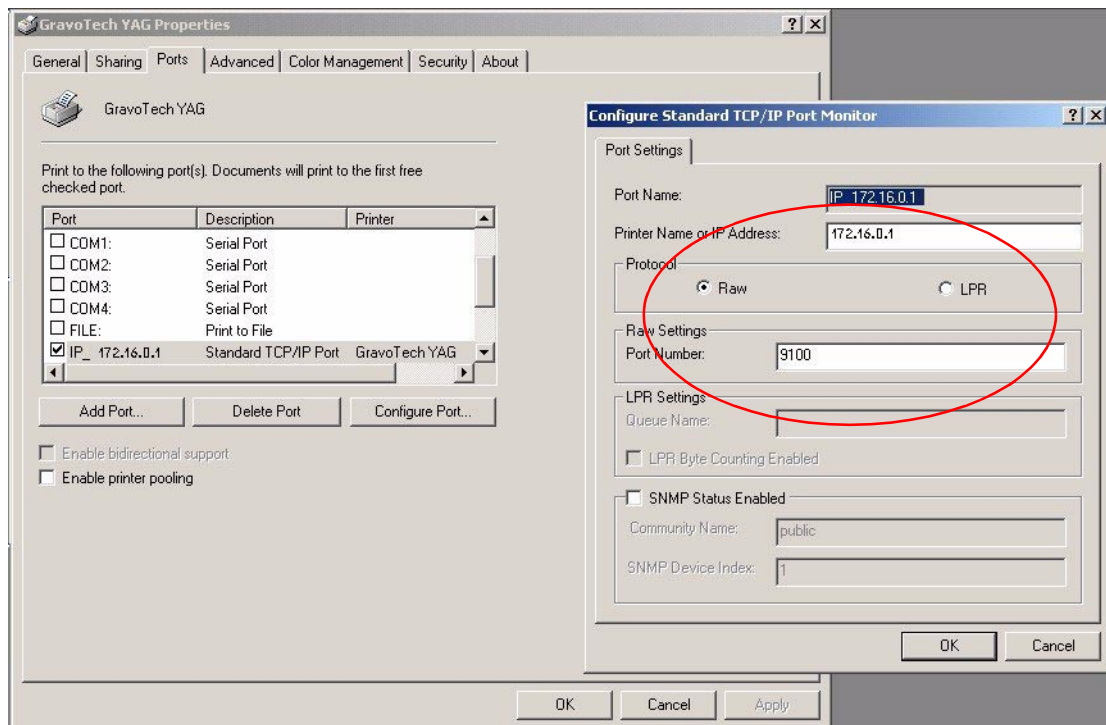
Display Driver properties (right click on the driver icon). The following window is displayed:



Printing Preferences button will open the Driver graphical interface.

In the tab "Ports", the printer must be configured to use the TCP/IP port previously created.

Press Configure Port, check the port configuration (check it is in Raw mode, with port Number = 9100).



The Driver is now properly installed and the machine is properly configured for receiving and marking jobs.

6

START-UP AND OPERATION

6.1) Powering the YAG100 machine

Connect the YAG 100 to the mains using the plug on the rear of the enclosure.

The other elements are powered by connecting them to the enclosure.

Turn on the main power switch (on the rear of the station). The internal light source is turned on.



Main Power switch

Turn on the Control unit power switch, and press the re-arming button (SE) to proceed with the start-up procedure.

If this does not trigger start up, it means that E-stop is activated. Check E-stops on the control unit and on the station, and inspect connection on U10.

After boot-up time (35-40 seconds), the green light flashes to indicate that boot is completed and the laser can be turned on.



The door must be closed to start the Laser source (Interlock light is OFF on the front panel). If Interlock is ON (safety loop open), an error E14 will occur when turning on the laser source.

Turn on the Key switch (position 1 / horizontal). Ignition procedure starts.

Ignition usually takes around 25-30 seconds.

