

Laser Safety Manual

Baykal Fiber Laser Tube Cutting Machines



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ABOUT THIS MANUAL

This manual applies to the product with which it shipped. Features and functionality described herein may or may not be applicable to existing product in user possession.

This instruction manual contains information to help buyers and operators understand how to prepare and operate the BAYKAL Fiber Laser.

This manual will help to operate the laser safely and properly. Careful attention to this manual will help avoid risks, reduce repair costs, reduce process downtime and increase the overall reliability of the laser.

The instruction manual must be read and applied by user of this laser product. Specific topics covered in this instruction manual include:

- * Laser safety

This manual provides guidelines for safe and reliable laser operation. In addition to following the instructions found in this manual, the laser operator should adhere to the mandatory safety regulations, professional technical rules for laser safety and other professional guidelines for safe laser operation.

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1. INTRODUCTION

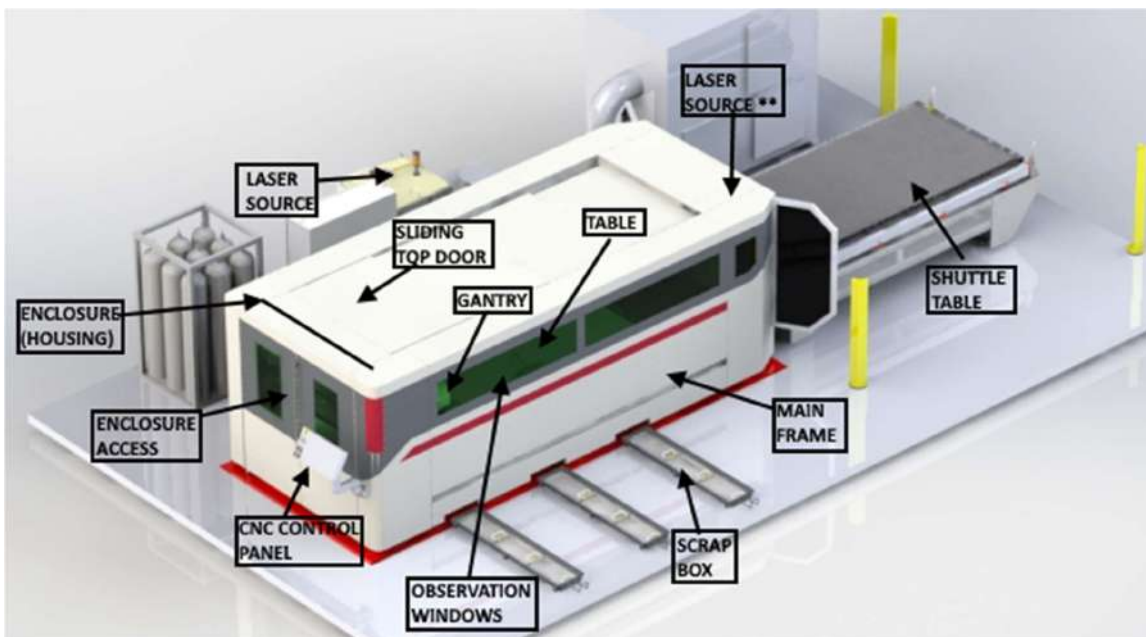
1.1. DESCRIPTION BAYKAL LASER SYSTEMS BLE, BLE-PRO, BLS-N, BLS-P, BLT - FIBER LASER FOR TUBE AND SHEET CUTTING

The Baykal Fiber Laser System produces two or three dimensional contoured shapes from flat material or tubes by moving a focused laser beam along a programmed path. The beam comes from a stationary laser generating unit and is directed to a moving lens by a fiber optic cable routed through a moving gantry. The workpiece remains stationary while a narrow strip of material is removed along the path made by the lens. Material is removed by vaporization and melting where the lens concentrates laser power into a small spot on the workpiece. Assist gas is also used to control the cutting process. The gantry moves the lens to produce the programmed workpiece geometry. A motion controller commands servo drives to control the gantry motion. The program provided by the user includes commands to specify feed rate, laser power, and assist gas.

The Fiber Laser cutting machine uses a Class 4 invisible laser for cutting materials and a visible semiconductor laser with a wavelength range of 650 nm for checking cutting positions. If the partitions and other protective covers are all closed and the safeguards are all enabled, the outside of the laser machine corresponds to that of a Class 1 laser product. If these conditions are not satisfied, the laser machine is a Class 4 laser product. Close the partitions and all other protective covers, and enable the safeguards. The visible laser is emitted even if the partitions are opened, but the visible laser belongs to a Class II laser product and operator must wear safety glasses with suitable OD supplied by BAYKAL. Use the laser machine in compliance with safety laws, regulations, and standards in the country or region of use.

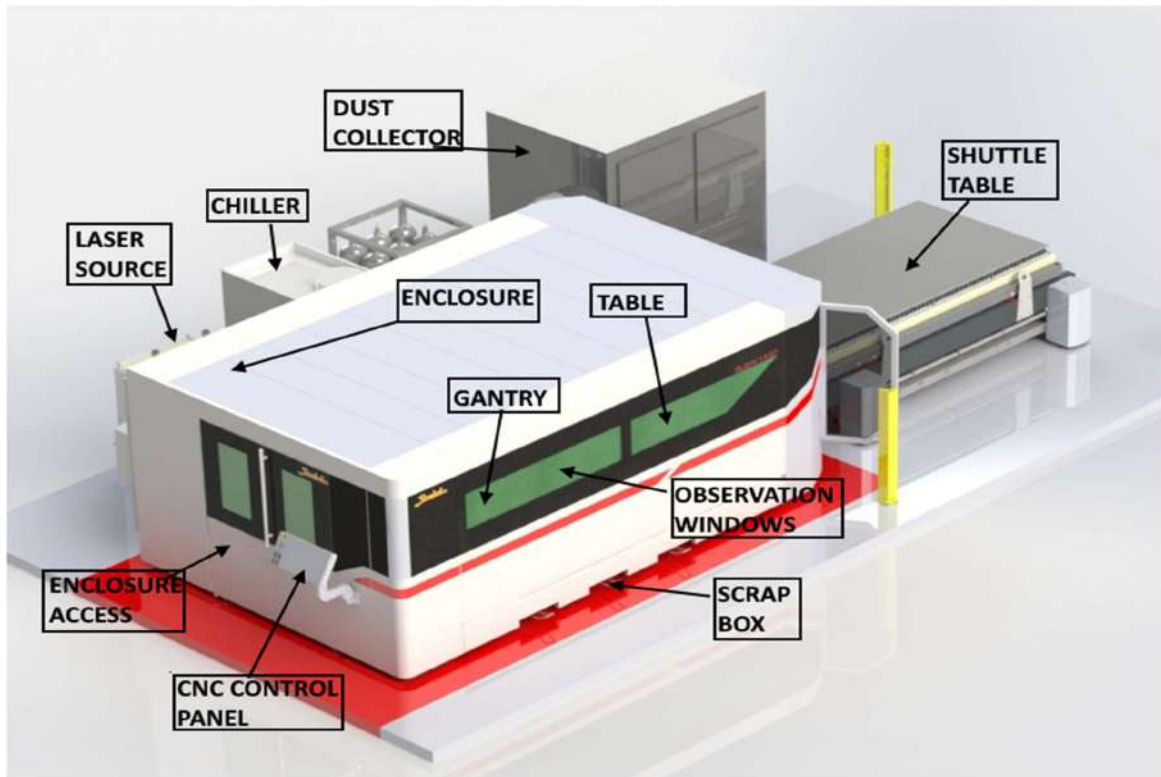
1.2. GENERAL VIEW

1.2.1. MODELS BLE and BLE-PRO



****IF THE LASER POWER IS LOWER THAN 4000W, LASER SOURCE IS PLACED INSIDE MAIN FRAME.**

1.2.2. MODELS BLS-N and BLS-P



MAIN FRAME The table, gantry (X-axis), and laser resonator are installed on the main frame. Racks are installed on both sides of the frame to move the gantry driven along the X-axis.

ENCLOSURE (HOUSING) The Cut Area Enclosure completely keeps the laser beam and any reflected radiation, below the maximum permitted exposure limitations. It also provides localized protection from strike and pinch hazards caused by the automatic motion from the gantry, cutting head, and pallets.

ENCLOSURE ACCESS (MAIN ACCESS DOOR) door will disable the laser preventing the delivery of the laser beam, turn off the red light, flash the on screen Laser on-off button and remove power from pallets and hydraulic pump. This ensures protection for the operators who must enter the cutting area temporarily to perform adjustments or retrieve parts.

SLIDING TOP DOOR is installed only in BLE and BLE-PRO models and will disable the laser preventing the delivery of the laser beam, turn off the red light, flash the on screen Laser on-off button and. This ensures protection for the operators who must enter the cutting area temporarily to perform adjustments or retrieve parts.

TABLE Support grids are installed to the table (Two pallets) to support a worksheet.

GANTRY The gantry is driven along the X-axis by the servo motors installed to the main frame. The gantry has the laser head Y, Z installed.

CNC CONTROL PANEL The CNC controls the drives of the axes, motion of the respective components, and operation of the laser oscillator and cooling unit

LASER SOURCE The laser source (Resonator) is installed on the machine frame if the laser power is lower than 4000W. If the power is higher, it installed behind the machine. The laser source produces a invisible fiber laser beam. The laser beam output conditions are determined according to worksheet material type and thickness, cutting rate and the like and are controlled by the CNC unit. A red visible laser beam (semiconductor laser beam) can also be emitted. It is used to verify the cutting position of the worksheet before actually cutting the worksheet with the invisible fiber laser beam..

COOLING UNIT The cooling unit is installed separate from the machine. The cooling unit circulates cooling water through modules of the laser resonator and cutting head, so that the laser resonator can produce a stable laser beam and the cutting head optics has stable temperature to have a stable focus point.

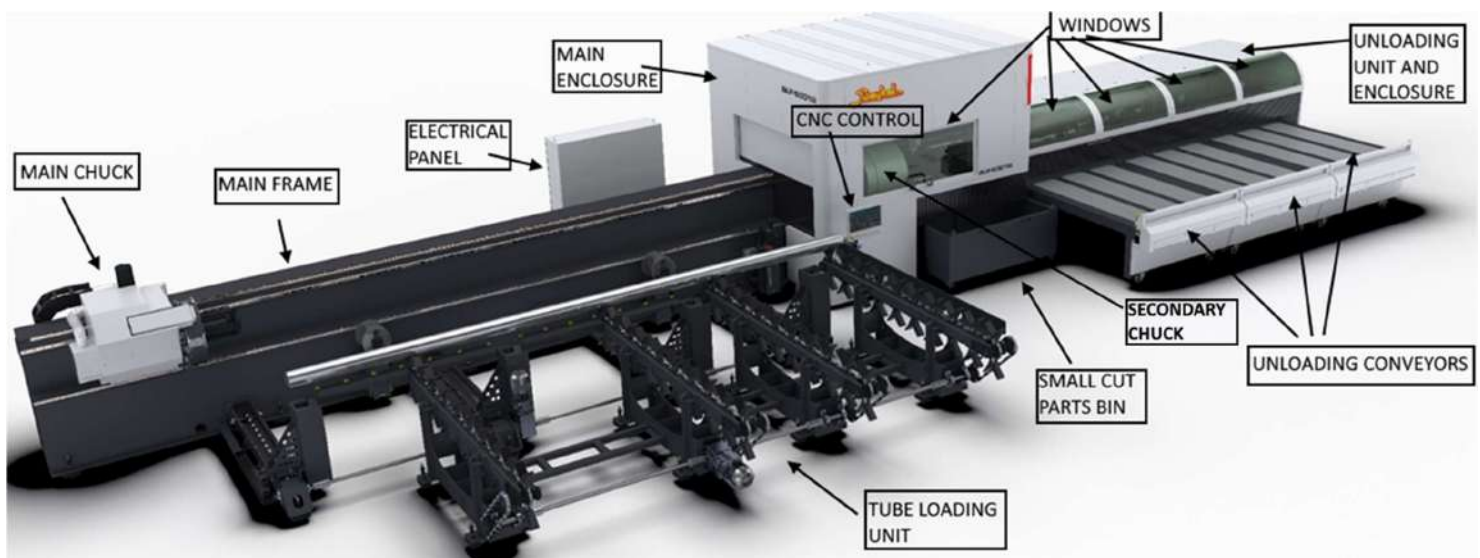
SHUTTLE TABLE The table of the machine is of the pallet type. The shuttle table has two pallets and shuttles the pallets to the machine. The shuttle table is adjusted to the same pass line as the table of the machine, so that it can exchange a pallet with the table of the machine.

SCRAP BOX The scrap removal system is designed to remove scrap material from the cutting area after processing. The system components are: scrap tray mounted on top of the fume collection system, and a scrap cart with removable scrap totes

DUST COLLECTOR The dust collector is installed separate from the machine. Dust collection doors in the main frame opens sectionally to remove the generated dust. The dust is collected in the filter of the dust collector.

OBSERVATION WINDOW(ENCLOSURE WINDOWS) with suitable OD let the operaors watch cutting area safely.

1.1.3. MODELS BLT TUBE CUTTING



MAIN FRAME Main chuck (X-axis and U-Axis), U2 axis(secondary chuck), Y and Z axis assembly and the cutting head are installed on the main frame. Racks are installed on both sides of the frame to move the gantry driven along the X-axis.

ENCLOSURE (HOUSING) The Cut Area Enclosure completely keeps the laser beam and any reflected radiation, below the maximum permitted exposure limitations. It also provides localized protection from strike and pinch hazards caused by the automatic motion from the main and secondary chuck, cutting head, and pallets.

ENCLOSURE ACCESS (SLIDING MAIN ACCESS DOOR) door will disable the laser preventing the delivery of the laser beam, turn off the red light, flash the on screen Laser on-off button and remove power from pallets. This ensures protection for the operators who must enter the cutting area temporarily to perform adjustments or retrieve parts.

TUBE LOADING UNIT Loads maximum 8 tubes automatically, one by one, to the main chuck.

UNLOADING UNIT Unload long cut pieces (min 300 mm) from the machine.

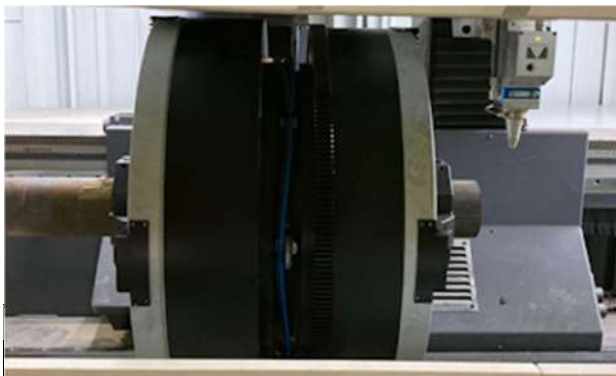
SMALL CUT PARTS BIN Small cut pieces (max 300 mm) drops inside this bin.

UNLOADING CONVEYORS brings the long cut pieces to the front for collecting parts easily.

MAIN CHUCK ASSEMBLY is driven along the X-axis by the servo motors installed to the main frame. It has the X axis motor and U-Axis rotary chuck installed.



SECONDARY CHUCK ASSEMBLY is driven along the X-axis by the T1 servo motor installed to the main frame. It has U2-Axis rotary chuck installed. This device is responsible for fixing the tube under the cutting head.



CNC CONTROL PANEL The CNC controls the drives of the axes, motion of the respective components, and operation of the laser oscillator and cooling unit

LASER SOURCE The laser source (Resonator) is installed on the machine frame if the laser power is lower than 4000W. If the power is higher, it is installed behind the machine. The laser source produces an invisible fiber laser beam. The laser beam output conditions are determined according to worksheet material type and thickness, cutting rate and the like and are controlled by the CNC unit. A red visible laser beam (semiconductor laser beam) can also be emitted. It is used to verify the cutting position of the worksheet before actually cutting the worksheet with the invisible fiber laser beam..

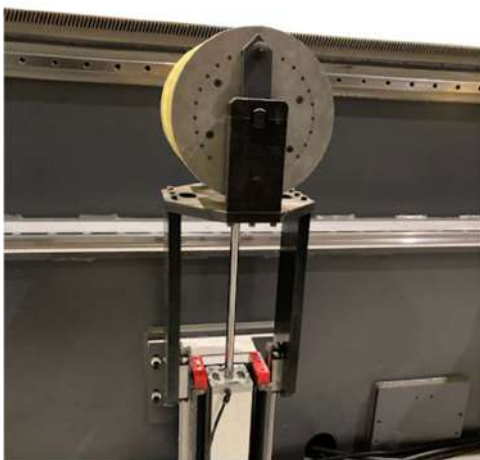
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OBSERVATION WINDOW(ENCLOSURE WINDOWS) with suitable OD let the operators watch cutting area safely.

TUBE CUTTING SUPPORTS used for guiding the tubes to prevent it from swinging.



2. LASER SAFETY PRINCIPLES

2.1. SAFETY STANDARDS AND PUBLICATIONS

There are a wide variety of laser safety standards and publications. These include regulations of the federal government and of several state and local governments. Additionally, there are non-regulatory standards, such as the ones of the American National Standards Institute (ANSI) and of the American Conference of Governmental Industrial Hygienists (ACGIH). Internationally, the World Health Organization (WHO) has laser safety guidelines, and the International Electrotechnical Commission (IEC) has been developing laser safety standards.

In 1968, the U.S. Government passed a law regulating products used in the United States that radiate energy. The law is the "Radiation Control for Health and Safety Act of 1968". This law sets standards of performance for electrical products that emit radiation.

Laws like these are called U. S. Federal Laser Product Performance Standards or FLPPS. Manufacturers use FLPPS to ensure the design and manufacture of their product properly controls radiation hazards before the product is released to their customers. Examples of some of the products covered under this law are x-ray machines, microwave ovens, hair dryers, and all types of lasers.

The Federal Standards covering Lasers and Laser Products (for example, devices or machines containing a laser) are covered in the Federal Register at 21 CFR Part 1040.

Based on these standards, the level of radiation accessible to persons is used to group lasers into one of four classes. The classes are Class I, Class I.A., Class II, and Class IIIA., and Class IIIB, Class IV. These classes or risk categories establish the hazard controls required in the product's design before a manufacturer can turn a product over to a user.

Research studies, along with an understanding of the hazards of sunlight and conventional, man-made light sources have permitted scientists to establish safe exposure limits for nearly all types of laser radiation. Laser safety specialists call these limits Maximum Permissible Exposures (MPE's).

The standards and publications listed below will be the most helpful to users of Baykal Laser Systems:

- **ANSI B11.21**
"American National Standard for Machines Using Lasers". The contents of this standard came from the users and manufacturers of the machines that use laser generated beams to process material.
- **ANSI Z136.1**
"American National Standard for Safe Use of Lasers". This standard, which is technical in content, was developed by the research and health community to cover all types of lasers and laser applications.
- **OSHA Publication 8-1.7**
"Guidelines for Laser Safety and Hazard Assessment". This was developed for OSHA field personnel to help in their job of enforcing workplace safety standards.

2.2. Principal Hazards of Baykal Laser Systems

There are seven principal hazards associated with laser operation in Baykal Laser Systems: **electrical shock, laser and collateral radiation, toxic gases, struck by the moving gantry or trapped between the gantry and the material support grids and trapped between two moving palets, fire, dust explosion.** Properly designed laser systems that are operated by careful, educated operators in an

industrial environment constituted with safety in mind are no more hazardous than any other type of industrial machine, and are far safer than many.

2.2.3. Electrical Hazards

Laser cutting machines use high voltage electricity. This hazard may cause severe burns, nerve damage, and even instant death.

Causes of Death. Although the causes of death from electrical shock are not known with certainty, it is probably caused by asphyxiation or heart failure due to exhaustion and shock to the nervous system.

Respiration Inhibition. Respiration inhibition is dangerous because paralysis of the respiratory organs may last for a considerable period even after interruption of the current. Artificial resuscitation must be applied promptly to prevent suffocation.

Ventricular Fibrillation. Ventricular fibrillation is caused by moderately small currents. The ventricles go into asynchronous or fibrillary spasm in contrast to their normal synchronous contractions. It is believed that once ventricular fibrillation occurs, it is unlikely to stop spontaneously before death.

Tissue Destruction. Destruction of tissues due to high temperatures may cause complications leading to death. Patients who have been revived sometimes die suddenly without apparent cause. This may occur minutes, hours or even days after the accident. The phenomenon is thought to be due to aggravation of pre-existing conditions, or the result of hemorrhages affecting vital centers. It may also be due to shock or burns.