Ignition is complete when the measured current in the laser diode I_d has reached the requested value I_c .

Upon completion of the ignition procedure, the Laser Emission light is ON on the control unit front panel.

With the door closed, open the Shutter (pressing F4 on the control unit).



From this point on, the shutter will be automatically closed when door is open (interlock switches ON) and closed when the door is closed. It is thus not necessary to wear eye protection equipment to work with the machine.

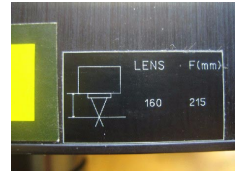
6.2) Positioning the part to mark

In order to achieve a good mark on the part, the part must be positioned at the focal distance (*working distance*) under the scanhead.

The exact working distance can vary slightly from one machine to the other, but is mentioned on a label applied on the scanhead..

Typical working distances are:

- F-100 lens 135 mm,
- F-160 lens 215 mm,
- F-254 lens 345 mm.



The working distance adjustment is performed using the Z adjustment of the machine.

The position is displayed on a digital counter positioned inside the marking area

Reset button
(Red)



The position is changed pressing simultaneously the Up or Down key AND the validation button (black button on the left handside of the unit).

Validation button



Up / Down buttons

When installing the machine, it is recommended to reset the counter so that the exact working distance is saved. To do so:

- Position the Laser in Z so that the working distance is measured between the table top (or the fixture if a fixture is used) and the scanhead.
- Reset the counter pressing the red button. Table top is now the reference.
- From this point on, the working distance is adjusted by positioning the laser at the proper value corresponding to the thickness of the part to mark.



Important tip : some types of markings request the part to be slightly out of focus to optimize the quality of the mark.

Typical example is black annealing on stainless steel or titanium. A perfectly focused beam will remove material as the power density is very high. Defocusing will increase spot size, decrease power density and avoid material removal.

Defocusing is not handled by the driver, so it is advised to mention the defocusing distance as a comment in the job file.

The X-Y position of the part will be defined using the printing driver and the job creation in Gravostyle (see section 6.3).

For all GravoStyle instructions, refer to the GravoStyle manual supplied with the installation CD rom.

6.3) Printing Driver and marking parameters

The creation and modification of marking jobs is performed using GravoStyle 5.

Marking is performed through the printing driver.