2.2.4. Biological Effects of Laser and Collateral Radiation

Baykal Laser Cutting Machines do not emit collateral radiation due to their design.

General Overview. Laser radiation can cause irreversible damage to the skin and eyes. The principle cause of damage is thermal. Thermal damage is generally associated with lasers operating at exposure times greater than 10 microseconds in a wavelength from 0.315 to 10^3 micrometers. Other damage mechanisms include photochemical reactions following exposures to either actinic ultraviolet radiation (0.200 to 0.315 micrometers) or short-wave visible radiation (0.4 to 0.55 micrometers), when exposures are greater than 10 seconds. The principle damage mechanism for repetitively pulsed exposures is still questionable. It appears that the major mechanism is thermal, where the effect of the individual pulses is additive.

Skin and Internal Organs. Large skin surfaces make the skin susceptible to both acute and chronic exposures. Skin injury is less important than eye damage; however, the skin may be more often exposed to hazardous levels of radiation. In the 0.3 to 1.0 micrometer range, almost 99% of the radiation penetrating the skin will be absorbed in the outer 4 mm of tissue.

Principle thermal effects depend on:

- Absorption and scattering coefficients
- Irradiance or radiant exposure
- Duration of the exposure
- Extent of the vascular flow
- Size of the area irradiated.

The Eye. The principle hazard associated with laser radiation is exposure to the eye. The particularly important regions of radiation hazard are in the visible and the near-infrared spectral regions. The parts of the eye are:

- Cornea
- Aqueous humor

- Lens
- Iris
- Retina
- Macula fovea - sensitive to color and detail.

Retinal effects of visible optical radiation are influenced by the size of the retinal image and the time duration of the laser exposure. In general, the larger the pupil, the smaller the point spread and the greater the magnification factor at the retina as compared with the intensity at the cornea. The optical gain for a 7 mm diameter pupil is at least $1 \times 100,000$. It may be greater, depending on the magnitude of the experimental error in determining the data used in the estimates. The most severe damage to the eye occurs at the fovea. Damage here will severely reduce visual function as regards to detail and resolution. Injury to the parafovea or the peripheral retina is less of a problem and may be undetectable from a functional point-of-view.

Visible and Near-Infrared Wavelength used in Baykal Laser cutting machines Effects. Ocular hazards generally depend on which structure absorbs the most radiant energy per unit volume of tissue. Laser radiation can be focused to an extremely small spot size on the retina, causing excessive irradiance (W/cm^2) or radiant exposure (J/cm^2) incident on the retinal tissues even for modest corneal exposure levels.

In the visible portion of the spectrum, the cornea, lens and the ocular media are largely transparent. Only about 5% of the incident radiation is used for vision. The remainder is absorbed in the pigment granules of the retina. The absorbed energy is converted into heat, which can cause an irreversible retinal burn. A retinal burn occurring in the macula is a very serious trauma. Destruction of this area degrades one's visual acuity to the point where the large "E" on the Snellen chart is no longer discernible; vision function is reduced to 10-200 or worse. Blindness can be the result of a laser exposure that lasts only an infinitesimal fraction of a second. Similar damage in the periphery of the retina will often have minimal, if any functional significance. A macular burn would be the most probable result if the individual is viewing the beam directly. A peripheral burn may occur through an accidental exposure when the eye is not directly viewing the beam.

LASER HAZARD CLASSIFICATION

Virtually all of the U.S. domestic as well as all international standards divide lasers into six major hazard categories called the laser hazard classifications. The classes are based upon a scheme of graded risk. They are based upon the ability of a beam to cause biological damage to the eye or skin. In the FLPPS, the classes are established relative to the Accessible Emission Limits (AEL) provided in tables in the standard. In the ANSI Z 136.1 standard, the AEL is defined as the product of the Maximum Permissible Exposure (MPE) level and the area of the limiting aperture. For visible and near infrared lasers, the limiting aperture is based upon the "worstcase" pupil opening and is a 7 mm circular opening. Lasers and laser systems are assigned one of six broad Classes (I to IV) depending on the potential for causing biological damage. The biological basis of the hazard classes are summarized in the table below.

Class I: Cannot emit laser radiation at known hazard levels (typically continuous wave: cw $0.4 \mu\text{W}$ at visible wavelengths). Users of Class I laser products are generally exempt from radiation hazard controls during operation and maintenance (but not necessarily during service).

Since lasers are not classified on beam access during service, most Class I industrial lasers will consist of a higher class (high power) laser enclosed in a properly interlocked and labeled protective enclosure. In some cases, the enclosure may be a room (walk-in protective housing) which requires a means to prevent operation when operators are inside the room.

Class I.A: A special designation that is based upon a 1000-second exposure and applies only to lasers that are "not intended for viewing" such as a supermarket laser scanner. The upper power limit of Class

I.A. is 4.0 mW. The emission from a Class I.A. laser is defined such that the emission does not exceed the Class I limit for an emission duration of 1000 seconds.

Class II: Low-power visible lasers that emit above Class I levels but at a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person. Only limited controls are specified.

Class IIIA: Intermediate power lasers (cw: 1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended.

Class IIIB: Moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm² or the diffuse reflection limit, whichever is lower). In general Class IIIB lasers will not be a fire hazard, nor are they generally capable of producing a hazardous diffuse reflection. Specific controls are recommended.

Class IV: High power lasers (cw: 500 mW, pulsed: 10 J/cm² or the diffuse reflection limit) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

CLASS	US: FDA/CDRH	IEC 60825 (AMENDMENT 2)
Class 1	- No known hazards during to eye or skin <i>during normal operation</i> - Note: Service Operation may require access to hazardous embedded lasers	
Class 1M	N/A	No known hazards to eye or skin, unless collecting optics are used
Class 2a	- Visible lasers not intended for viewing. - No known hazards up to maximum exposure time of 1000 seconds	N/A
Class 2	- Visible lasers - No known hazard with 0.25 seconds (aversion response)	
Class 2M	N/A	No known hazard with 0.25 seconds (aversion response) unless collecting optics are used
Class 3a	- Similar to Class 2 with the exception that collecting optics cannot be used to directly view the beam - Visible only	N/A
Class 3R	N/A	- Replaces Class 3a (with different limits) 5 x Class 2 limit for visible 5 x Class 1 limit for some invisible
Class 3B	- Medium-powered (visible or invisible) - Intrabeam and specular eye hazard - Generally not a diffuse or scatter hazard - Generally not a skin hazard	
Class 4	- High powered lasers (visible or invisible) - Acute eye and skin hazard intrabeam, specular and scatter conditions - Non-beam hazard (fire, toxic fumes, etc.)	

Because of the power needed to cut metal, **all** lasers used to cut metal are Class 4 lasers. Some Class 4 lasers are embedded in enclosures or rooms and called Class 1 laser products or Class 1 laser systems. However, control measures **must** still be established to insure that the enclosure is maintained and that proper operating procedures are followed.

2.2.5. Hazards of Toxic Gases and Vapors

Another problem that laser workers face is exposure to chemical vapors and industrial fumes. Laser cutting may form poisonous fumes, and that the nature and ventilation of these fumes must be determined. When laser cut, plastics produce carbon monoxide and other toxic gases. When you laser cut materials whose safety is not verified, ask their manufacturers if they generate toxic gases and dust

and if they present fire or explosion hazards. When you laser cut such materials, take necessary measures on your own responsibility

2.2.6. Being struck by the moving gantry or trapped between the gantry and the material support grids.

Approaching the gantry or enter the cutting area while drive power is on. Severe injury can result from being struck by the moving gantry or being trapped between the gantry and material support grids. Enclosures, fences, light curtains and other safeguarding devices are required to prevent the moving parts of the laser cutting machine from impacting or crushing the operator's body parts while the laser cutting machine is operating. When worksheets overhang the table during repositioning, for example, it is necessary to install an auxiliary table

2.2.7. Being trapped between two moving palets.

Entering the area between the two pallets while pallets are changing.

2.2.8. Fire hazards

A fire occurs only when three conditions, a heat source, oxygen and a combustible material, are all combined. Of these conditions, the heat source is molten spatter from laser cutting or the laser light itself. Oxygen is used as assist gas. Effort must be made to eliminate the combustible material.

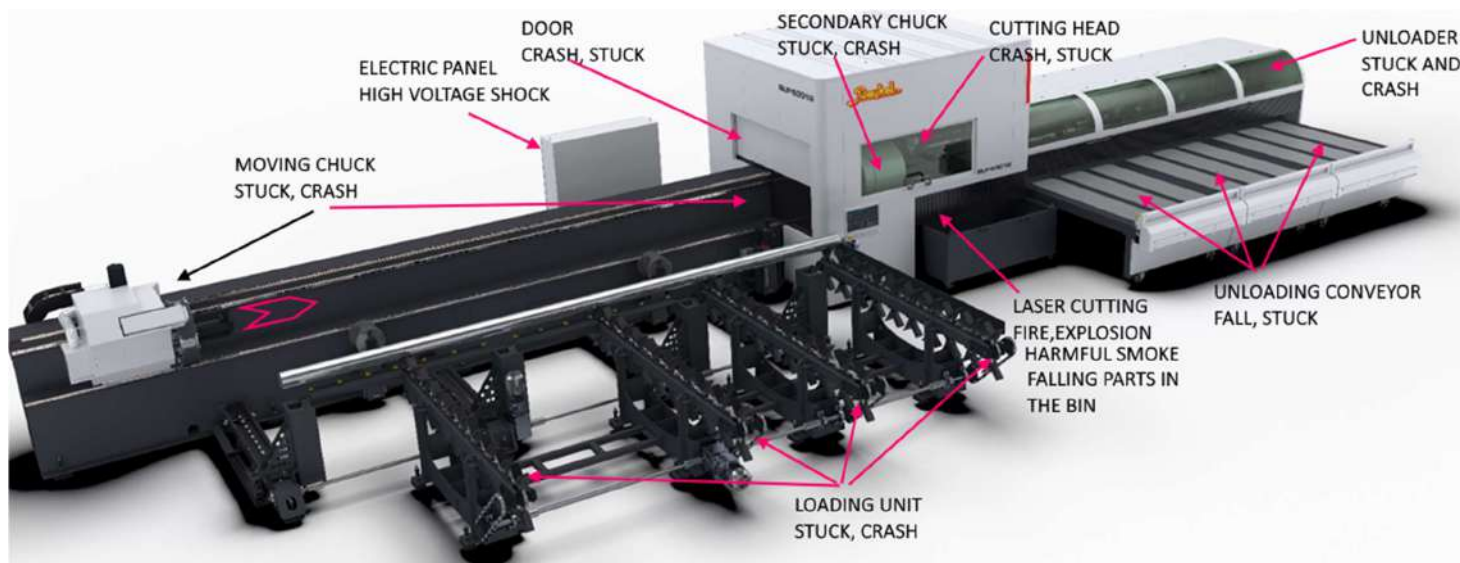
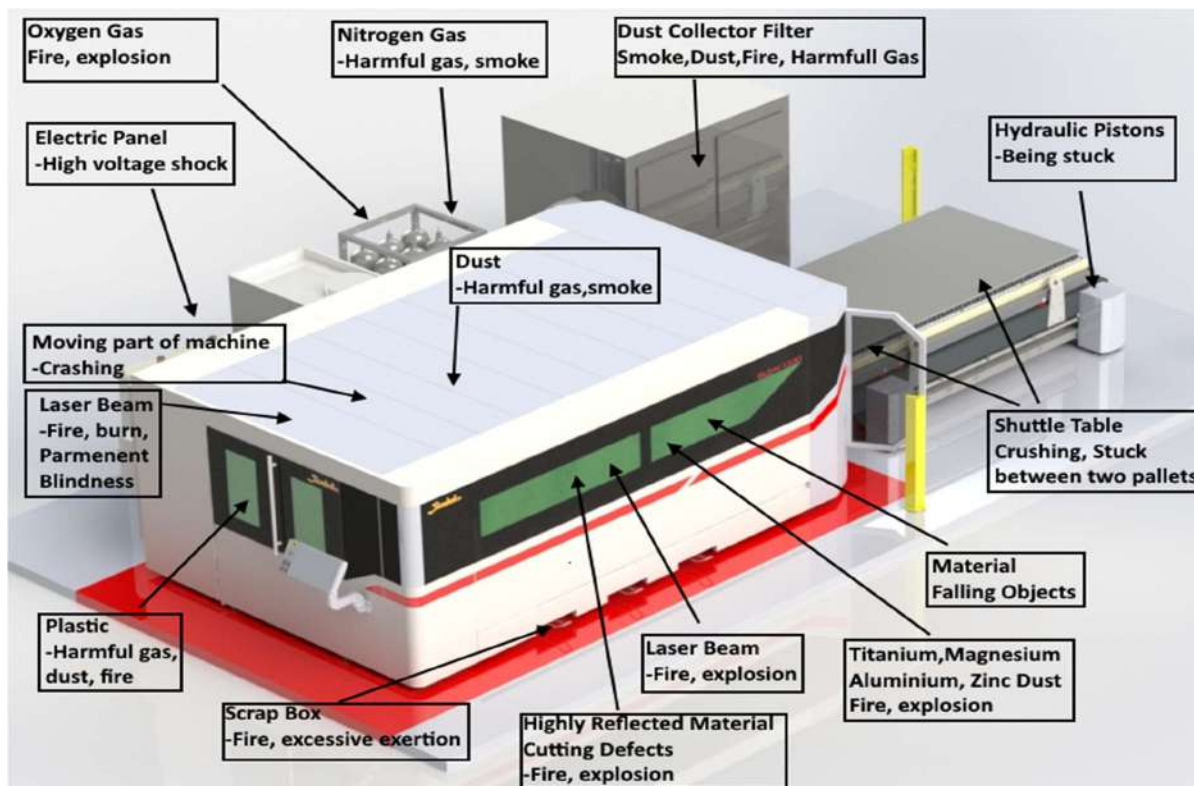
- Do not bring combustible materials around the laser cutting machine. Constantly watch for the occurrence of a fire during laser cutting. Install a fire extinguisher against fire emergency.
- Oil, dust and protective film powder built up on the brush table and conveyor may burn. Check and clean the brush table and conveyor every day.
- Failure to clean the dust collector filter or dust box may lead to a fire.
- Be sure to install your laser cutting machine in a fire-resistant shop building.
- If you continue to operate the laser cutting machine for many hours of marking or with cutting defects uncorrected, there may be a fire hazard due to reflected laser light. Pay attention to this possibility.
- Do not laser cut acrylics, plywood, and other combustible materials. Doing so always carries a risk of fire.
- Do not cut film-coating materials (except laser grade film coating) with oxygen assist gas since it might cause a fire accident.

2.2.9. Dust explosion hazard

Dust from laser cutting presents dust explosion hazards as well as fire hazards. Dust explosions occur the instant three conditions, oxygen, dust above the lower explosion concentration and minimum ignition energy, are all met. If dust is accumulated, the first dust explosion scatters the accumulated dust and may develop into a secondary explosion of greater scale.

- Clean scrap boxes, pre-boxes, and dust collector dust boxes every day.
- Dust from the laser cutting of magnesium and magnesium alloys has the highest risk of dust explosion. Do not laser cut magnesium and magnesium alloys.

2.3. Hazard map of the machine



3. MANAGEMENT RESPONSIBILITIES

3.1. Complying with safety laws, regulations, and standards concerning laser machines in country or region of use

Use the laser machine in compliance with safety laws, regulations, and standards in the country or region of use.

3.2. Laser safety officer

Appoint a laser safety officer from among the employees who have enough knowledge and experience about the operation of the laser machine and the prevention of laser hazards. When an organization uses powerful laser products such as those strong enough to cut metal, it is recommended that someone in the organization be designated the Laser Safety Officer. This is especially true when dealing with Class 4 lasers whether they are embedded in a full enclosure and called Class 1 systems or not.

The laser safety officer must:

- Control keys and other devices for operating the laser machine.
- Inspect and maintain the laser machine, and save its inspection and maintenance records.
- Inspect and maintain the protective gears and monitor its usage.
- Conduct the occupational health education of operators, and save their records.
- Practice other items necessary for preventing fires and other hazards due to the laser machine.

3.3. Conducting safety and health education of operators, maintenance and service personnel

When employing workers to be engaged in laser jobs, assigning workers to laser jobs, or assigning workers to different laser machines, conduct their safety and health education in compliance with safety laws, regulations, and standards in the country or region of use. Concerning the following items in particular, establish safety and health rules in compliance with this manual, and conduct the education and training of operators, service and maintenance personnel accordingly:

- Hazardousness and harmfulness of laser machines in compliance with the Hazard Information on Machine.
- Construction of laser machines
- Methods of operating, servicing and maintaining laser machines
- Performance of protective gear and devices, and methods of handling them
- Emergency measures and evacuation

3.3.1. OPERATING PERSONNEL

These people are responsible for the productive use of the laser cutting system over the full range of its intended function. These persons should be thoroughly familiar with all operating controls, adjustments, and hazards associated with their function.

3.3.1. MAINTENANCE PERSONNEL

Laser safety procedures classify Maintenance level tasks as those done on machinery when the laser beam hazards are not present. Therefore, maintenance personnel are responsible for procedures that are completed in and around a laser system with the laser power off. Maintenance personnel should be thoroughly trained in the performance of those procedures.

3.3.3. SERVICE PERSONNEL

Service personnel do the work required to maintain the laser system. They **must** have the complete knowledge of laser hazards and the controls provided by the system manufacturer for their protection from those hazards. They are responsible for doing the procedures and adjustments described in the manufacturer's service manual. The duty of a service person requires a higher level of training and education than that of the maintenance function.

3.4. Eye health care

Administer eye health care for workers regularly engaged in laser jobs in compliance with eye health care laws, regulations, and standards in the country or region of use if there are any such ones. As soon as any workers suspected of exposure to laser radiation are found, bring them to a doctor for examination or treatment.

3.5. Inspection and maintenance

Perform maintenance on the laser machine before the start of the day's work. Before the start of the day's work, instruct the laser safety officer to check the laser beam path, interlock functions, safeguards, and protective gear. Try to find equipment failures or problems as early as possible. When you find a problem, repair it or take any other necessary measure to prevent an accident.

- Do not operate the laser machine with its maintenance doors and those open.
- Do not repeatedly turn on and off the power of the laser machine at rapid intervals.

3.6. Precautions on clothing to wear during operation

Do not wear loose clothing or jewelry when operating the laser machine. Otherwise you may be caught in or pulled into the laser machine. As dictated by the work to be performed, wear personal protective gear, such as a safety hat, laser safety glasses, dust safety goggles, safety shoes, ear plugs, gloves, a gas mask, or a dust mask. Select such protective gears that comply with specific work safety standards.

4. PROHIBITION OF MODIFICATION OF ANY PART OF THE MACHINE

4.1. Prohibition of changing CNC control unit

The laser machine is controlled by a real time PC called CNC control unit. Any software or hardware changes may cause the laser machine to misoperate and lead to a serious accident.

- Do not add or change any hardware (Harddisk, ram, IO module, Servo drives).
- Do not install or uninstall software.
- Do not change, add, delete, or move Windows files and folders.
- Do not operate on the Windows system files (e.g., control panel and registry file).
- Do not save files other than programs in the CNC unit through a USB flash drive
- To prevent infection with computer viruses, do not use media that contain files and programs of unknown origin.

4.2. Prohibition of removal of safeguards and of change of their installation position

Do not remove the safeguards, entry prevention panels behind light curtain sender and receiver unit and covers, and do not change their installation position. Do not operate the laser machine with its interlocks removed.

5. CFR 1040.10 COMPLIANCE REQUIREMENTS

All Baykal Laser Systems incorporates the following safety features required by Title 21, Code of Federal Regulations, Subchapter J, (21 CFR). These features are essential to the classifications of the laser system as a certified laser product. *Modification or use of the Baykal Laser System in any way that changes the design or function of these safety features invalidates the certification of the laser by Baykal A.Ş. and subjects the user to the compliance and certification requirements imposed upon laser manufacturers by 21 CFR.*

WARNING: The use of controls or adjustments, or the performance of procedures, other than those specified in the equipment user's manual, may result in exposure to hazardous radiation. Baykal A.Ş. designs and produces laser systems to be in compliance with Federal standards. They are certified for safe operation when the following required features are properly used:

5.1. Protective Enclosure (Housing):

The laser radiation emitted by a Class IV laser product must be contained within a protective housing at all points where access to radiation is not required during normal operation of the product in the performance of the function for which it was designed. [21 CFR 1040(f)(1) and EN 60825:2007, 4.2].