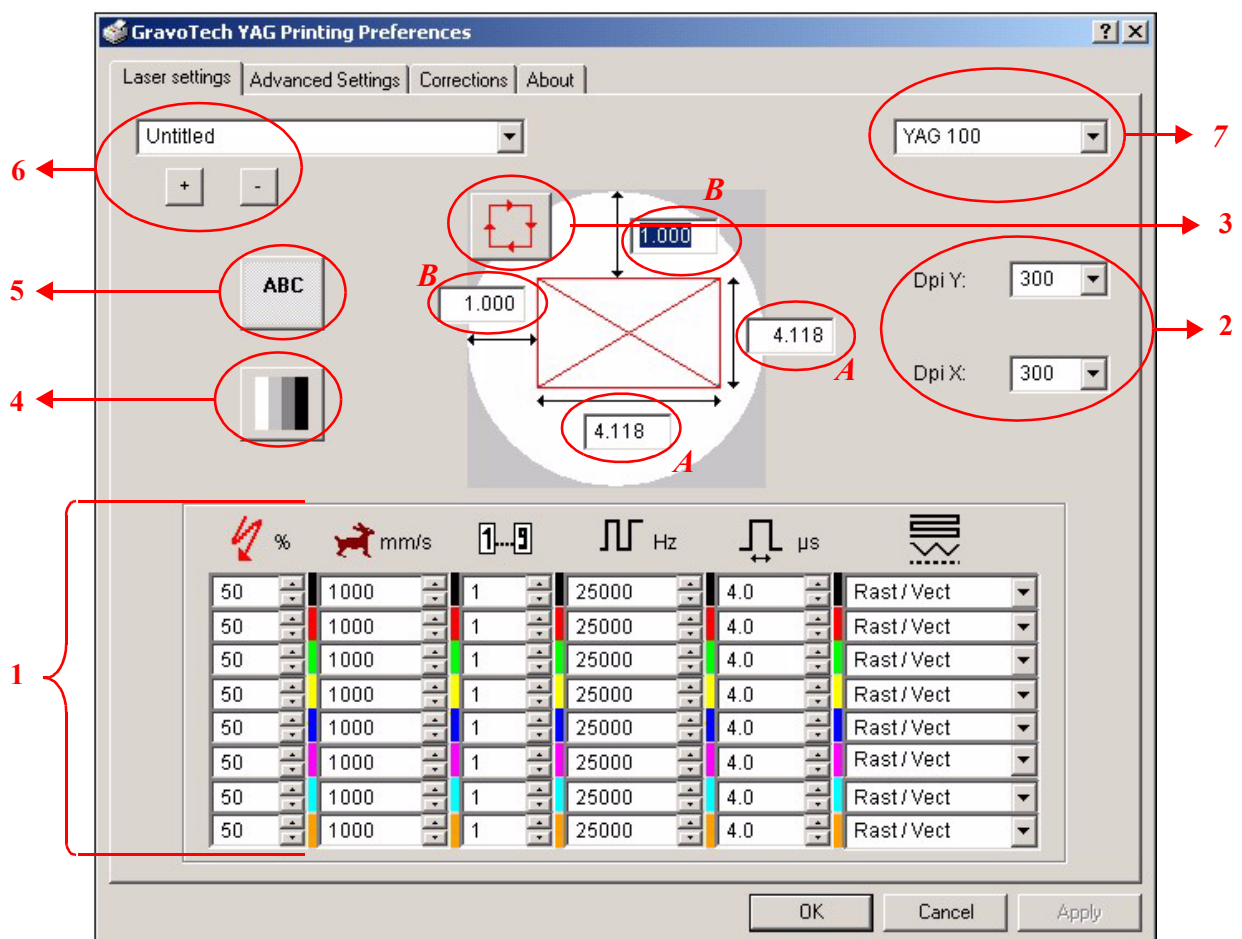
The marking parameters are thus set in this driver.



Each set of parameters can be stored using a settings name in the driver. It is recommended to store the parameters for each material.

6.3.1. General Laser settings

In this tab are defined the main parameters needed for laser marking settings:



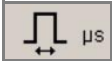
Definition of the plate to mark:

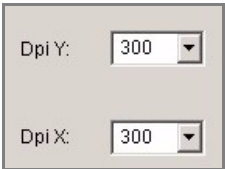
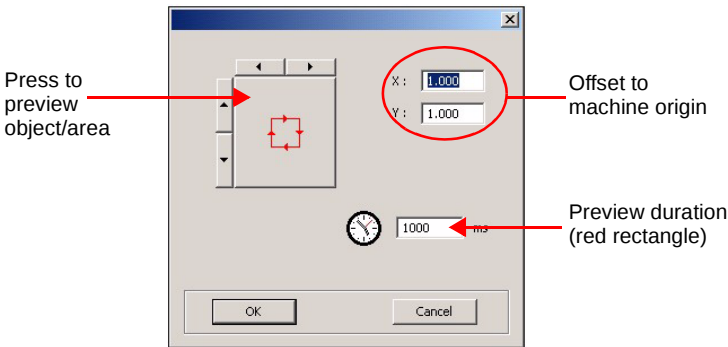
A: These values correspond to the sizes of the plate which **must be EXACTLY the same as in the Gravostyle 5 or any other marking software (Corel draw, etc...).**