The protective laser housing and any work enclosure are fitted with interlocks designed to shut down the laser when the interlocks are activated during operation or maintenance. BLE and BLE-PRO models also has a top sliding door with safety interlock switch. These interlocks prevent closure of the laser cabinet when the interlocks are defeated. B10D value of the interlock switches are rated by the manufacturer to be operationally reliable for at least 2,000,000 actuations. To ensure continued safe operation, the interlocks should be replaced when they reach their rated life.

Safety standards define a laser's Nominal Hazard Zone (NHZ) as "the space within which the level of the direct, reflected, or scattered radiation during operation exceeds the applicable Maximum Permissible Exposure (MPE)". When considering a Baykal Laser System - Fiber Laser, the radiation hazard is the laser beam which is strong enough to cause severe burns to the surface of the eye or skin if a worker is directly in its path or hit by the beam as it is reflected off machine or piece part surfaces. The NHZ is the space in all directions away from the beam where the heat from the beam is strong enough to cause injury. The NHZ can be calculated using the formulas and charts contained in the ANSI Z136.1 Safety Standard and used in this manual.

During piece part cutting, the beam is fully contained within the fiber optic cable and exits only at the cutting head. Figure 5-1 shows the usual path of the laser beam. At the cutting head, the lens focuses the beam downward to a spot as the beam exits to process material.

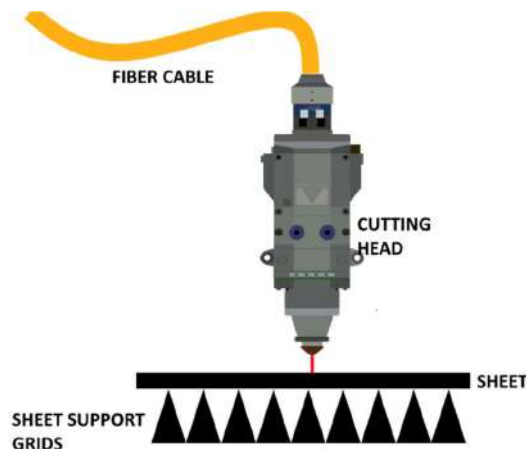


Figure 5-1

There are three categories of potential laser beam exposures on any laser cutting system:

- **Direct Beam Exposure**

This occurs when an object is in the beam's path. The fiber optic cable fully contains the beam to the fiber head. The fiber optic cable is interlocked so that if the cable is damaged, the laser beam is disabled. The fiber head is also interlocked with the collimator so that if the fiber head is not connected to the collimator, the laser beam is disabled. The cutting head and collimator provide for a fixed downward beam direction, with two-axis motion. Automatic beam shutdown occurs through a head fixing sensor if the cutting head is broken away.

Focused and downward directed energy is absorbed by the sheet to be cut, machine main frame and duct system frame. See Figure 5-1.

- **Specular Reflection Beam Exposure**

This mirror-like reflection of the focused beam off a work piece is directed upward into the cutting head and gantry due to the fixed downward beam direction and the horizontal work piece orientation. This occurs when cutting high reflective materials like copper.

Most of the reflected energy goes through the laser head and then to the laser. The features provided to keep workers far enough away from the hazards presented by specular reflection are

The Main Frame

The Safety Enclosure

The Observation Windows with suitable OD.

- **Diffuse Reflection Beam Exposure**

This occurs when the beam reflects off the work piece during cutting or when the unfocused beam hits an object. See Figure 5-2

The features provided to keep workers far enough away from the hazards presented by diffuse reflection are:

The Main Frame

The Safety Enclosure

The Observation Windows with suitable OD.

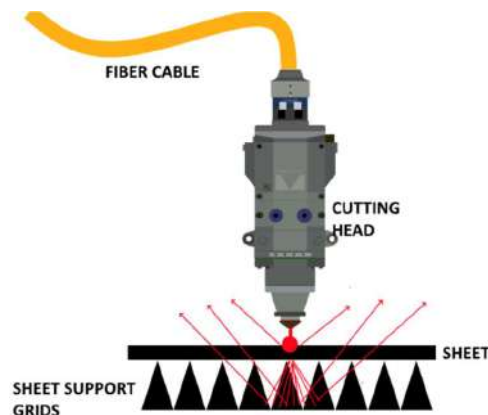


Figure 5-2

5.2. Safety Interlocks

Any part of the protective housing that must be opened, removed or displaced during normal operation of the laser must be interlocked to prevent access to laser radiation. [21 CFR 1040.10(f)(2) and EN 60825:2007,4.3].

Interlocks have been utilized to immediately turn off the laser emission in the event that the main access door (Figure 5-3, Figure 5-5) or the top sliding door (only in BLE and BLE-PRO Figure 5-5) or the pallet door (Figure 5-4, Figure 5-6) are opened.

MODELS BLS-N , BLS-P

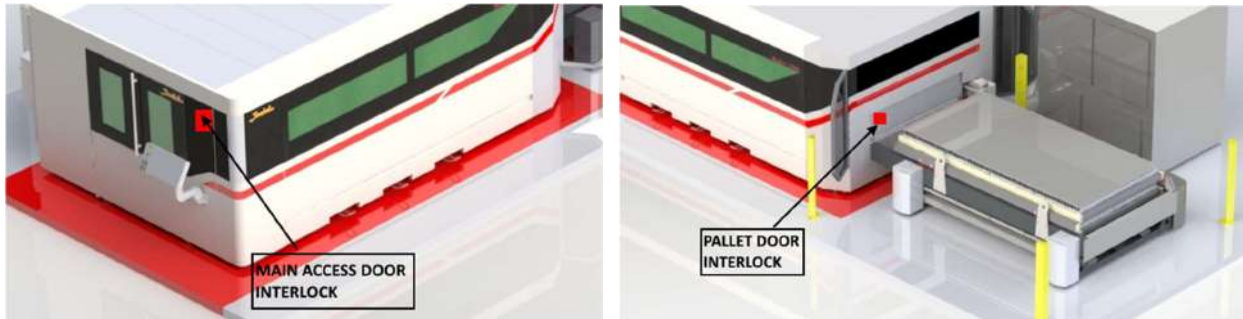


Figure 5-3-4

MODELS BLE , BLE-PRO

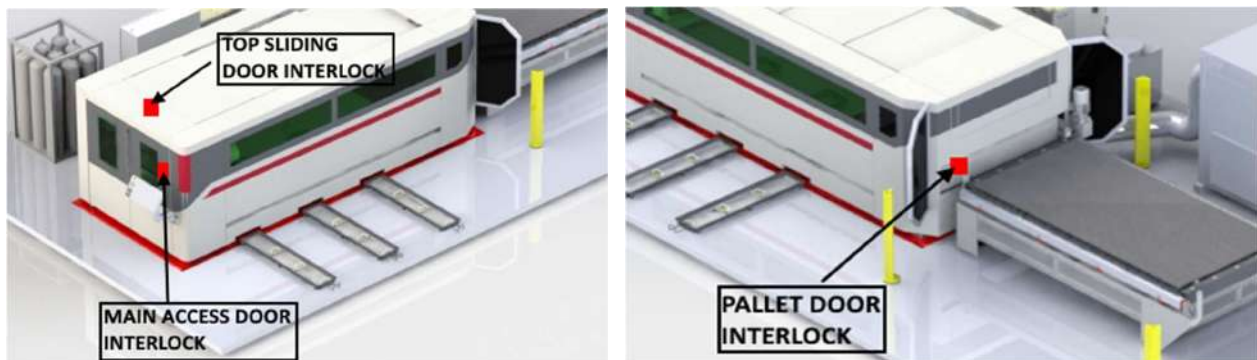
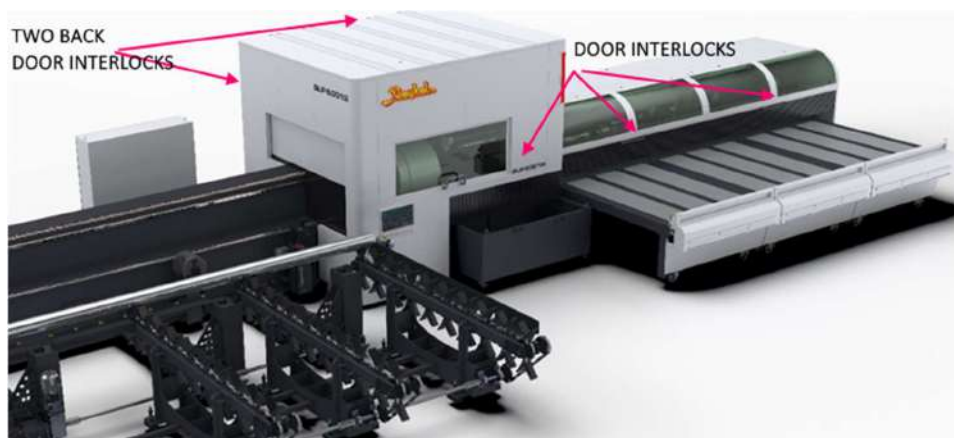


Figure 5-5-6

MODELS BLT



5.3. Beam Attenuator

A beam attenuator (safety shutter) must be provided to enable the user to terminate lasing without turning off the master keyswitch or main power switch. [21 CFR 1040.10(f)(6) and EN 60825:2007, 4.7].

The shutter terminates lasing by blocking the laser beam before it reaches the output optics. Solid state fiber laser does not include a shutter device. IPG or Nlight fiber lasers used in our machines do not have a shutter device.

5.4. Laser Control Panel and controls:

Controls which are necessary for operation of the laser must be located so they can operate without exposure to laser radiation. [21 CFR 1040.10 (f)(7) and EN 60825:2007, 4.8].

The laser control panel and other operating controls are located in such a way that exposure to laser radiation is not required during operation. See Figure 5-7.

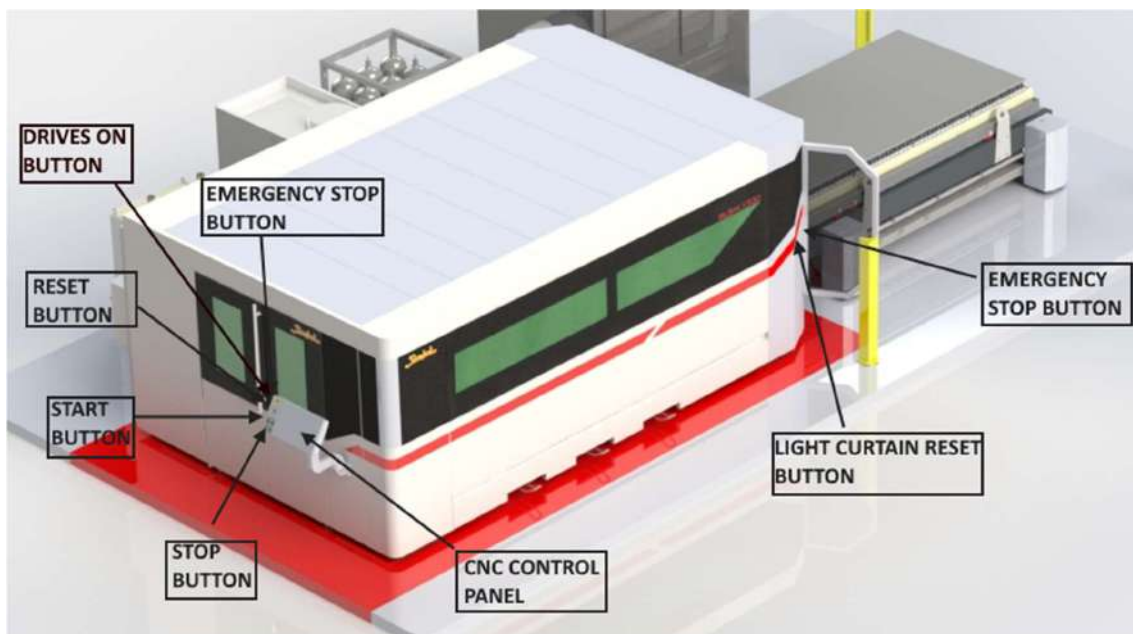


Figure 5-7

CNC CONTROL PANEL Multi-touch monitor shows HMI (Human Machine Interface) for monitoring various conditions and variables of the Laser System and selecting various control functions.

START BUTTON Pushing this button commands the laser system to begin executing the loaded program.

STOP BUTTON When this button is pushed during automatic operation, axis motion decelerates to a stop, all cutting functions such as laser beam and assist gas flow are turned off.

EMERGENCY STOP BUTTONS Pressing the Emergency Stop pushbutton stops all axis motion, turns off the laser power supply, and inhibits all cutting functions such as assist gas flow. When this pushbutton is pressed during automatic operation, axis motion decelerates to a stop, and all cutting functions are turned OFF.

RESET BUTTON Press this button to reset the axes drives, cancel all alarm message, all cutting functions such as laser beam and assist gas flow are turned off and cancel part program processing. When this button is pushed during automatic operation, axis motion decelerates to a stop.

LIGHT CURTAIN RESET BUTTON A light curtain prevents access to moving pallets during operation. Reset button is used to reset safety light curtain after interruption.

DRIVES ON Pressing this pushbutton enables all motor drives on the Laser System. The indicator is illuminated when the drives are enabled.



CNC CONTROL PANEL Multi-touch monitor shows HMI (Human Machine Interface) for monitoring various conditions and variables of the Laser System and selecting various control functions.

START BUTTON Pushing this button commands the laser system to begin executing the loaded program.

STOP BUTTON When this button is pushed during automatic operation, axis motion decelerates to a stop, all cutting functions such as laser beam and assist gas flow are turned off.

EMERGENCY STOP BUTTONS Pressing the Emergency Stop pushbutton stops all axis motion, turns off the laser power supply, and inhibits all cutting functions such as assist gas flow. When this pushbutton is pressed during automatic operation, axis motion decelerates to a stop, and all cutting functions are turned OFF.

RESET BUTTON Press this button to reset the axes drives, cancel all alarm message, all cutting functions such as laser beam and assist gas flow are turned off and cancel part program processing. When this button is pushed during automatic operation, axis motion decelerates to a stop.

LIGHT BARRIER RESET BUTTON A light curtain prevents access to moving pallets of the tube loader during operation. Reset button is used to reset safety light curtain after interruption.

DRIVES ON Pressing this pushbutton enables all motor drives on the Laser System. The indicator is illuminated when the drives are enabled.

LOADING UNIT CONTROLLER Small screen HMI (Human Machine Interface) for controlling and monitoring the automatic loader.

5.5. Certification and Warning Labels

Labels must be affixed to each laser to identify the manufacturer, certify compliance with 21 CFR and EN 60825:2007, provide warnings to the user about the wavelength, level, and location of accessible laser radiation present, and give precautions that should be taken to avoid exposure to the laser radiation. [21 CFR 1040.10(g) and EN 60825:2007, 5].

Certification and warning labels are affixed to the laser system to assure the user that it complies with 21 CFR 1040 and to warn the user against accidental exposure to laser radiation.

DANGER - LASER SPECIFICATIONS

This sign is mounted at four places in Models BLE and BLE-PRO: one sign is on the operator's side of the main access door of the cut area enclosure, the second sign is mounted on the rear of the cut area enclosure (Shuttle table side), the third and fourth is mounted on the top sliding door. See Figure 5-8

This sign is mounted at two places in Models BLS-N and BLS-P: one sign is on the operator's side of the main access door of the cut area enclosure, the second sign is mounted on the rear of the cut area enclosure (Shuttle table side).

The large, bold lettering warns persons working around the laser to be aware of potential radiation hazards. Below the warning is a list of specifications for laser type, power, and class. The left side of this sign shows the class, wavelength and power of the fiber laser. At the bottom of the right side is a warning for the positioning (red beam) laser and its specifications are listed. It warns persons not to stare into the red beam, which can cause eye injury. Operators use this visible beam to locate the cutting head position. Maintenance personnel use the visible beam to align the beam delivery system.

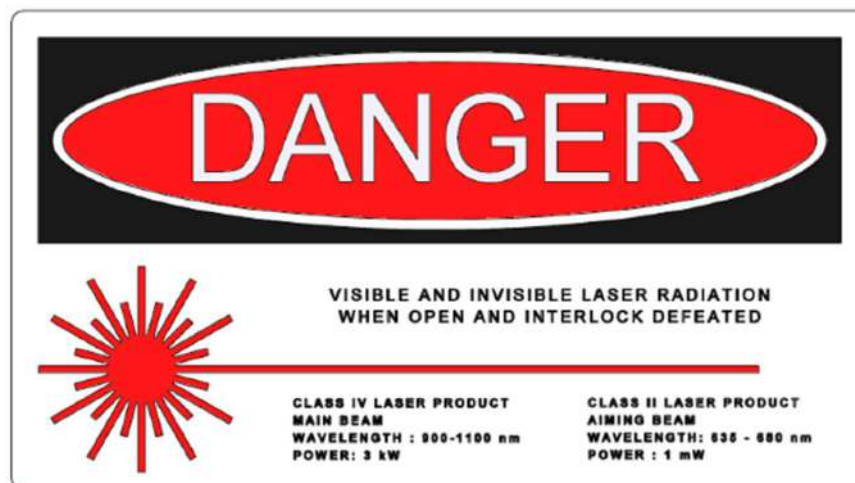


Figure 5-8

AVOID EXPOSURE

This sign is mounted on the bottom front of the cutting head assembly. It warns of laser radiation emitted from the cutting head. This sign is also mounted above the aperture of the laser head and warns of laser radiation emitted from the laser head. See Figure 5-9



Figure 5-9

DANGER-LASER RADIATION ON REMOVABLE COVERS

These signs warn of a laser radiation hazard that will be present when a cover is removed from the machine. See Figure 5-10. The signs are located on removable covers and on the interior surfaces that are exposed when the cover is removed.

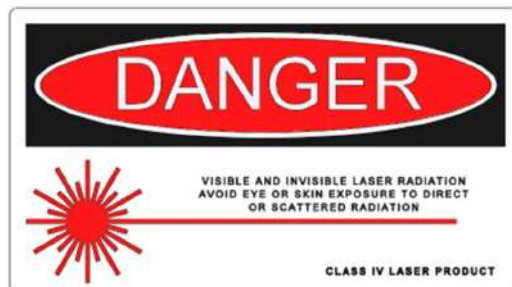


Figure 5-10

This sign is mounted on the operator's side of the main access door of the cut area enclosure. See Figure 5-12. It instructs operators, service and maintenance persons to wear safety glasses. The operator checking start point of the sheet with visible red laser and service technicians adjusting or servicing BLS systems has to wear a laser protective eyewear.



Figure 5-12

5.6. Instructions for safely operating, maintaining and servicing

Instructions must be provided that will enable the user to safely operate and maintain the laser. [21 CFR 1040.10(h) and EN 60825:2007, 6.1].

Instructions for safely operating, maintaining and servicing the Baykal Laser Systems are provided in the user's manuals for the systems. **In section 7, all the instructions must be read before operating, maintaining and servicing Baykal Laser Systems.** Carefully read the instructions. If you have questions concerning this information, or if you find errors or omissions, please contact the factory at:

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16140 Bursa / TURKEY
T: +90 (224) 294 77 00
F: +90 (224) 243 12 86
E: baykal@baykal.com.tr

5.7. Master key control

The laser cannot be turned on without the master key to operate the key control. This is to assure that only trained personnel have access to the laser. All Baykal Laser Systems uses both IPG and NLight fiber laser resonators and all the resonators have a master key and a emission indicator on their front panel. **See Figures 5-13, 5-14, 5-15**



Figure 5-13 NLight CFL-2000-3000



Figure 5-14 NLight CFL-4000-15000



Figure 5-15 IPG YLS, YLS-U 2000-15000

5.8. Emission indicator

An emission indicator is located on the laser control panel and laser on-off button shown in HMI in the machine control panel. It lights when the master control key switch is turned on to indicate that the laser is being readied for emission of laser radiation. The indicator lights prior to actual emission to give nearby personnel time to avoid exposure to laser radiation. It remains on as long as the laser is capable of lasing. See Figures 5-13, 5-14, 5-15

5.9. Laser Safe Eyewear

This sign is mounted on the operator's side of the main access door. Laser-safe eyewear attenuated to the wavelength of 1060-1080 nanometers fiber laser for cutting and 650 nanometer solid state visible laser for viewing start point with a minimum optical density (OD) of 6 should be worn at all times when servicing Baykal Laser Systems.