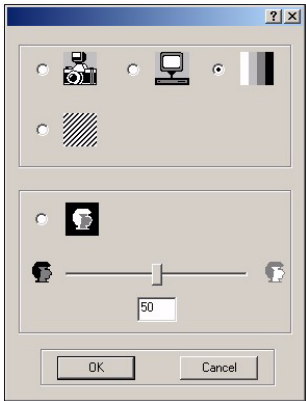
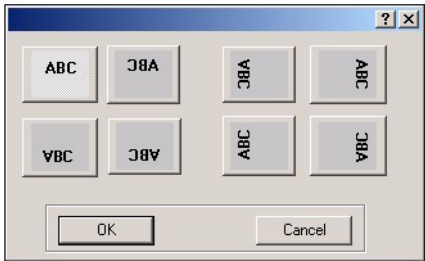
The operator must check that these values are correct. The dimensions must be smaller than the available marking area depending on used focal lens (F-100: Ø80mm; F-160: Ø120mm; F-254: Ø200mm).

B: These values correspond to the origin of the marking which is by default on the top left corner.

Explanation of the tab

No.	Symbol	Description
1		Details of the parameters (1 set of parameters for each color):
		Power setting (%): corresponds to the current setting of the laserdiode. 0% corresponds to laser threshold, 100% to maximum current.
		Speed setting (in mm/s) : marking speed (typical values range from 10 to 2500 mm/s).
		Number of passes for the selected color, from 1 to 9.
		Repetition Rate (Hz): pulse repetition rate, will provide various pulse peak power (typical values range from 10,000 to 100,000 Hz).
		Activation time (μs) : adjustable time for pulse generation, will provide various peak powers for a fixed repetition rate (range from 0.1 to 10 μs).
		Marking mode (Raster or Vector mode). This must be compatible with the color definition in Gravostyle.
		Rast: all the lines of this color defined in raster mode are treated and marked. Vector lines are ignored.
		Vect: all the vector lines are treated and marked. Lines defined in raster mode are ignored.
		Rast/Vect: all the vector and raster lines are treated and marked.

No.	Symbol	Description
2		DPI settings Sets the DPI value for Raster mode marking. For colors in vector mode, this value is ignored. This setting corresponds to the image resolution in DPI (Dot Per Inch). There are different settings available, up to 1200 DPI. High resolution marking will generate a more defined marking but will increase the marking time. According to the application, and the requested marking, it is important to make several tests to optimize the marking cycle. The setting of the Y resolution adjusts automatically the X value.
3		Plate position setting The object to engrave must be positioned in the marking area properly. This feature enables visualization of the position of the object to engrave. It opens the following window:

No.	Symbol	Description
4		Processing mode selection (for photo engraving) Selection of the mode to process the graphical objects properly. The YAG100 works like a black and white printer. The “bitmap” pictures in grey scale or in color with clipart multicolor pictures are transformed into smoothed pictures. This operation is done by the software. The different possibilities are described below: <u>Picture mode:</u> The pixels are randomly distributed to create a shadow effect. Each point will be marked with the same power (as defined for the color black). <u>Automatic mode:</u> The colors in clipart and texts are converted in grey levels so that the corresponding power is affected to each pixel (proportional to the black color). <u>User color mode:</u> The colors in clipart and texts are converted in 8 basic colors defined in the printer driver interface. The other colors are converted to the closest color of these 8 colors. <u>Frame mode:</u> The colors in clipart and texts are converted in grey levels (like in an automatic mode); the power range is divided in 64 levels, a specific frame is applied. <u>Negative image:</u> The image is converted to its negative image. Objects initially marked are unmarked.
5		Marking direction setting To select the orientation of the marking within the marking area
6		Storage of preset parameters Type the name and press + to save current parameters for a specific material. Type – to remove a material
7		Definition of the machine The list of machines available is displayed on the screen (YAG100).