The operator checking start point of the sheet with visible red laser and service technicians adjusting or servicing BLS systems has to wear a laser protective eyewear.



Figure 5-16

5.10. Laser system CFR compliance lable

Baykal Laser Systems comply with the requirements of 21 CFR 1040.10. The class of laser system is identified on labels attached to the system itself.

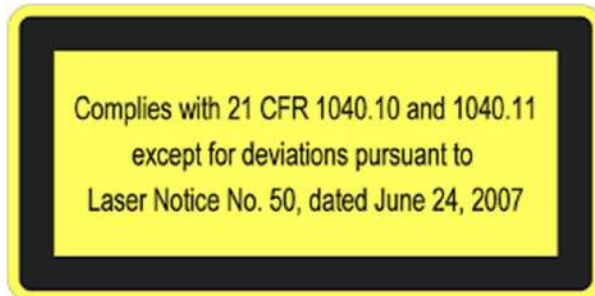
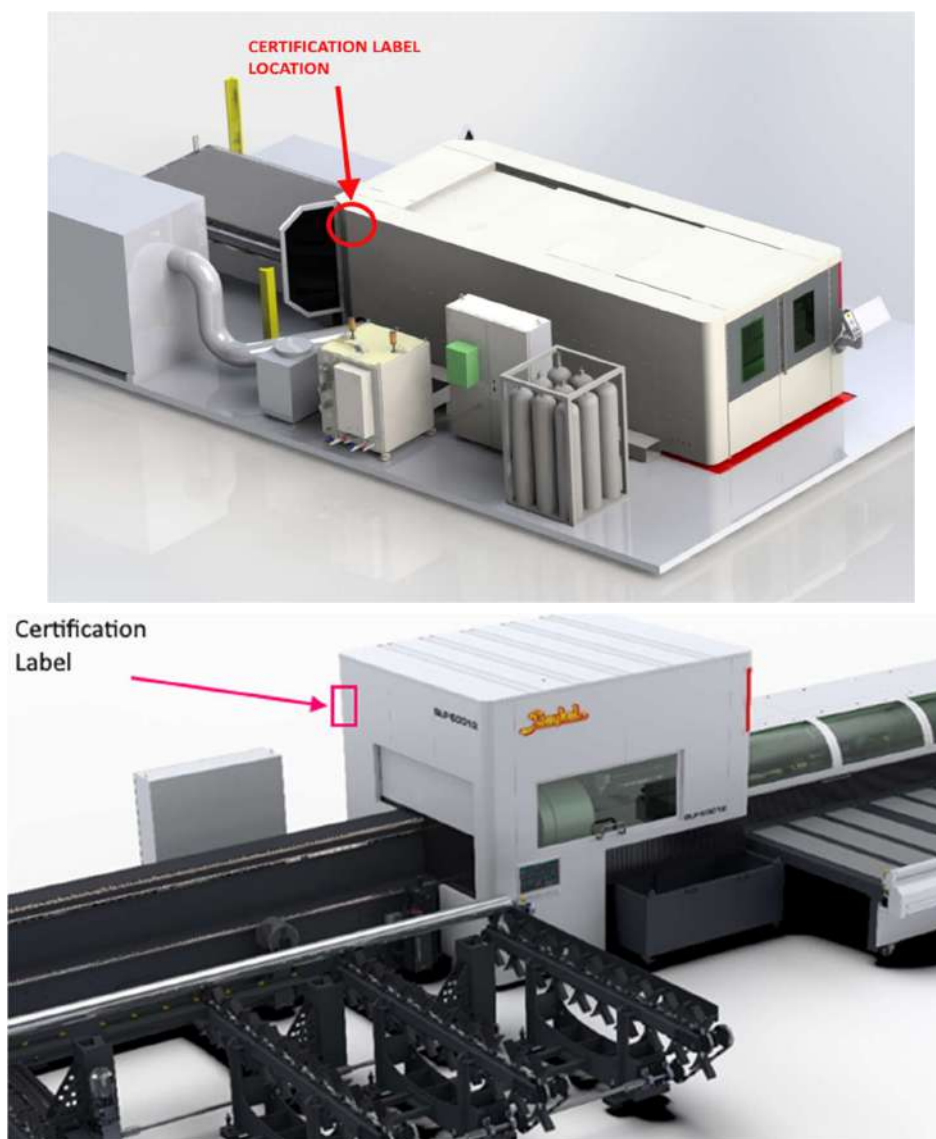


Figure 5-17



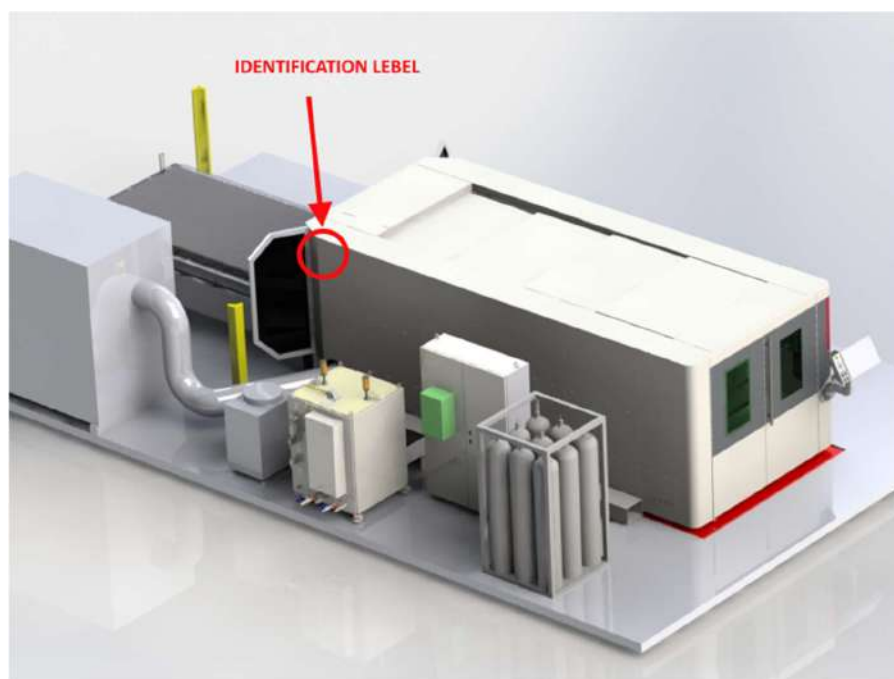
Verification of compliance may be obtained from:

**Health and Human Services Food & Drug Administration Office of compliance, HFZ-312
Center for Devices and Radiological Health Rockville, MD 20857**

It is recommended that the position of Laser Safety Officer, as defined in the *ANSI Z136.1* standard, be established in any company which uses industrial lasers. This person should be trained in laser safety and given the authority to control the operational environment of the laser systems being used.

5.11. IDENTIFICATION LABEL

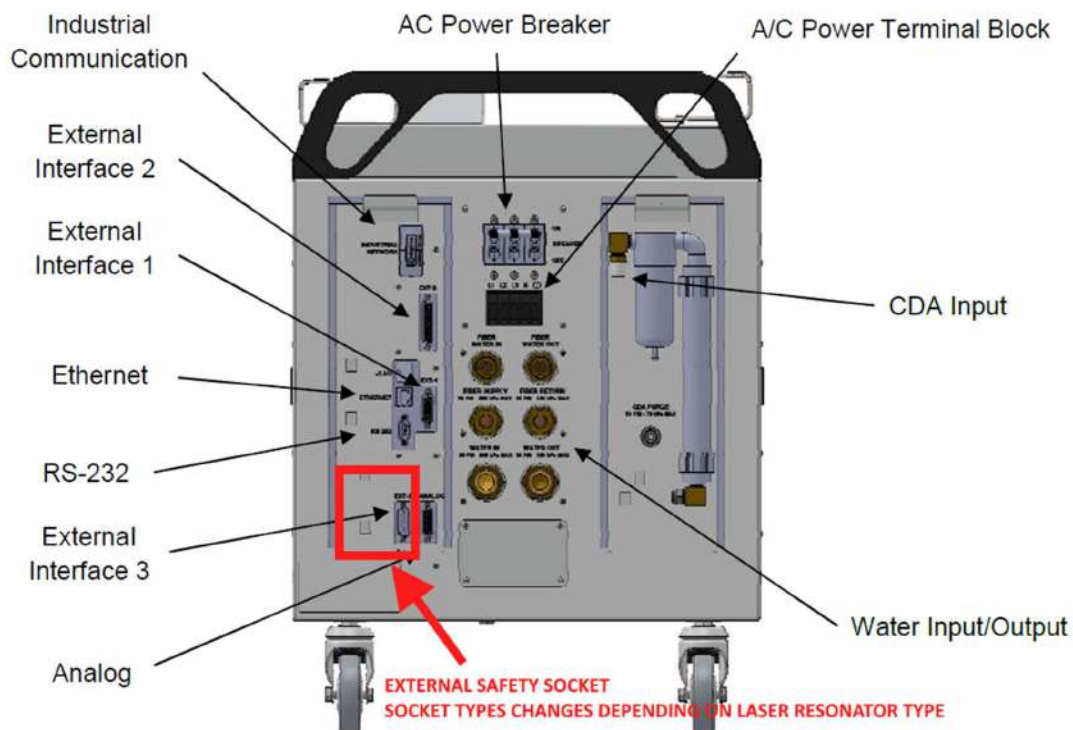
			
ÜRETİCİ	MANUFACTURER	"BAYKAL Makina San. Tic. A.Ş. OSB Lacivert Caddesi 2.Sokak No:1/A Bursa / TÜRKİYE Tel: +90 224 2947700"	
MAKİNE TİPİ	MACHINE TYPE		
MODEL	MODEL		
ÜRETİM YILI	MONTH/YEAR		
SERİ NO	SERIAL NO		
LAZER SINIFI	LASER CLASS		
KESME TABLASI	CUTTING TABLE		mm
ANMA GÜCÜ	NOMINAL POWER		kW
ANMA GERİLİMİ	NOMINAL VOLTAGE		V/Hz/Ph
HAVA BASINCI	AIR PRESSURE		Bar
YAĞ TANKI KAPASİTESİ	OIL TANK CAPACITY		lt
BOY	LENGTH		mm
EN	WIDTH		mm
YÜKSEKLİK	HEIGHT		mm
AĞIRLIK	WEIGHT		kg



5.12. REMOTE INTERLOCK CONNECTOR



SEE ATTACHED DOCUMENT EX-OM-0032 REV 01.PDF, PAGE 66-67. INTERLOCK NAMES RMT-OUT-A, RMT-IN-A, RMT-OUT-B, RMT-IN-B



6. LOADERS, TABLES

6.1. SHUTTLE TABLE

WARNING Install the light curtain to prevent access to moving pallets during operation.

The shuttle table is installed in the back side of the machine. The table of the machine is of the pallet type. The shuttle table has two pallets and shuttles the pallets to the machine. The shuttle table is adjusted to the same pass line as the table of the machine, so that it can exchange a pallet with the table of the machine

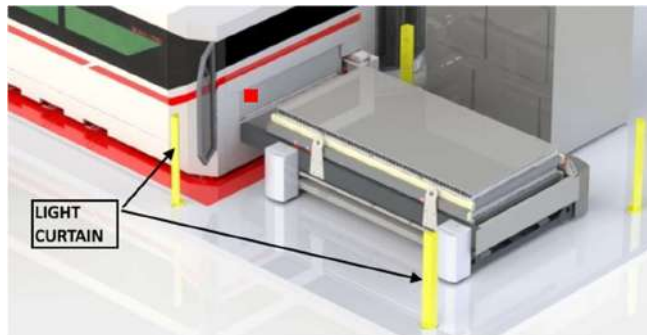


Figure 6-1

WARNING When handling the worksheet, wear leather gloves or thick cotton gloves. If you do not wear such gloves, you may get injured at the edges, corners, or burrs of the worksheet.

WARNING – DO NOT STAND ON MATERIAL SUPPORT GRIDS ON SHUTTLE TABLE

This sign is mounted on each side of the shuttle table. It warns against standing on the material support grids on the shuttle table. These structures are not designed as walking or working surfaces and could collapse, resulting in severe injury. It is also possible to be struck by the moving gantry or trapped between the gantry and the material support grids, resulting in severe injury or death.



Figure 6-2

WARNING – DO NOT ENTER AREA BETWEEN THE SHUTTLE TABLE AND MAIN FRAME

This sign is mounted on both sides of the shuttle table near the main frame. It warns against entering the area between the shuttle table and main frame unless unintended pallets is prevented.



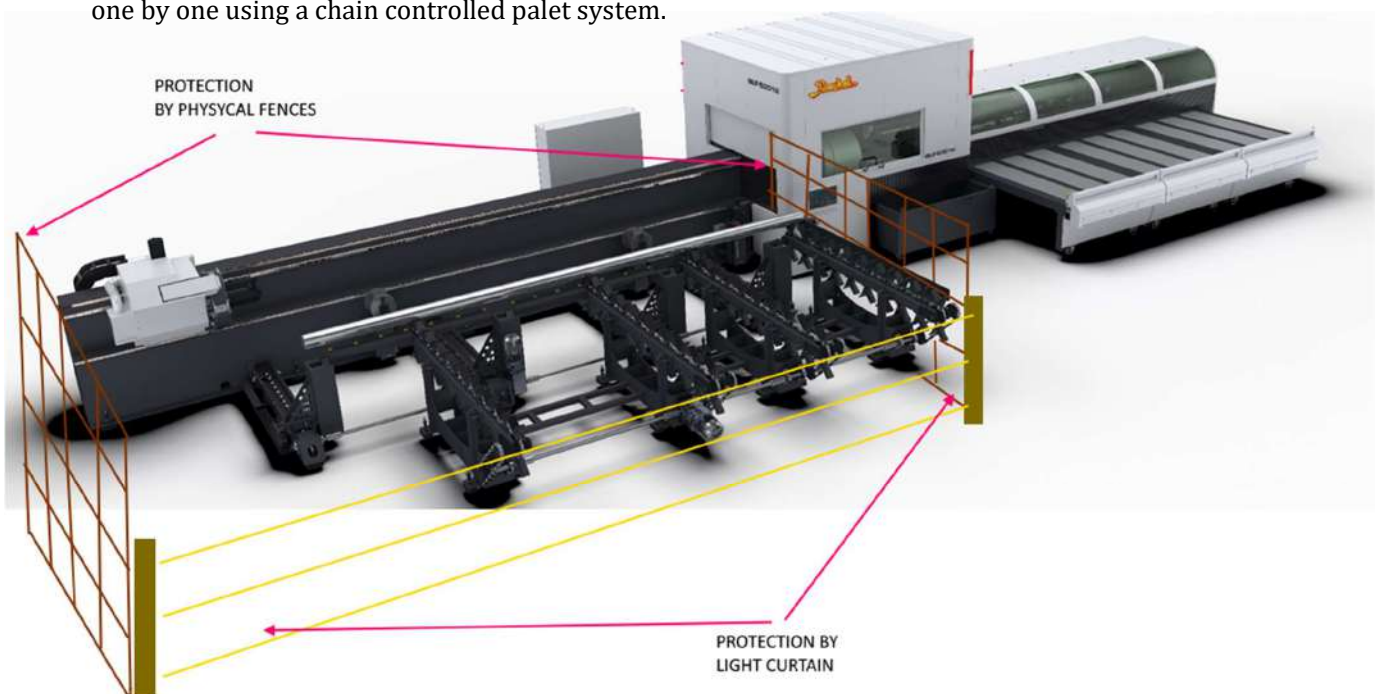
Figure 6-3

WARNING – IF YOU ARE WORKING IN SHUTTLE TABLE AREA, DO NOT RESET THE LIGHT CURTAIN CIRCUIT.

6.2. TUBE LOADER

WARNING Install the light curtain to prevent access to moving pallets and chains during operation.

The tube loader table is installed in the left side of the machine. The loader of the machine is of the pallet type. Operator loads maximum 8 tubes at a time on the loader. Each tube is loaded to the main chuck one by one using a chain controlled palet system.



WARNING When handling the tubes, wear leather gloves or thick cotton gloves. If you do not wear such gloves, you may get injured at the edges, corners, or burrs of the tubes.

WARNING – DO NOT ENTER BETWEEN TUBES ON THE LOADER

This sign is mounted on each side of the loader. It warns against entering between tubes on the loader. These structures are not designed as walking or working surfaces and could collapse, resulting in severe injury. Entering between tubes can cause trapped between tube and the loader body, resulting in severe injury or death.

7. INSTRUCTIONS FOR SAFELY OPERATING, MAINTAINING AND SERVICING.

7.1. SAFETY GUIDELINES FOR ALL

The following guidelines should be followed to ensure safety:

- Protective housing parts, such as panel covers, are in place and working. At the start of the day's work, check the enclosure and other protective covers for breakage (holes) or burn marks and the door
- Interlocks for operation
- All safety interlocks are engaged and operating properly.
- No portion of the body is exposed to laser beam when performing service work.
- Personal protective equipment, such as safety glasses, gloves, shoes, and hand tools are in use. Wear the laser safety glasses (attached to the machine). Take care that the glasses cannot shield the laser beam when directly exposed to it.
- When you use the visible laser beam for checking the cutting position, wear the laser safety glasses.
- The work area is free of non-essential tools and equipment.
- Know the controls; be familiar with emergency shutdown procedures.
- Fume and dust control system is operating properly.
- Do not position any part of the body where it may be struck or crushed by machine movement.
- Turn off or lock-out operating controls while not using Laser.
- Make sure everyone is clear of the pallets and gantry before operating.
- Warning signs and lights are visible to all personnel.
- There are no obstructions between the laser cutting head and the material being processed.
- Use material handling devices for movement of heavy work pieces.
- Do not stack material on the idle pallet.
- Never cut magnesium and its alloys.
- Never place combustible materials (typically, oil, grease, acetone, plastics, waste cloth, wood, paper, and dust collector filters) around the machine. Wipe off any oil adhering to the processing pallet.
- Do not laser-cut acrylics, plywood, and other combustible material.
- Dust generate by laser cutting may present a fire risk as well as a dust explosion risk. Clean the scrap box and the dust box of the dust collector every day.
- Clean Dust Collector Box every day.
- When a highly reflective material is cut, the reflected light may burn combustible materials in and around the machine. Use correct cutting parameters when cutting high reflective material.
- If you continue to operate the machine with a cutting defect, the reflected light may burn combustible materials in and around the machine. Take full care not to continue to operate the machine with a cutting defect.
- Check the filter and periodically change it. Leave a record of what you have done. Check and change the filter of the dust collector on a scheduled basis.
- Constantly ventilate throughout the shop. If dust and assist gas nitrogen or oxygen accumulate to high enough levels, they may do harm to you.

7.2. SAFETY MAINTENANCE CHECK

- Protective housing operating properly.
- All service access panels bolted in place.
- Main safety interlock switch checked and working properly.
- Light curtain guarding properly installed and functional.
- Operator controls working properly.
- Operating modes functioning properly.
- Gantry and Cutting head positioning properly.
- Safety clean and easily read.
- Work area and fume plenum area clear of debris.
- Air filtration received recommended scheduled cleaning.
- Electrical wiring in good condition.
- All emergency stop buttons checked and working properly.
- Hand and personal protective equipment in good order and readily available.
- Safety and Operator Manuals in holder near the Operator Control Station.
- Scheduled normal maintenance work completed.

8. List the procedure performed during maintenance.

List the procedure performed during maintenance.

When cleaning the laser head housing. X, Y and Z axis bellows, rack and rails, X and Y axis cable chain, tightening the laser head breakaway bolts.

1. Turn off the servo drives by pushing the drive on-off button.
2. Turn off the master key switch on the front panel of the laser source and remove the key.
3. The master key will disable Class II visible laser and Class IV laser emission.

During maintenance, visible and invisible laser emission and collateral laser radiation will be disabled.

9. List the procedure performed during service.

List the procedure performed during service.

When changing the laser cutting head, focusing lens in the cutting head, the fiber cable, servo motors and AC motors, gear boxes, racks, pinions, electrical panel components (Servo drives, contactors, IO modules, relays, air conditioners, fans)

1. Turn off the main power switch.
2. Turn off the master key switch on the front panel of the laser source and remove the key.
3. The main power switch and master key will disable Class II visible laser and Class IV laser emission and all axes movement.

During service, visible and invisible laser emission and collateral laser radiation will be disabled.