6.3.2. Advanced settings

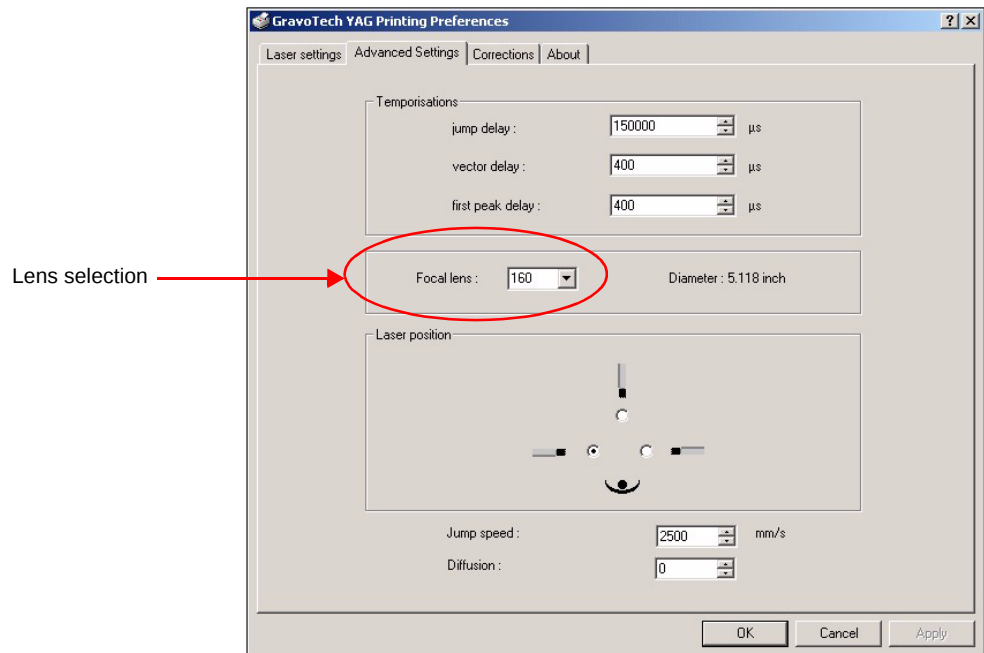
This tab includes advanced settings attached to the machine configuration.

Temporization values are linked to the laser beam movement. The position of the laser determines the orientation of the X and Y axis according to the position of the operator.

The jump speed and diffusion parameters are internal parameters that should not be modified.

All these parameters are set properly at the installation of the machine and must not be changed.

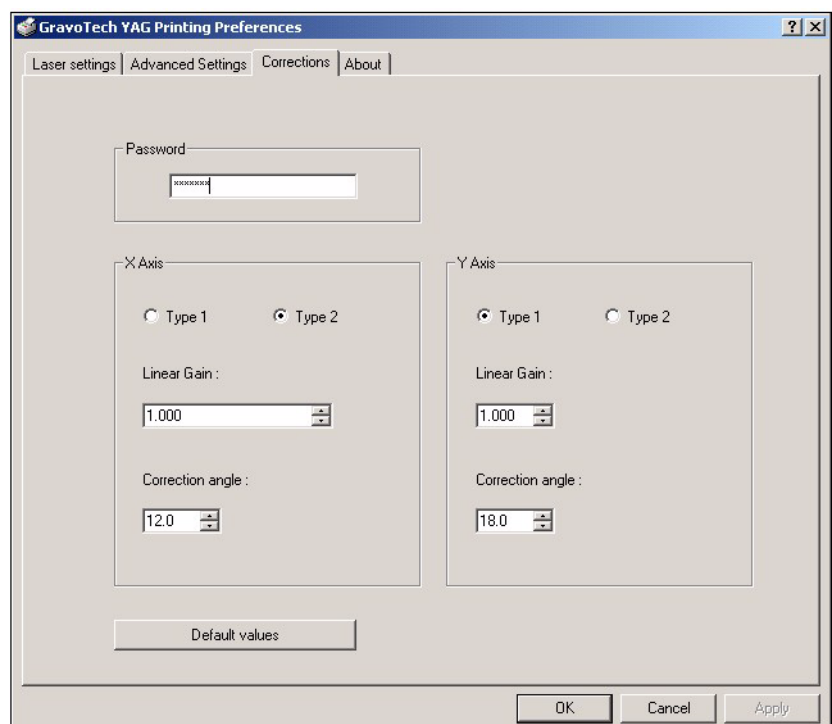
In case the machine is equipped with 2 lenses, the selection of the mounted lens is in this tab.



6.3.3. Correction parameters

Here are adjusted the correction parameters that are applied to optimize the shape and size of marked objects.

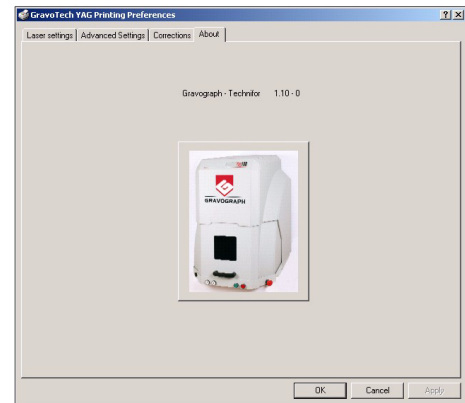

This tab is password protected and the modification of these parameters can only be applied by a trained technician, as it may alter the quality of the marking.



6.3.4. Firmware update

The about tab includes the utility routines that are used to update the machine firmware.

Press the button and follow the instructions.



6.4) Marking with GravoTech YAG Driver

Once the plate / part is properly positionned under the scanhead in the marking area, marking can be triggered using the driver laser settings.

For each color to mark, define the best suited parameters depending on the material to engrave and the lens to use.

When marking a new material, it is advised to store (by clicking on the “+” button in the driver interface) the parameters as new presets with a detailed name (ex : brushed stainless 316L). This will enable quick setting when processing new parts of the same material.

6.4.1. Table of parameters

The following table gives indications on typical marking parameters to use with a F-160 lens in **Vector engraving mode**. (DPI settings have no influence)

For raster mode, these values will have to be adapted according the material and the DPI values.

Material	Power (%)	Frequency (Hz)	Speed (mm/s)
Black anodized aluminium	80	25 000	600
Aluminium	80	30 000	400
PVC plastic	70	20 000	400
Stainless steel <i>Annealing</i>	95	20 000	25-50
Stainless steel <i>Light Engraving</i>	95	30 000	400
Brass	100	15 000	100
Copper	100	15 000	100
Steel	90	70 000	100
White ABS	70	20 000	400
Polypropylene	70	20 000	200
Black ABS	60	17 500	200

6.4.2. Marking tips

These tips are general advice that may not work for all materials.

Plastic marking

- Unneeded power will create burning effect on the surface of the part. To optimize quality and aspect, lowering the power is usually a good solution.
- High frequency may generate a lot of fumes because interaction time is increased. Lowering the frequency may contribute to a better marking quality with less fumes.
- Always use extraction when processing plastics.

Coated materials (anodized, painted, etc.)

- Always use extraction as heavy production will quickly create a lot of dust.
- Always set power above the minimum value to remove the coating, as thickness may vary and the result may not be very consistent
- Do not expect to have great “gray scale” aspects as it is usually 0-1 marking (night / day).

Metals

- Some metals will not provide very high contrast as they cannot turn to black under the laser radiation (bare aluminum, brass, etc.)
- To achieve a clean black mark on steel or titanium, increase the repetition rate, reduce the speed and if you get some material removal and a brownish aspect, set the laser slightly out of focus (2-3 mm).
- Most precious metals have a very high thermal conductivity, as a result, too much power will create a fuzzy mark because of heavy diffusion. Reduce the power and the repetition rate to decrease thermal problems.