Operating Manual of the Baykal Fiber Laser Cutting Machines



Any part into this Operating Manual cannot be modified or copied by anyone without prior permission of BAYKAL MACHINE TOOLS.

ABOUT THIS MANUAL

This manual applies to the product with which it shipped. Features and functionality described herein may or may not be applicable to existing product in user possession.

This instruction manual contains information to help buyers and operators understand how to prepare and operate the *BAYKAL* Fiber Laser.

This manual will help to operate the laser safely and properly. Careful attention to this manual will help avoid risks, reduce repair costs, reduce process downtime and increase the overall reliability of the laser.

The instruction manual must be read and applied by user of this laser product. Specific topics covered in this instruction manual include:

- * Laser safety
- * Operation

This manual provides guidelines for safe and reliable laser operation. In addition to following the instructions found in this manual, the laser operator should adhere to the mandatory safety regulations, professional technical rules for laser safety and other professional guidelines for safe laser operation.

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SUPPORT

For technical support, please contact BAYKAL Sales and Service Headquarters:

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1. INTRODUCTION

Machine components

Machine Frame

The machine's robust chassis consists of a structure made of steel sheets and tubes. The machine frame supports the entire beam path which holds the carriage, the crossbar and the machining head. It was built with specific antivibration characteristics in consideration of the high accelerations of the machining axes. The bottom part of the machine frame is divided into extraction chambers. In the extraction chamber in which the machining head is positioned, the valves are opened and the air containing impurities is extracted. A conveyor carries the slag that fall through the rack supports of the grid to the disposal tray.

Machining table

The table with a built-in grid is used for supporting the workpieces during flat machining.

Grates

The grates may be made of various metals. Copper bars offer the greatest resistance to the effects of heat in time. Slag is easily removed. Nevertheless, the high reflectivity of copper may have a detrimental effect on thin sheets with small holes (the holes become imprecise) or when cutting with oxide (formation of plasma, interruption of beam). Bars made of steel and V2A can be cut by the customer himself. The cutting plans are present on the hard disk of the PCPanel. The life of these bars depends on the Laser power used for the cut.

Crossbar

The crossbar supports the carriage. The mirror in the crossbar deflects the laser beam in the direction of the axis of the crossbar.

Sensing

Optimum machining quality is dependent upon a constant distance between the nozzle and the workpiece. There are two ways of measuring this distance: By sensing (mechanical) in contact with the workpiece, the distance of all materials can be measured. Sensing is, however, used mainly for machining tubes and materials with no electrical conductivity. The distance is measured using a high-resolution potentiometer. Capacitive sensing is used for measuring the electrical capacitance between the nozzle and the workpiece. Capacitive sensing can therefore only be used with flat materials that conduct electricity. By moving the Z axis, the distance between the nozzle and the workpiece is regulated to a preset value.

Machining Head

The machining head represents the last component on the beam path. Its built-in lens brings the laser beam into focus and enables it to reach the necessary density of power on the workpiece.

The process gas is fed in the machining head:

During cutting, the gas pushes the fused material out of the cutting slot and prevents the focusing lens from being damaged by slag.

During welding, the process gas prevents the oxygen in the air from reaching the bead.

The process gas flow is modelled by the nozzle so that during the cut, as much gas flows through the cutting slot as possible

Interchange Table System

The interchange table system consists of an additional frame (loading frame) and two blades, which run above one another. By exchanging these blades, the machined workpieces can be removed and the next workpiece can be set in position while the machine is processing a program.

Exhaust Air Filter

The exhaust air filter blocks most of the particles that are emitted during machining and can be extracted. A description of the exhaust air filter is provided in the documentation supplied by the manufacturer of the device.

Necessary space for control and maintenance

The necessary minimum space for the laser machine can be calculated from the lay-out diagrams in the volume "Machine documentation". To ensure the operation of the machine without any hindrance, please allow for the necessary space for the following:

- Loading:** Manual loading, through crane/lifting fork.
- Disposal:** Removal of scraps from machining of tube and templates.
- Unloading:** Possible storage of workpieces. Gas
- Feeding:** Access to the gas cabinet with the appropriate transport equipment.
- Maintenance:** Free access for replacement of components, possible with auxiliary means

Capacitive sensor

A sensor is intended to mean a measuring tool that regulates the distance between the workpiece and the nozzle. The nozzle distance is regulated according to the cutting parameters. Capacitive sensing enables the nozzle distance to be adjusted for all the parts and sheets that conduct electricity.*

Operation

The nozzle and the workpiece constitute the two plates of a variable capacitor. This capacitor is connected to the regulator by a special cable. The regulator compares the capacitive load with the rated value corresponding to the selected nozzle distance. The nozzle distance may be set to the selected value by moving the Z axis.

* Due to the capacitive sensor and fiber laser characteristics, the material list that can be cut in fiber laser metal cutting machine is as follows:

Materials allowed to cut with the Fiber laser cutter

- Stainless Steels
- Carbon Steels
- Aluminum
- Brass and Copper
- Titanium

2. SAFETY

For detailed safety information, please read the SAFETY MANUAL given separately.

BAYKAL Fiber Lasers are carefully designed and tested to ensure that they are safe and reliable tools when used properly. However, BAYKAL Lasers typically emit light at wavelengths and optical powers that can be extremely hazardous to both people and property if the proper safety guidelines are not followed. This danger can be compounded when the output wavelength of laser light is invisible to the naked eye, as is the case of the BAYKAL Fiber Laser which emits in the infrared spectrum.

Responsibility for Safety

Both the owner and the operator of the laser product are responsible for ensuring that it is operated in a safe manner.

Safekeeping

Keep these operating instructions at hand near the machine at all times.

Training

All persons entrusted to work on the machine must read and thoroughly follow these instructions before beginning any activity. In particular all safety regulations herein contained, must be respected. The machine can be operated and serviced by trained personnel only. Also the minimum age limit for machine operators must be absolutely respected.

Supplementary instructions

Besides all use and maintenance instructions, and the accident-preventing rules enforced in the country where the machine is operated and on the work location, also the specific regulations concerning the safety on the job and the qualification of the personnel must be complied with.

Warranty

During the warranty period, possible faults will be dealt with by the warranty conditions of BAYKAL. Any consequence of modifications or variations arbitrarily carried out will be considered as user's responsibility. This is particularly valid for those modifications compromising the safety of the machine.

Technical modifications

The builder reserves the right to modify the specifics of the machine in order to improve its performances even if they might differ from informations and descriptions contained in this manual.

Company directive

These instructions should always be kept at hand in the compartment provided for this purpose. Observe and enforce all statutory or otherwise applicable accident prevention rules that may have to be fulfilled in addition to the provisions contained herein! Such rules may concern the handling of hazardous substances

or the use of personal protection equipment. These operating instructions should be completed with all other relevant company's directives, including supervision and reporting requirements. (E.g. with respect to labour organisation, job procedures, personnel). All personnel using the machine must first read these operating instructions, and specifically the chapter entitled "Safety Instructions" before commencing work. Once the machine is in operation it will be too late. Perform at least occasional checks to ensure that all personnel using the machine is aware of the relevant safety and hazard instructions and observes the necessary precautions! Where necessary or required by applicable regulations, provide personal protection equipment. (shoes and goggles for laser class 4) and enforce its use! Make sure that the safety and hazard warnings affixed to the machine are duly observed. Keep warning labels in a perfectly legible condition at all times! Immediately switch-off the machine if unusual noise or vibrations are observed and report this condition to the responsible supervisor. Don not perform modifications to this machine without prior consultation with BAYKAL. Observe the prescribed frequency for periodical checks indicated in the operation instructions. Inform all personnel about the location and proper use of the fire-extinguishers! Observe fire reporting and fire fighting regulations!

Personnel qualification

Only reliable personnel must be allowed to work on or with the laser machine. Observe the statutory minimum age limits! Use only trained and appropriately instructed operators. Ensure that all personnel responsibilities concerning the operation maintenance and repair of the machine are clearly defined! Ensure that the machine cannot be run by unauthorised personnel! Provide an appropriate definition of operator responsibilities and allow operators to refuse third party instructions if these are not in accordance with applicable safety rules. Apprentices, trainees and other personnel not fully qualified for using this machine must only use it under the supervision of an experienced staff member! All work on electrical systems shall be restricted to qualified electricians observing applicable regulations and codes of practice. Personnel working on gas-carrying systems (gas consuming system) must be duly trained for these functions. Hydraulic system work must be carried out by personnel possessing the necessary knowledge and specific experience in the field of hydraulics.

Injures caused by machine movement

Before entering a dangerous area, cut off the machine power to avoid bodily harm.

Operator Safety

Operator safety is ensured by the safety doors and the fixed guard panels, which are regulated according to the specific arrangement of the customer's machine. If the non-linear or linear loading unit or the tube handling device is installed, user safety is also ensured by their light barriers. During the cutting process, the safety door is always closed and protects the operator from:

- * direct exposure to laser radiation
- * reflected laser radiation
- * slag expelled during machining
- * risk of injury during crossbar motion

The light barriers protect the operator from the risk of injury during loading

Laser Classification

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Standards and regulations require the laser to be classified according to accessible output power or energy. The BAYKAL Fiber Laser is classified as Class IV based on 21 CFR, subchapter J, part II, section 1040-10(d).

The BAYKAL Fiber Laser is classified as Class 4 based on the International Standard IEC 60825-1:2014 Clauses 4 and 5. The laser is designed to emit radiation in the infrared part of the spectrum at 1080 nm and has additional spectral content at both 920 and 1135 nm.

The BAYKAL Fiber Laser also includes an integrated visible, low power aiming laser beam to assist in optical alignment. The integrated aiming laser is classified as Class II or Class 2 according to the same documents, respectively.

Throughout this manual these classifications will be referred to as Class 4 and Class 2.

Hazards and Safety Symbols

The following table based on the ANSI Z535 SERIES details the safety consideration symbols used to indicate hazards:



DANGER indicates hazardous situation which, if not avoided, **will** result in death or serious injury.



WARNING indicates hazardous situation which, if not avoided, **could** result in death or serious injury.



CAUTION indicates hazardous situation which, if not avoided, **could** result in minor or moderate injury.



NOTICE is used to address practices not related to physical injury. Used to indicate 'Best Practices' for successful use of this laser.



Safety instructions (or equivalent) signs indicate specific safety related instructions or procedures.



This symbol indicates an imminent danger of electrical energy. Failure to follow the guidelines here can result in life-threatening injuries or death.



IEC WARNING TRIANGLE is used to further highlight safety information related specifically to the laser output of this device. This indicates a danger of laser radiation.



Risk of Electrostatic Discharge damaging components.



Wear laser safety glasses.



ANSI heavy lift hazard indicator, use proper technique.

IMPORTANT: To ensure the safe use of this product, safety information is included within this section and throughout the manual at appropriate points to highlight key safety considerations. Safety information is in addition to any safety information relating to the laser beam is also highlighted with the IEC warning triangle.

SAFETY INSTRUCTIONS

Safety Guidelines

High-power lasers, such as the BAYKAL Fiber Laser, are capable of producing light at power levels and wavelengths that could cause permanent eye damage if proper safety guidelines are not followed. In addition to the main beam, any reflections that create secondary beams can also be of sufficient power to cause eye damage.

Some BAYKAL Fiber Lasers operate at a high enough power to burn skin, clothing or other surfaces. Volatile substances can inadvertently be ignited by some laser beams.

Baykal provides the following recommendations to promote safe use of the *Baykal* Laser. Operators are advised to adhere to these recommendations and employ sound laser safety practices at all times.

- Use protective eyewear when operating the laser and guard against inadvertent exposure to skin or clothing. Be sure to select eyewear that is suitable for use with the wavelengths and radiation intensity that the laser emits.
- Do not remove covers from the laser housing. These confine internal reflections within the laser housing so that the reflections are not hazardous to operators
- Never look directly into the laser output port.
- Always maintain the beam path below eye level.
- Provide enclosures for the laser beam whenever possible.
- Post the appropriate laser warning signs and placards.
- Assure that the laser beam path is clear of combustible materials and is terminated with an appropriate beam dump.
- Avoid operating in a darkened environment.
- Avoid installing in areas where there are significant trip hazards, falling equipment, moving equipment, open/ exposed electrical circuits, pools of water/coolant, etc.
- Avoid working by canceling the machine's protective shields
- Do not operate with damaged cables, hoses or fibers. Defective cables, hoses and fibers must be replaced before laser start-up. Prior to laser start-up, verify that all cables, hoses and fittings are properly and securely connected.
Faulty connections can interrupt operation and cause irreparable damage to the product.
- Shut down in the event of a laser non-recoverable fault, and contact an *BAYKAL* Service Representative. Do not resume operation until the fault has been completely resolved.
- **All Class 4** lasers and lasers require a master switch control. The *BAYKAL* Fiber Laser master switch control is operated by a key. When disabled (key removed), the laser cannot be operated. In the 'ON' position the key is not removable. Only authorized laser operators are to be permitted access to the key.

Laser eyewear is required for operation of the BAYKAL fiber laser when the possibility of exposure to laser radiation in excess of the Maximum Permissible Exposure (MPE) exists. Laser Parameters Summary

When the electrical and fiber system panels are removed for service activities, laser exposure from the aiming beam can exceed Class 2 limits. Therefore, the aiming beam shall be considered Class 3B during service and appropriate laser eyewear shall be worn for the main beam and aiming beam.

Electrical Safety



BAYKAL Fiber Lasers are designed to operate at voltages and currents that could be dangerous if proper safety precautions are not met. Never remove the Fiber Laser cover(s). Doing so will void the product warranty and expose a risk of electrical shock. Always ensure that the electrical connections are in good working order and properly secured before applying any electrical energy to the *BAYKAL* Fiber Laser.

Electrical energy supplied to the *BAYKAL* Fiber Laser can reach as high as 530VAC and 60A. Refer to the nameplate attached to your specific *BAYKAL* fiber laser for the exact operating voltage and current. Every portion of the electrical system should be regarded as posing a risk of electrical shock.

3. CONTROL SOFTWARE

3.a FIXED SOFTWARE MENUS AND HARDWARE CONTROL BUTTONS

The fixed software menus and hardware control buttons will be explained in this chapter. The means of the fixed software menus are shown in [Figure 8](#). These keys can be accessible in every page as well.



Figure 6

To be able to see extended name of the menus, the regarding button as shown in [Figure 7](#) must be pressed by the operator.



Figure 7

Once the regarding button pressed, the full names of the menus will be appeared as shown in [Figure 8](#).



Figure 8

The controller's computer can be restarted or shut down by pressing the regarding button shown in [Figure 9](#) which is located on the upper right corner of each pages.



Figure 9

Once the regarding button pressed, the following message will be appeared immediately to confirm that which action has to be performed as shown in [Figure 10](#).



Figure 10

Actual alarm/warning messages can be monitored by the operator once the controller has been started-up or any cycle is being performed as shown in [Figure 11](#). The number on the left side is shown that how many alarms/warnings that have been detected on the system.



Figure 11

Active part program's name can be monitored by the operator along with the path of the file as shown in [Figure 12](#). Once the different part program has been selected, this area will be automatically changed by the system.

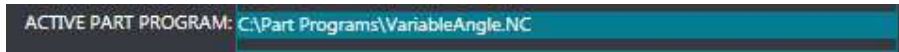


Figure 12

Activated cutting parameter's name for regarding type of the material can be monitored as shown in [Figure 13](#). Once the different cutting parameter has been loaded, this area will be automatically changed by the system.



Figure 13

The conditions of TwinCAT System Manager and PLC software can be monitored by the operator as shown in [Figure 14](#). To proper and continuous functionality on the machine, both status must be in RUN mode all time once the system has been started-up properly.



Figure 14

CLEAR ALARMS button as shown in [Figure 15](#) is commonly used to clear the temporarily occurred system alarm/warning messages while cutting process in being performed (Tip-touch alarm etc.) from the screen. Please note that some of alarms on the controller cannot be deleted until NC RESET button must be pressed such as Body Touch alarm etc.



Figure 15

3.b FUNCTION BUTTONS



Figure 16

DRIVES button is used to run the servo drivers ON position when they are OFF which is able to use for proper axis movement. When the system started-up from the beginning the Drives will always be OFF position as shown in [Figure 17](#).



Figure 17

Once the regarding button pressed, the Servo drivers will be energized by the internal system signals and its animation will be become as shown in [Figure 18](#) if there is no emergency signals. When the Drivers got energized the machine axes are ready for movement.



Figure 18

LASER button is used to enable connected Laser unit to be ready to cut. When the system started-up from the beginning the Laser will always be OFF position as shown in [Figure 19](#).



Figure 19

Once the regarding button pressed, its animation will be started to flashing first and if there is no missing internal signal on the Laser unit after approximately 5 seconds the animation becomes red colored constantly as shown in [Figure 20](#) which means that the Laser unit is ready to cut.

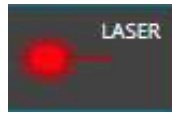


Figure 20

VENTILATION button is used to enable connected Fume Extractor unit and open the ventilation doors into the machine manually. When the system started-up from the beginning the Ventilation will always be OFF position as shown in [Figure 21](#).



Figure 21

Once the regarding button pressed, the Fume Extractor unit will be started and its animation will be become as shown in [Figure 22](#). If the animation is flashing which means that the Fume Extractor unit will be stopped by the system in a minute after NC Part program has been successfully finished or there is an internal error/alarm into the unit.



Figure 22



IMPORTANT NOTE: If the Fume Extractor unit is failed while has been running somehow the regarding warning message will be appeared immediately into Alarms and Warnings area as shown in [Figure 23](#).

Figure 23

GO TO ZERO button is used to move back to the Cutting head to the last sheet zero position which has been found and saved by the system before. One the regarding button as shown in [Figure 24](#) pressed, the cutting head moves to the last zero position in low speed and at the same time the machine mode is changed to JOG mode automatically by the system if it is already in AUTO mode.



Figure 24

GUIDE LASER button is used to enable the red aiming beam from laser unit which helps to the operator to easily notice where the nozzle is being located on the sheet metal. If the beam is not enabled, its animation will be become as shown in [Figure 25](#).



Figure 25

Once the regarding button pressed, the red beam will be released from laser unit passing through to the nozzle and its animation will be become as shown in [Figure 26](#). Please note that the red beam can only be visually seen in JOG mode!

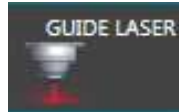


Figure 26

LASER SENSOR button is used to enable the sheet edge detection sensor which helps to the operator to easily notice where the sensor is being located on the sheet metal. If the sensor is not enabled, its animation will be become as shown in [Figure 27](#).



Figure 27

Once the regarding button pressed, the red aiming beam will be released from laser unit passing through to the sheet metal and its animation will be become as shown in [Figure 28](#).



Figure 28

Feed Override value is affected the axis movement speed actively. If this value is 100% as shown in [Figure 29](#), the machine axes move with exact cutting speed while cutting is being performed. (For example; if cutting speed is set to 2000 mm/min and feedrate override value is 75% by the operator, the actual feedrate will be $(2000 \text{ mm/min} \times 75) / 100 = 1500 \text{ mm/min}$ during the cutting. This value setting is similarly altered rapid traverse command (G0) as well.

FEED OVERRIDE button as shown in [Figure 29](#) is used to set the feedrate value to 100%. Once the regarding button pressed where the number writes, the previous feedrate defined by the operator changes back to 100% immediately by the system. Feed override value can be adjusted from 5% to 120% manually using floating scale factor by the operator.

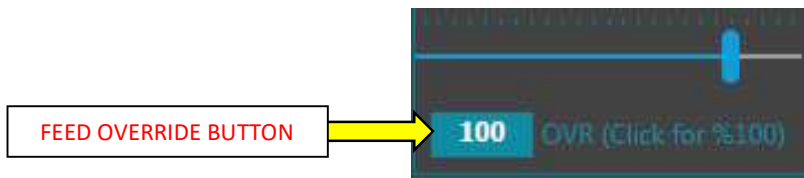


Figure 29

3.C. MODE BUTTONS



Figure 30

AUTO button is used to change the machine's mode to AUTO. In this mode any kind of part program can be started by the operator if the Drives are ON already. Once the regarding button pressed, its animation will be become as shown in [Figure 31](#) and the software buttons related with AUTO mode will be appeared immediately on the lower right side of the page as shown in [Figure 32](#).