7

TROUBLESHOOTING AND MAINTENANCE

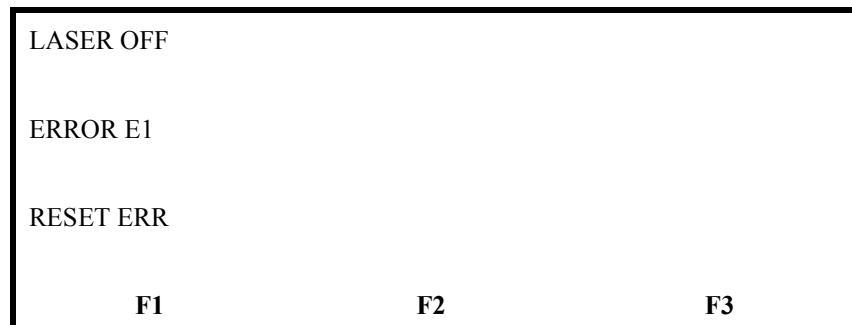
This chapter outlines potential problems that you may encounter with the Laser.

7.1) Error messages

The marking system is equipped with sensors and detectors to enhance safety and stop the laser if there is a problem.

This avoids causing major damage to the equipment.

With every problem-induced system stop, an error message is displayed on the Control Unit screen with a code specifying the type of error.



The errors are indexed by error codes (E1, E2,..., En) that correspond to specific problems (see paragraph 7.2).

To clear the error message, press F1.

Next, you should turn the key to the vertical position and press the SE button to be able to start again.



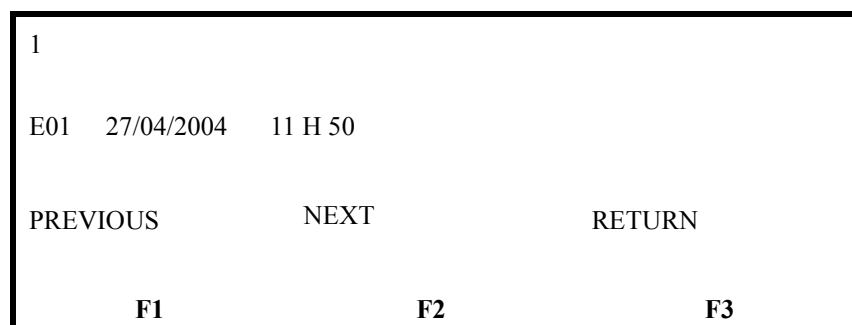
7.2) History of error messages

In order to help discover what the problem is (in the case of a recurring problem), the system saves and stores errors that have caused the Laser to stop.

Every message is marked with the hour, date, and error code for the problem.

The history is accessible from the information screen (press F3 in the main screen).

Press F2 to display the list, then F1 or F2 to navigate within the error list.



7.3) Error message codes

ERROR CODE	DESCRIPTION	MEASURING DEVICE
E1	Open hood	Hood detector
E2	Faulty shutter	Shutter detector + Electromagnet
E3	Crystal T°	Laser crystal temperature sensor
E4	Q-switch T°	Q-switch temperature sensor
E5	Low diode T°	Diode temperature sensor
E6	High diode T°	Regulates via diode temperature sensor
E7	Alarm diode T°	Alarm diode temperature sensor
E8	Power supply problem	ASTEC power signal
E9	Diode overvoltage	Diode voltage measure (> 2 V)
E10	Diode current error	Current measured too different from required value
E11	Diode overcurrent	Measured current > I max
E12	T° regulation problem	T° system regulation detection OFF
E13	Id regulation problem	Id system regulation detection OFF
E14		
E15		

7.4) Preventive maintenance procedure

In order to maintain the marking equipment in good operating condition, some preventive maintenance may be requested depending on the application.

The main tips are:

- Leave the station as clean as possible.
- Use extraction if the process generates fumes or dust.
- Check that the optical output (lens on scanhead) is clean and not scratched. Clean it with optical paper and ethanol if necessary.
- Check that air entry grids (laser module and control unit) are free and clean, as poor air flow would reduce cooling efficiency and therefore the quality of marking.
- Properly maintain the extraction system.

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