Figure 31

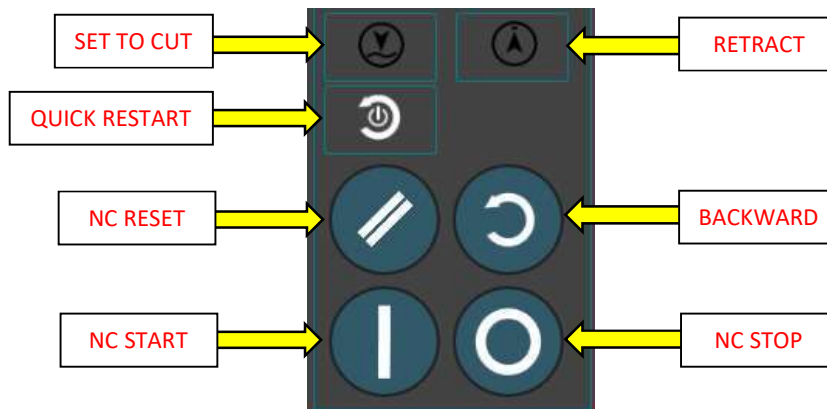


Figure 32

NC START button is used to start the selected part program from the beginning or continue at the current block where has been stopped by the operator. Once the regarding button pressed, the cutting gas opens first to check if enough pressure has been coming from the gas line and then the cutting head goes down to the find the sheet metal and after the laser beam activates by the system. At the same time the associated green lamp is lighted up automatically (Green lamp is located onto the Hardware and Software Buttons Extension Area as shown in [Figure 33](#)).

Figure 33

NC STOP button is used to stop the cutting process on the selected part program. Once the regarding button pressed, the selected part program and movements of the machine axes are stopped immediately. After movement stopped the head raises up to retract position by the system. At the same time the laser beam and cutting gas are also closed and associated red lamp (NC Stop) is lighted up and also green lamp (NC Start lamp) is started to flashing (Both lamp is located onto the Hardware and Software Buttons Extension Area as shown in [Figure 33](#)). To continue the part program, the NC Start button must be pressed by the operator.

NC RESET button is used to reset all activities on the system.

BACKWARD button is used to return easily back into the active contour while cutting is being performed. When the damaged point notices by the operator this button must be used to return back without laser beam and gas flow along with very low speed for sensitive adjustment. To use this button correctly the following instructions must be followed carefully by the operator:

- The part program must be stopped by the operator by pressing NC STOP button first (as N70 interruption point shown in [Figure 34](#)).

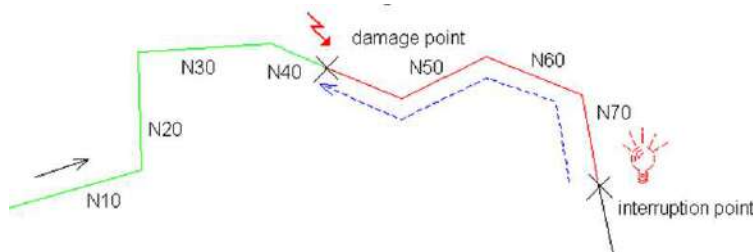


Figure 34

- After movement stopped, the regarding button must be pressed by the operator to activate the function. After activating done, its animation will be as shown in [Figure 35](#).



Figure 35

- To return back into the contour NC START button must be pressed by the operator. After pressing the cutting head moves back at current block on retract position by using the automatically created inverted NC blocks (as throughout N70 - N60 - N50 - N40 points shown in [Figure 34](#)).
- In this movement, the damaged point must be noticed by the operator where the bad cutting was started and he must be stopped the movement with NC Stop button before beginning of damaged point (Before the N40 point in shown [Figure 34](#)).
- After stopping the movement “Backward” key must be pressed for second time to deactivate the function. After 2nd time pressing its animation is closed and the “Block Search” function is started to calculate the continuing position by system automatically and notification message will be appeared as shown in [Figure 36](#).

Figure 36

- Finally the head is gone down to find the metal plate and the cutting gas and laser beam are opened by system after Block Search function is done to continue the part program before damaged point.

QUICK RESTART button is used to return easily back into the active contour while cutting is being performed. This function is related with NC STOP button. Once the regarding button pressed, the cutting head moves back to exactly where NC STOP button has been pressed by the operator.

Figure 37

SET TO CUT button is used to move down the cutting head to find the sheet surface. To use this function a care should be taken by the operator. Because when the head moves down there must be a sheet under the cutting head. Otherwise the head may be hit to somewhere on the table!

RETRACT button is used to retract the cutting head to its zero position manually.

JOG button is used to change the machine's mode to JOG mode. Once the regarding button pressed, its animation will be as shown in [Figure 38](#). In this mode the machine axes can be moved to any direction manually (X+, X-, Y+, Y-, Z+ or Z-) by the operator if the drives ON already. Rapid key is used to move the machine axes faster than normal JOG mode speed. When this button is used together with any axis button the machine axes are moved faster. The rapid movement speed is 10000 mm/min.



Figure 38

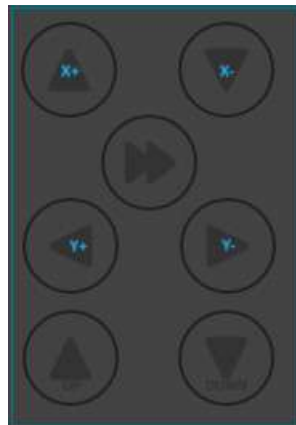


Figure 39

SIMULATION button is used to test the selected part program without any cutting gas and laser beam. In this mode the head is stayed always on retract position while the machine axes move. Once the regarding button pressed, its animation will be as shown in [Figure 40](#).

Figure 40

REFERENCE button is used to reference linear motors to get the machine axes in order. If the motion system will be controlled by the servo drivers and motors, this animation will be as shown in [Figure 41](#) all the time.



Figure 41

3.d ACTIVE PARAMETERS

The general view of the Active Parameters page as shown in [Figure 42](#). This page is allowed to access most used statuses such cutting parameters, cutting power, gas pressure, axes speed, and temperatures of the cutting head e.g.

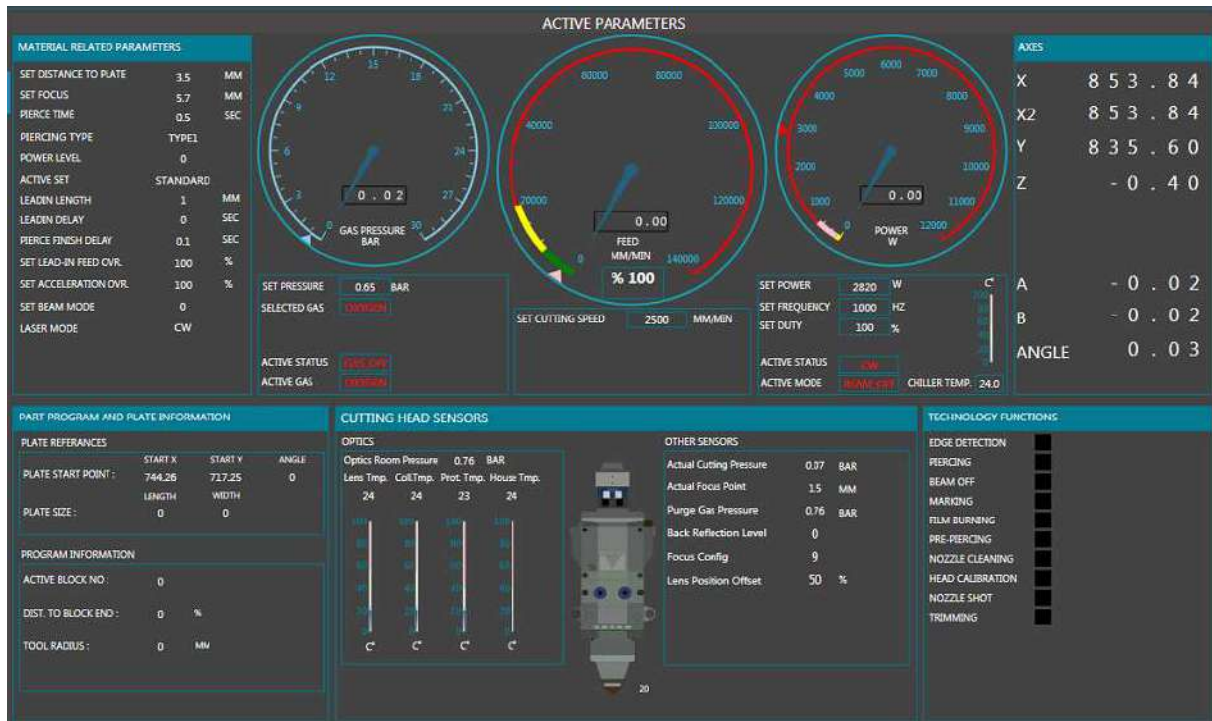


Figure 42

In **MATERIAL RELATED PARAMETERS** area the selected and loaded cutting parameters can be monitored by the operator while cutting process is being performed as shown in [Figure 43](#). The cutting parameters will be explained in detail in next pages.

MATERIAL RELATED PARAMETERS		
SET DISTANCE TO PLATE	3.5	MM
SET FOCUS	5.7	MM
PIERCE TIME	0.5	SEC
PIERCING TYPE	TYPE1	
POWER LEVEL	0	
ACTIVE SET	STANDARD	
LEADIN LENGTH	1	MM
LEADIN DELAY	0	SEC
PIERCE FINISH DELAY	0.1	SEC
SET LEAD-IN FEED OVR.	100	%
SET ACCELERATION OVR.	100	%
SET BEAM MODE	0	
LASER MODE	CW	

Figure 43

Actual gas pressure, axis speed and output power can be monitored by the operator while cutting process is being performed and at the same set pressure, status of the gas, set cutting speed, set power, status of the laser mode and chiller temperature can also be monitored as shown in [Figure 44](#).



Figure 44

In **AXES** area the actual axes positions can be monitored by the operator as shown in [Figure 45](#).

AXES				
X	8	5	3	. 8 4
X2	8	5	3	. 8 4
Y	8	3	5	. 6 0
Z	-	0	.	4 0

Figure 45

In **PART PROGRAM AND PLATE INFORMATION** area the sheet information to be cut can be monitored by the operator while cutting process is being performed as shown in [Figure 46](#). Once the part program has been started, active block number, distance to block end and Kerf (Tool radius) rate can also be monitored in same area.

PART PROGRAM AND PLATE INFORMATION			
PLATE REFERENCES			
	START X	START Y	ANGLE
PLATE START POINT :	744.26	717.25	0
	LENGTH	WIDTH	
PLATE SIZE :	0	0	
PROGRAM INFORMATION			
ACTIVE BLOCK NO :	0		
DIST. TO BLOCK END :	0	%	
TOOL RADIUS :	0	MM	

Figure 46

In **CUTTING HEAD SENSORS** area some of special sensor values which are located into the cutting head can be monitored as shown in [Figure 47](#).



IMPORTANT NOTE: These sensor values can only be seen if Precitec® ProCutter type of the cutting head is installed on the machine. Otherwise all the values in this area will be zero!!

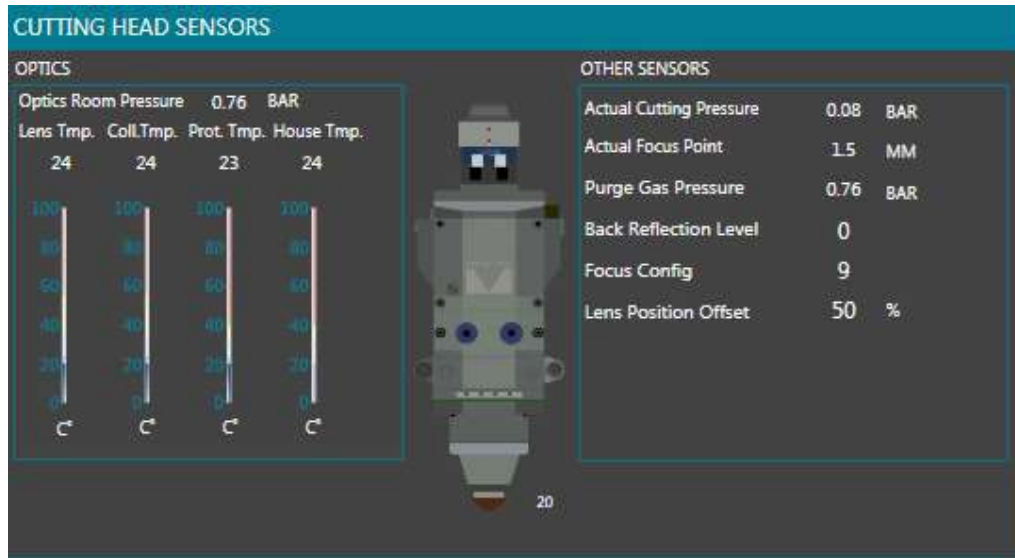


Figure 47

In **TECHNOLOGY FUNCTIONS** area some of special functions like piercing, nozzle cleaning, trimming etc. can be monitored by the operator while cutting process in being performed as shown in [Figure 48](#).



Figure 48

3.e PART PROGRAMS

The general view of the Active Parameters Page as shown in [Figure 49](#). This page will be explained the following in detail.

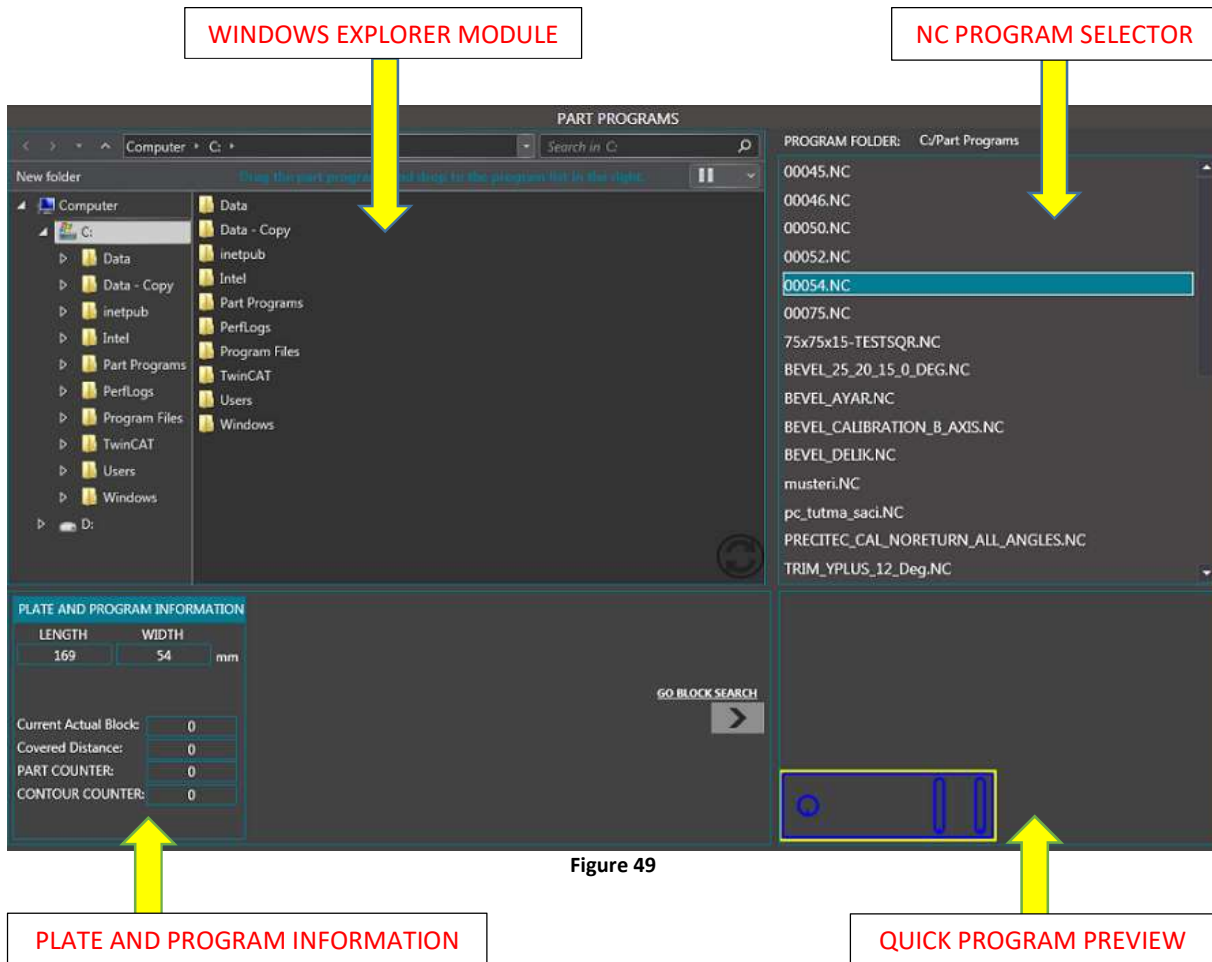


Figure 49

In **PLATE AND PROGRAM INFORMATION** area the length and width of the sheet plate, current actual block, part counter and contour counter can be monitored as shown in [Figure 50](#).

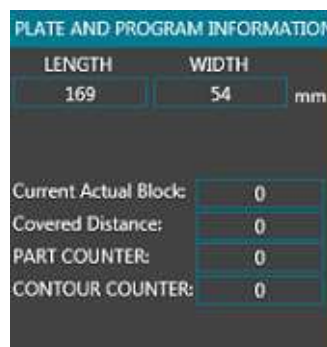


Figure 50

3.f GRAPHIC VIEW

GO TO BLOCK SEARCH button is used to access Block Search function that allows to continue from interruption point or contour/part number into the part program.



Figure 51

CONTINUE FROM THE PART		CONTINUE FROM INTERRUPTION	
☐	Enter the part number: 1	☐	
	Enter the contour number: 1		
Calculated Block No:		Interrupted Block: 0	
		Covered Distance: 0	
CONTINUE WITH CONTOUR NUMBER:			
☐	Enter Block Number or Select From Graphic: 0		START

Figure 52



Figure 53

3.g PART PROGRAM OPTIONS

PART PROGRAM OPTIONS

AUTOMATIC PLATE EDGE DETECTION ENABLE EDGE DETECTION ☐ DISABLE ENABLE PERIMETER RUN ☐ DISABLE SELECT THE SENSOR TYPE FOR EDGE DETECTION USE LASER SENSOR ☐ DISABLE USE CAPACITIVE SENSOR ☒ ENABLE LIMIT THE EDGE DETECTION AREA LENGTH: 300 WIDTH: 300	MANUAL PLATE REFERENCING SCREW ADJUSTMENT ENABLE SCREW POINTS SELECTION ☐ DISABLE 1. Select a point along the file right side You can set zero position or radius OK 2. Select the angle position corner When pressing to selection point, confirm with the confirm button SIDE OK ? CORNER OK ? ENTER PLATE REFERENCES MANUALLY ENABLE MANUAL REFERENCE ☐ DISABLE X 0 Y 0 SET ZERO ANGLE: 0 SET ANGLE PLATE ACTUAL POSITIONS REFERENCE POSITION 338.82 REFERENCE POSITION 609.85 PLATE ROTATION ANGL 0	
TABBING AT THE END OF THE CONTOURS ENABLE ☐ DISABLE MIN. CONTOUR SIZE: (Below this size, tabbing will not be applied) LENGTH: 10 WIDTH: 10 mm MAX. CONTOUR SIZE: (Above this size, tabbing will not be applied) LENGTH: 20 WIDTH: 20 mm 	PROGRAM END OPTIONS CHANGE TABLE AT THE END ☐ DISABLE GO TO PLATE ZERO ☐ DISABLE GO TO MACHINE ZERO ☐ DISABLE GO TO THE POSITION BELOW ☐ DISABLE OPERTOR DEFINED POSITION: X: 1345 Y: 1056 mm	PROGRAM REPEAT ENABLE PROGRAM REPEAT ☐ DISABLE REPEATING NUMBER 6 Consider the minimum and select the exact number of operations to be performed.

Figure 54

AUTOMATIC PLATE EDGE DETECTION button is used to perform a nozzle cleaning manually. When this key is pressed the cutting head is moved to the cleaning station as shown in [Figure 55](#) and after the head is gone down and it is stopped into the metal brush. After the vertical head movement is stopped in defined Z axis position the machine is moved to the head in X+ and X- direction. This movement is helped to cleaning the nozzle. When the cleaning is finished the cutting head raised up first to zero (retract) position and then moved back to interruption point automatically.

AUTOMATIC PLATE EDGE DETECTION

ENABLE EDGE DETECTION ☐ DISABLE

ENABLE PERIMETER RUN ☐ DISABLE

SELECT THE SENSOR TYPE FOR EDGE DETECTION

USE LASER SENSOR ☐ DISABLE

USE CAPACITIVE SENSOR ☐ DISABLE

LIMIT THE EDGE DETECTION AREA

LENGTH: WIDTH:

Figure 54

MANUAL PLATE REFERENCING

SCEW ADJUSTMENT

ENABLE SCEW POINTS SELECTION ☐ DISABLE

1. Select a point along the right side.
You can use laser pointer or nozzle tip.

2. Select the right bottom corner.

After moving to location point, confirm with the related button.

SIDE OK ?

CORNER OK ?

ENTER PLATE REFERENCES MANUALLY

ENABLE MANUAL REFERENCE X ☐ Y ☐ DISABLE

0 0 SET ZERO

ANGLE : 0 SET ANGLE

PLATE ACTUAL POSITIONS

REFERENCE POSITION 0 REFERENCE POSITION 0 PLATE ROTATION ANGLE 0

Figure 54

TABBING AT THE END OF THE CONTOURS

ENABLE ☐ DISABLE

MIN. CONTOUR SIZE: (Below this size, tabbing will not be applied)

LENGTH: 0 WIDTH: 0 mm

MAX. CONTOUR SIZE: (Above this size, tabbing will not be applied)

LENGTH: 0 WIDTH: 0 mm



Figure 54

PROGRAM END OPTIONS

CHANGE TABLE AT THE END ☐ DISABLE

GO TO PLATE ZERO ☐ DISABLE

GO TO MACHINE ZERO ☐ DISABLE

GO TO THE POSITION BELOW ☐ DISABLE

OPERTOR DEFINED POSITION:

X: Y: mm

Figure 54

PROGRAM REPEAT

ENABLE PROGRAM REPEAT ☐ DISABLE

REPEATING NUMBER

Enable the function and enter the total number of plate which you want to cut.

Figure 54

3.h CUTTING OPTIONS

CUTTING OPTIONS		
CUTTING HEAD BEHAVIOR AT CONTOUR END RETRACT DISTANCE: 20 RETRACT AT CONTOUR END: ☐ DISABLE PING-PONG: ☐ DISABLE RETRACT TO TOP BETWEEN PARTS: ☒ ENABLE	AUTOMATIC NOZZLE CLEANING ENABLE ☐ DISABLE SET CLEANING PERIOD 0 CLEANING COUNTER 0 CLEAN BEFORE CALIBRATION ☐ DISABLE Periodic nozzle cleaning. Enter the number of piercing to cleaning.	CLEANING AIR PURGE ENABLE AIR BLAST ☐ DISABLE ON TIME 500 Purges air after piercing to clean piercing area.
STOP AT PART OR CONTOUR END STOP AT THE PART END ☐ DISABLE STOP AT THE CONTOUR END ☐ DISABLE Head moves up and stops at the cutting end. Machine waits START from operator to continue the next part or contour.	RESTART AUTOMATICALLY AFTER TIP-TOUCH ENABLE RESTART AFTER TIP-TOUCH ☐ DISABLE NUMBER OF RETRY 0 Try resuming the cutting after the nozzle tip touches the plate.	ADDITIONAL PIERCING AFTER PRE-PIERCING ENABLE ☐ DISABLE Machine makes additional piercing before cutting.
STYLE CUTTING ENABLE ☐ DISABLE MAX DEVIATION 1  Smooths the segmented contours.	FLY CUT ENABLE FLY-CUT ☐ DISABLE PRE-BEAM ON TIME 100 PRE-BEAM OFF TIME 100 Laser on/off time adjustment times.	

Figure 58

NOZZLE CLEANING: On the top of the box the regarding function can be enabled or disabled by operator using the sliding menu (If the menu as Figure 38 the function will be disabled).

When this function is enabled the value into the “Set cleaning period” will be taken into account by system and the number of “Cleaning Counter” area will be increased by system after every piercing cycle one by one when any kind of cutting program is started already. When the counter value is equal to set cleaning period value the cutting process is halted.

NOZZLE CLEANING	
Off	Enable
100	Set cleaning period
0	Cleaning Counter

Figure 59

AIR BLOW OUT: On the top of the box the regarding function can be enabled or disabled by operator using the sliding menu (If the menu as Figure 40 the function is disabled). This function is generally used to piercing thicker sheet metal to avoid the heating and cutting fume where the lead-in area. When this function enabled the value into the “On Time (millisecond)” will be taken into account by system. For example the compressed air will be blown-out 10 seconds for the beginning of every piercing as shown Figure 40.

STYLE CUTTING: In this area on the top regarding function may be enabled or disabled by operator (The function is disabled if floating menu as Figure 41). This function is generally used to make the small elements smoother while cutting.

CORNER COOL: In this area some of cutting parameters may be changed when the cutting head reached sharp corner as Figure 43. This function is used to cut sharp corner perfectly.

When the head reached the sharp corner the cutting parameters (power, frequency, duty, pressure) will be changed automatically and the head will be stopped for a while according to stop time on the corner and after the stop time finished the cutting will be continued with normal cutting parameters.



IMPORTANT NOTE: To use this function correctly regarding cutting program must be machined with Corner Cool function first in LANTEK CAD/CAM software before cutting on the machine as shown Figure 44. “Delay in sharp corner” question must be answered with “YES” by operator if the corner cool function wants to use on the cutting!

Z AXIS OPTIONS: In this area Z axis movement may be configured that how the head will be moved after cutting the contour. The Z may be configured 3 different movements in this area while cutting. At the same time only one floating function may be enabled. Both of them may not be enabled at the same time. It is prohibited by system due to safety reason!

If both functions are disabled as Figure 45 the cutting head will be raised up vertically to its actual zero (0) position and then will be moved in parallel to the sheet metal and finally will be gone down vertically on next contour lead-in position (from A to B vertical movement as in Figure 48).

If “Enable retract after beam off” function is enabled as shown in Figure 46 the cutting head will be raised up vertically to setting position only (for example 40 mm from the sheet) and then will be moved in parallel to the sheet metal and finally will be gone down vertically on next contour lead-in position (from A to B vertical movement as Figure 48).

If “Enable Ping-Pong” function is enabled as shown in Figure 47 the cutting head will be raised up only a little bit according to distance between old and new contour spirally (from A to B spiral movement as Figure 48). With this function small contours may be cut faster than retract mode.



IMPORTANT NOTE: To use this function safely the part may not be flipped off after cutting, because the head will not be raise up too much and if the head hits to the part that might be dangerous!

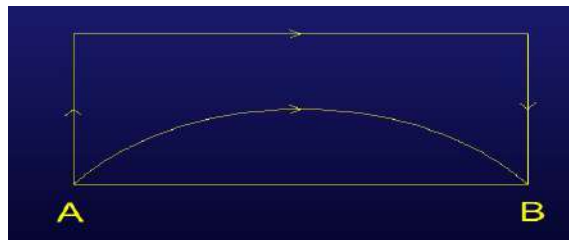


Figure 60

3.i SHEET PARAMETERS

PART PROGRAM TIMERS		RECENT PART PROGRAMS				
	HRS MIN SEC	Program Name	Finished Pending			
Last Piercing Time :	00:00:00	1. Part Program	C:\Part Programs\00054.NC 1 1			
Total Piercing Time :	00:00:00	2. Part Program	C:\Part Programs\00052.NC 2 1			
Last Rapid Time :	00:00:00	3. Part Program	C:\Part Programs\00050.NC 1 1			
Total Rapid Time :	00:00:00	4. Part Program	0 1			
Last Cutting Time :	00:00:00	5. Part Program	0 0			
Total Cutting Time :	00:00:00	6. Part Program	0 0			
Machining Time :	00:00:00	This list shows the last 6 part programs set by machine and the how many plates cut and pending plate numbers.				
Finishing Time	00:00:00					
Machining time consists of total cutting time and piercing time.						
Piercing time includes machining time, total rapid movement time and other delays.						
Total Number Of Piercing 0						
RESET TIMERS						
RECENT PLATE REFERENCES						
	X	Y	PLATE ROTATION	Interruption Line	Distance	
1.	338.82	609.85	0°	67	0	ACTIVATE
2.	335.52	533.01	0°	67	0	ACTIVATE
3.	335.52	533.01	0°	67	0	ACTIVATE
4.	332.22	454.07	0°	67	0	ACTIVATE
5.	184.45	968.57	0°	0	0	ACTIVATE
6.	968.57	184.45	0°	222	0	ACTIVATE

Figure 61

RECENT PLATE REFERENCES: In this area the last 6 sheet zero positions and their angle rates can be seen by the operator. The latest sheet zero position will be loaded by system on the top of the area as shown Figure 50. Known sheet zero position and angle rate can be activated by pressing "Activate" key which is located on the right side of the related sheet values (Before pressing Activate button the machine must be in AUTO mode and Reset button must be pressed). After pressing it Go to Zero key in the Hidden Software Control Panel must be pressed by the operator to move the machine axes to the activated sheet zero positions.

RECENT PART PROGRAMS: In this area the latest selected 6 part programs name can be seen. The latest part program name will be loaded by system on the top of the area as Figure 51.

The number "1" on the To Cut area is shown that the part program is compiled correctly by system and the number on the Cut area is shown that how many times the related part program has been finished completely.

PROGRAM START OPTIONS: In this area the process before starting the cutting program can be configured by operator.

If first selection is enabled in Figure 52 the sheet edge sensor type will be checked by system as Figure 53 and regarding sensor is activated.

PROGRAM END OPTIONS: In this area the process after finishing the cutting program may be configured by operator.



IMPORTANT NOTE: At the same time only one selection can be enabled!

If first selection enabled the cutting head will be moved back to sheet zero position after ending the cutting program. The movement will be continued until axes position equal to last sheet zero position.

If second selection enabled the cutting head will be moved back to axes zero positions after ending the cutting program. The movement will be continued until all axes position will be zero.

If third selection enabled the cutting head will be moved back to defined X and Y axis position by operator. For example the cutting head will be moved back to X: 20 mm and Y: 1000 mm after ending the cutting program if third selection enabled.

MANUAL SHEET REFERENCE: In this area sheet zero position and angle can be determined manually by the operator. For example any sheet zero position and its angle may be written from Figure 55 and the selected program may be started from that position directly. To use this function X and Y positions of sheet zero and its angle rate must be entered manually and then "Set Zero" and "Set Angle" buttons must be pressed by operator.

3.j MANUAL FUNCTIONS

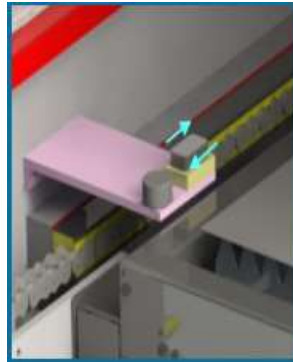


Figure 55

HEAD CHECK button is used to move the cutting head to front side of the machine to check its condition by the operator. To use this function the movement of the axes must be stopped by pressing “NC Stop” button first. When this key is pressed the cutting head is moved to front side of the machine and it is stopped on adjusted X and Y positions. After stopping red lamp (NC Stop) is lighted up and green lamps (NC Start) is started to blinking. After checking the head NC Start button must be pressed by the operator to go back to interruption point.

NOZZLE CENTERING button is used to check the laser beam centering. This beam centering is highly recommended by BAYKAL Machine Tools. It must be checked by the operator at least once day before the production!

When the regarding button pressed, the cutting head is moved to front side of the machine and it is stopped on adjusted X and Y positions. After stopping red lamp (NC Stop) is lighted up and green lamp (NC Start) is started to blinking. To check the beam centering the following instructions must be followed by the operator:

- A permanent marker pen (M size is recommended to paint) and a paper tape are required to perform the function.
- The flat surface of the nozzle must be painted with permanent marker pen.
- After painting the paper tape must be pasted on the flat surface of the nozzle.
- “Nozzle Shot” function must be selected by the operator (Before make a shot the Drives and laser unit must be ON position and the machine must be in AUTO mode).
- After selecting red lamp (NC Stop) is lighted up and green lamp (NC Start) is started to blinking as normal start events. To make a shot NC Start button must be pressed by the operator.
- After shooting the paper tape must be taken gently from the nozzle surface and checked the shape of painting area by the operator. The shooting point where the laser beam has made a shot must be exactly in the center of outer painted round area.

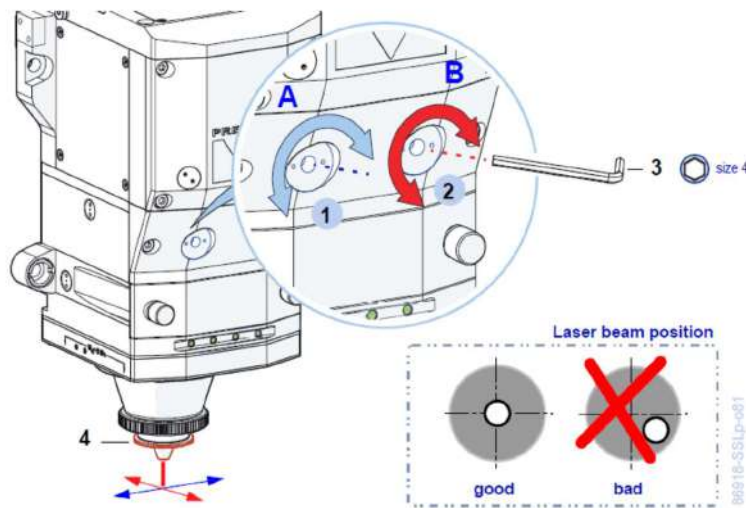


Figure 56

- If the shooting point is not in the center (as Figure 36) A or B lens adjustment screws on the head as Figure 35 must be turned to clockwise or counter clockwise direction by the operator depends on where is the position of the point.

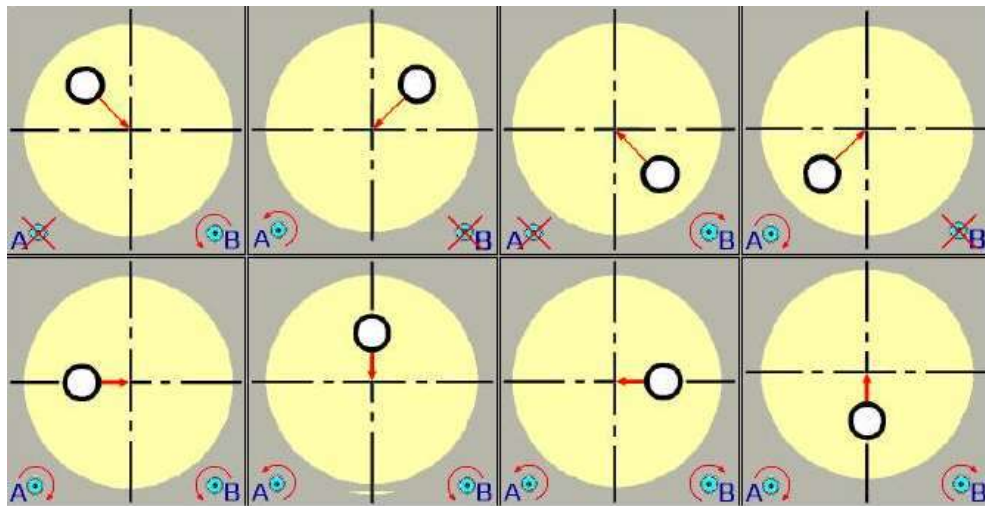


Figure 57

- Above instructions must be repeated to make the exact beam centering by the operator.

HEAD CALIBRATION button is used to calibrate the nozzle offset value (Distance between the nozzle and sheet plate). Before perform this function the machine must be in AUTO mode. To perform a full head calibration the following instructions must be followed carefully by the operator:

- When the regrading button pressed, the head moves to calibration plate and after reaching its calibration position the head moves down to the plate and stopped by the system above 10 - 15 mm the surface of the plate. At the same time red lamp (NC STOP) lights up and green lamp (NC START) starts to blinking.

- To start the function NC Start button must be pressed by operator. After pressing the following message is appeared on the Alarms and Warnings area: "PLEASE TOUCH THE NOZZLE!"
- The operator must be touched the nozzle with any kind of metal or his finger. After touching the following message is appeared on the Alarms and Warnings area: "TIP TOUCH IS SUCCESSFUL. PLEASE CONTINUE THE CALIBRATION WITH NC START!"
- After noticing above message NC Start button must be pressed for second time by operator.
- After pressing the head is gone down to the calibration plate automatically with very low speed by system until the nozzle is touched the plate surface. After touching the head is raised up to adjusted height position.
- After automatic retracting the head is gone down again with fast speed and it is stopped at 20 mm above from the surface of the calibration plate.
- If there is no alarm during calibration the following message is appeared on the Alarms and Warnings area: "CALIBRATION FINISHED SUCCESSFUL".
- Single Point Calibration: This function is used to perform a quick calibration manually. When this key is pressed the head is moved to the calibration plate.

CHECK GAS button is used to open the selected gas valve manually along with set pressure adjusted by the operator.

3.k SHUTTLE TABLE

The general view of the Shuttle Table page as shown in Figure 67. This page is allowed the access the status of the shuttle table and the buttons to control it. The machine has two cassettes (upper and lower cassettes) and 4 hydraulic cylinders.

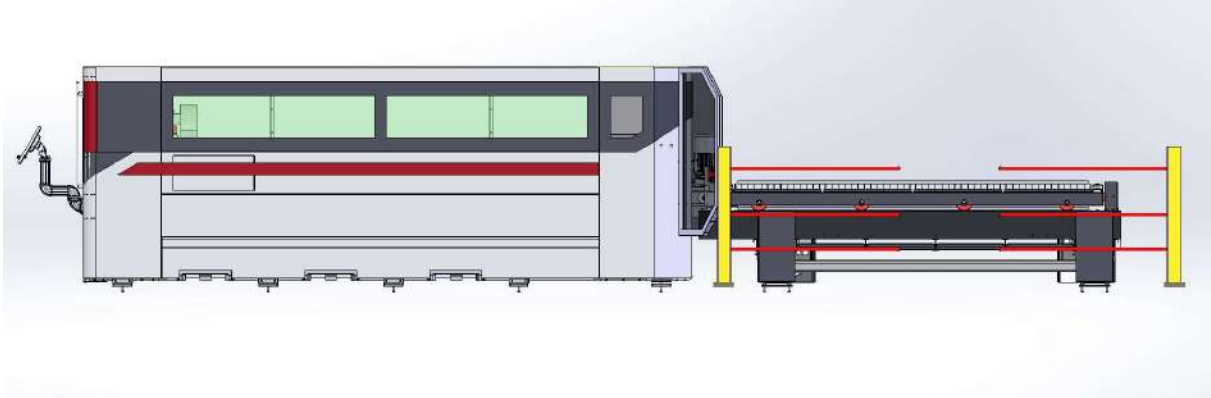


Figure 67

STATUS SIGNALS

In Figure 68, green circular indicators are shown that the regarding signal has been coming and red ones are shown the signal has not been coming actually.



Figure 68

WORK POSITION indicator is used to show the status of work position sensor to the operator. If regarding area is green as shown in Figure 68 means that one of cassette is located within cutting area of the machine.

UP indicator is used to show the status of upper position sensors to the operator. If regarding area is green as shown in Figure 68 means that all the hydraulic cylinders are at their upper positions. If any hydraulic cylinder is not at its upper position this area will be red.

DOWN indicator is used to show the status of down position sensors. If regarding area is green as shown in Figure 69 means that all the hydraulic cylinders are at their lower positions. If any hydraulic cylinder is not at its lower position this area will be red.



Figure 69

UPPER CASSETTE indicator is used to show the status of upper cassette sensor to the operator. If regarding area is green as shown in Figure 69 that means one of cassette is located at the back and upper rail.

LOWER CASSETTE indicator is used to show the status of lower cassette position to the operator. If regarding area is green as shown in Figure 70 that means one of cassette is located at the back and lower rail.

BACK TABLE SENSORS indicators are used to show the status of all limit switches for hydraulic cylinders to the operator as shown in Figure 70.

BACK DOOR indicator is used to show the status of the openable back door to the operator. If CLOSED indicator is green as shown in Figure 71 means that the openable back door is closed correctly.

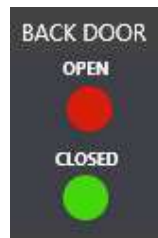


Figure 71



IMPORTANT NOTE: The openable back door is supplied by compressed air and controlled by PLC system. If the compressed air pressure is not enough the door will not be opened correctly and the changing cycle of the shuttle table will not be completed as expected!

CONTROL BUTTONS

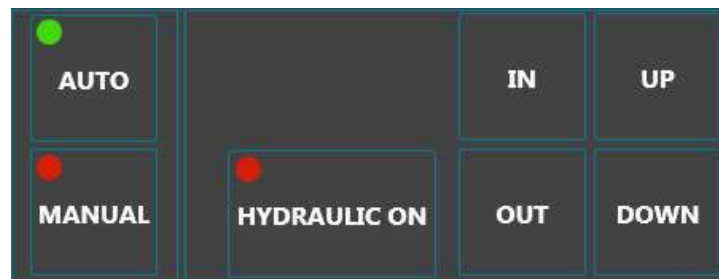


Figure 72

AUTO button is used to change the cassettes and hydraulic pistons positions automatically by the system according to the status signals. To use this button, one of the cassettes must be placed within the cutting area (WORK position's indicator must be green) and other one must be placed on the back area of the machine (Lower or upper cassettes' indicator must be green).

MANUAL button is used to change the cassettes and hydraulic pistons positions manually by the operator according to the status signals. This button is commonly used to change the shuttle table if AUTO changing mode has been cancelled somehow (Safety light barrier interruption, pressing EMERGENCY STOP or RESET button e.g.).

HYDRAULICS ON button is activated in AUTO mode by the system automatically. When UP or DOWN button pressed continuously in MANUAL mode, the hydraulic cylinders raise up or move down manually.

IN button is used to move one of outer cassettes manually from rear area to the cutting area with lower speed. When the regarding button pressed continuously, the cassette moves forward direction until WORK position signal turns to green. When the signal turned to green, the movement will be stopped by the system immediately.

OUT button is used to move the inner cassette manually from cutting area to the rear area with lower speed. When the regarding button pressed continuously, the cassette moves backward direction until LOWER or UPPER cassette signal turns to green. When the signal turned to green, the movement will be stopped by the system immediately.

UP button is used to move the hydraulic cylinders from down to UP position manually. This button is connected with Hydraulics On button directly. When the regarding button pressed continuously, HYDRAULIC ON signal turns to green and all the hydraulic cylinders raise up together until UP signal turns to green. When all the cylinders are at their upper positions, the movement will be stopped by the system immediately.

DOWN button is used to move the hydraulic cylinders from up to DOWN position manually. This button is connected with Hydraulics On button directly as UP button. When the regarding button pressed continuously, HYDRAULIC ON signal turns to green and all the hydraulic cylinders move down together until DOWN signal turns to green. When all the cylinders are at their lower positions, the movement will be stopped by the system immediately.

3.1 TRIMMING

The operator can decide a cutting line with angle and finish point depend on the point selection. To do trim cutting needs to follow istraction which is shown of the trim page.

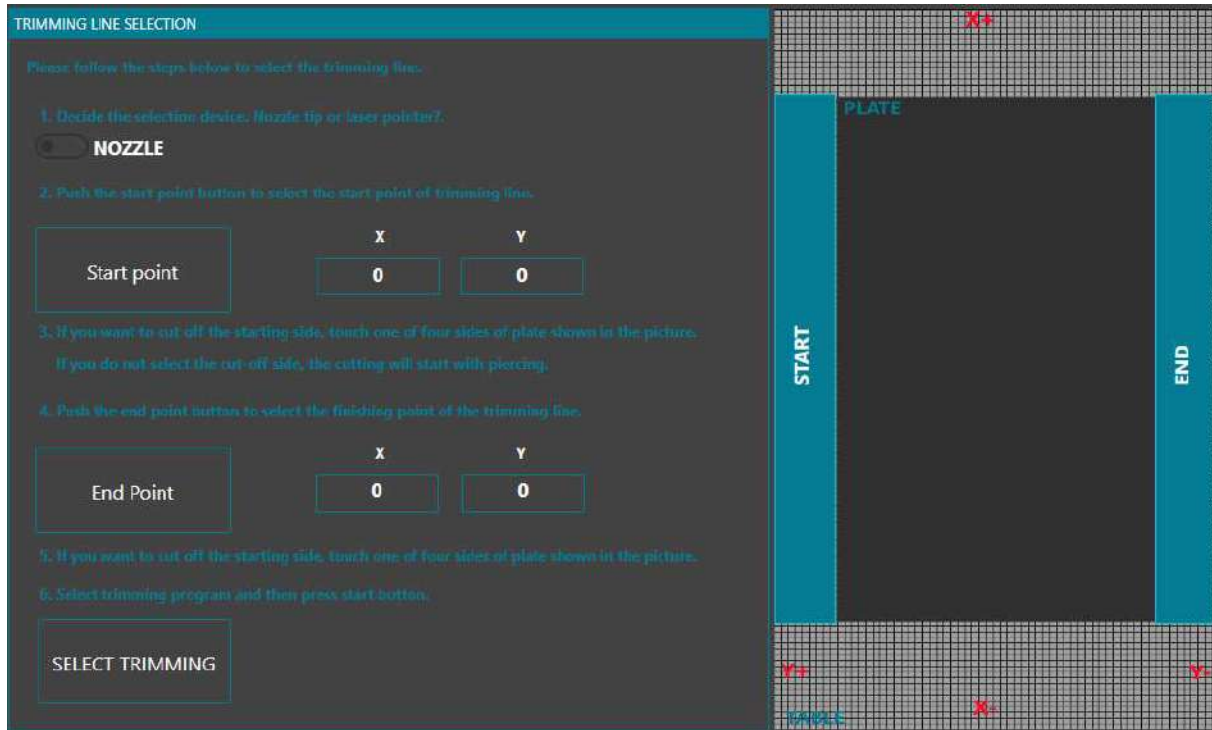


Figure 73

3.m LASER & CHILLER

This page is used to realize some conditions on connected laser unit such as output laser power by watt, mean and feed fiber temperatures by Celsius degrees, version of the unit, logger of the unit etc. as shown in Figure 75.

If any laser error is appeared on the Alarms and Warnings area while cutting, this page must be checked by operator. If the problem cannot be solved by her/him, Baykal Laser Service Team must be informed by sending an email to the following address:

laser@baykal.com.tr

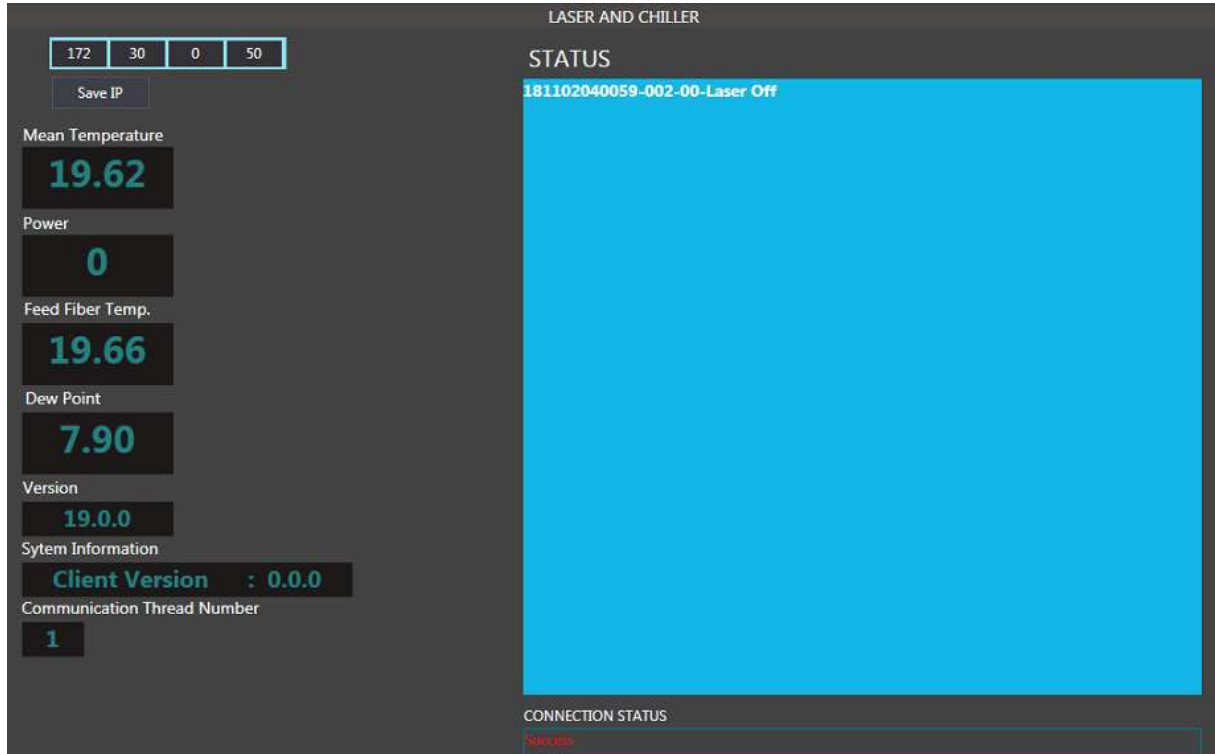


Figure 75

3.n CUTTING PARAMETERS

The cutting parameters which are most important settings for proper production along with advanced settings will be explained in this chapter.

NOZZLE DIAMETER: This setting is a manual adjustment that must be performed by the operator. This parameter is indicated which nozzle type and diameter should be used for correct cutting operation. The values can be found in "CUT SETS" tab, located right and bottom side.

CUTTING PARAMETERS

Cutting parameters are included all data which is needed for cutting and piercing process. In the right side of the page, there is a list of materials in the database. Each material name in the list shows a cutting parameter group and this group is shown in a table in the left hand side of the page. Each parameter group consist of 4 cutting and piercing sets.

SMALL (FINE): Parameter set for cutting small holes and contours

STANDARD (REGULAR): Parameter set for standard contours

SPECIAL (FAST): Parameter set for fast cutting. This parameter set can be used when the finish time of the sheet is more important than cutting quality.

POWER: This parameter is used to set the output laser power while cutting process. This value is limited up to available fiber laser source.

LASER MODE: This parameter is used to select the laser mode for cutting or piercing. 2 different type of laser mode can be selected by the operator (CW or PULSE mode).

CW MODE: This mode is generally used for cutting. In this mode the output laser power is constant and it is not change depending on time. The frequency is set to maximum (capable by the fiber laser source) and also duty is 100%.

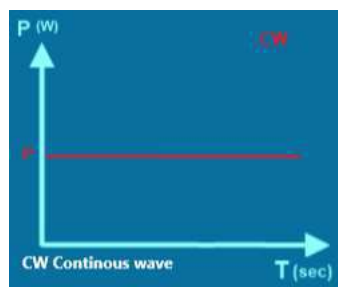


Figure 62

PULSE MODE: This mode is generally used for piercing. Sometimes the mode can also be used if the contour is too small while cutting thicker material. In this mode the output laser power can be set different values depending on time. Frequency and duty can be adjusted by the following formulas:

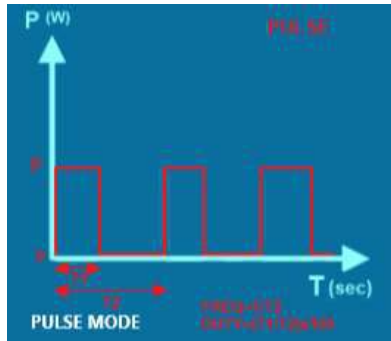


Figure 63

T1: Rise time
T2: Total time
P: Power (by watt)
T: Time (by second)

FREQUENCY: This parameter is determined the number of pulses of laser power per regarding time. This parameter can only be activated when the laser mode is selected as PULSE mode. For example; when the frequency is set to 10 as shown in Figure, T2 value can be calculated as following formula:

$$f = \frac{1}{T2} \Rightarrow T2 = \frac{1}{10} = 100 \text{ ms}$$

T2 is found 100 milliseconds. This value means the laser source is created 10 pulses in every 100 milliseconds while piercing.

DUTY: Duty cycle is the percentage of time laser power is output. This parameter can only be activated when the laser mode is selected as PULSE mode. For example; when the duty is set to 50 as shown in Figure, T2 value can be calculated as following formula:

$$D = \frac{T1}{T2} \times 100 = \frac{1}{10} \times 100 = 100 \text{ ms}$$

T1 is found 50 milliseconds. This value means the laser source is opened the laser beam every 50 milliseconds in 100 milliseconds (T2 time).

CUTTING SPEED: This parameter is used to set the actual cutting speed while cutting process. The value can be put up to 50000 mm/min by operator.

GAS TYPE: This parameter is used to select the gas type for cutting process. Three type of gases can be used (Oxygen, nitrogen and compressed air).

PRESSURE: This parameter is used to set the gas pressure value for cutting process. The gas pressure can be set from minimum 0.3 bar to maximum 25 bar.

CUTTING HEIGHT: This parameter is used to define the distance between flat surface of the nozzle and sheet surface. This value can be set from 0.5 mm to maximum 20 mm.

FOCUS POINT: This parameter is used to adjust the recommended position of the lens focal point relative to the top surface of the workpiece. A positive value is indicated that the focal position should be above the surface; a negative value one that it should be below the surface.

LEAD-IN FEED OVERRIDE: This parameter is used to change the feed override within lead-in processing. If the value is different than 100 this parameter changes

LEAD-IN LENGTH: This parameter is used to define a length of the lead in.

ACCELERATION OVERRIDE: This parameter is used to override the normal machine acceleration by the percentage set. Acceleration Override is used to improve the start-up of the cutting process, primarily for thick non-ferrous metals with high pressure nitrogen. This parameter is only affected the acceleration of profiling commands (e.g. G01, G02, G03 etc.) it does not affect rapid traverse commands (G00) or Jog commands from the operator panel. This ensures repositioning between cuts is carried out in the shortest possible time.

LEAD-IN DELAY: This parameter is used to define

DISTANCE DELAY: This parameter is used to define when the distance control system starts to work after piercing before cutting. This minimize the occurrence of tip-touch errors after piercing. After piercing, sometimes (in thick material cutting) very small slags (small melted metal pieces) like bubbles can exist in the direction of cutting. Then nozzle tip may touch this slags.

KERF (TOOL RADIUS): This parameter is used to define commanded kerf length which is really important for correct part dimension. Part dimensions can be changed by focus point, nozzle offset, beam centering, gas pressure, nozzle diameter etc. If the part dimension are not correct this parameter must be re-adjusted by operator manually.

PIERCING PARAMETERS

Cutting parameters includes all data which is needed for cutting and piercing process. In the right hand side of the page, there is a list of materials in the database. Each material name in the list shows a cutting parameter group and this group is shown in a table in the left hand side of the page. Each parameter group consist of 4 cutting and piercing sets.

FINE CUT (SET1): Parameter set for cutting small holes and contours

REGULAR CUT (SET): Parameter set for standard contours

FAST CUT (SET): Parameter set for fast cutting. This parameter set can be used when the finish time of the sheet is more important than cutting quality.

POWER: This parameter is used to set the output laser power while piercing process.

LASER MODE: This parameter is used to select the laser mode for cutting or piercing. Two different type of laser mode can be selected by operator (CW or PULSE mode).

CW MODE: This mode is generally used for cutting. (Sometimes the PULSE mode can be used if the contour is too small while cutting thicker material). In this mode the output laser power does not change depending on time and frequency is set to maximum (capable by laser source) and also duty is 100%.

PULSE MODE: This mode is generally used for piercing. In this mode the output laser power can be set different values depending on time. Frequency and duty can be adjusted by the following formulas:

T1: Rise edge of the set power value

T2: Through time between two rise edges of the set power values

P: Power (by watt)

T: Time (by second)

FREQUENCY: This parameter is used to set frequency of the laser power for pulse mode

DUTY: This parameter is used to define the amplitude in the set frequency of the laser unit.

GAS TYPE: This parameter is used to define the gas type in piercing mode. There are 3 type of gases can be selected by operator depending on the material.

PRESSURE: This parameter is used to define the actual gas pressure in piercing mode.

FOCUS POINT: This parameter is used to define exact invisible focal height position. To best cutting quality the parameter must be adjusted correctly by operator.

START HEIGHT: This parameter is used to define the start height distance from the sheet surface in piercing mode.

FINISH HEIGHT: This parameter is used to define the finish height distance from the sheet surface in piercing mode.

FINISH DELAY: This parameter is used to define the delay time after piercing successfully done by system. To prevent the heating of the material this parameter can be used by operator.

PIERCE TYPE: This parameter is used to define which type of pierce setting will be used while the machine has been performing a piercing.

ADVANCED CUTTING PARAMETERS

This parameters directly related to the burn in the corners. Because the cutting speed slowdown in the sharp corner, average power given to the metal will increase. So the power should be automatically adjusted according to the actual path speed.

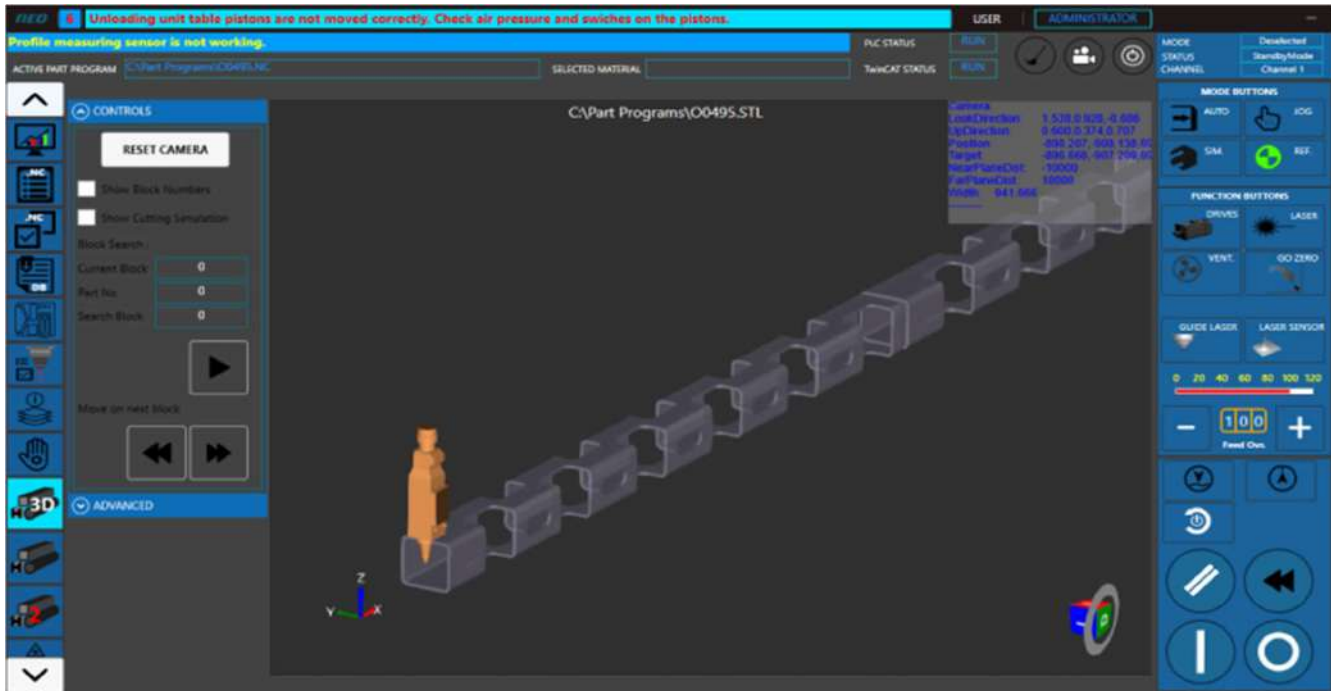
START HOLE: This function used in thick stainless steel and aluminum cutting. It improves piercing and start of cutting. When enabling this function, machine makes a small circular hole after piercing.

ADVANCED PIERCING PARAMETERS

This function used in thick stainless steel and aluminum and mild steel cutting. It improves piercing time, nozzle and protection glass life. For correct functioning, all parameters should be adjusted correctly. When this function is enabled, pierce type 3 must be selected in piercing parameters. Piercing parameters and Fast piercing parameters are used together.

As shown in Figure 3A, cutting head first goes to the start height in piercing parameters. After pierce time in piercing parameters elapsed, it stop the laser beam and the gas. Then it moves the cutting head to the position "Pierce Height "in the fast piercing set. Then start second piercing procedure with the parameters in the fast piercing set.

3.0 TUBE PAGES 1. 3D TUBE NESTING VIEW

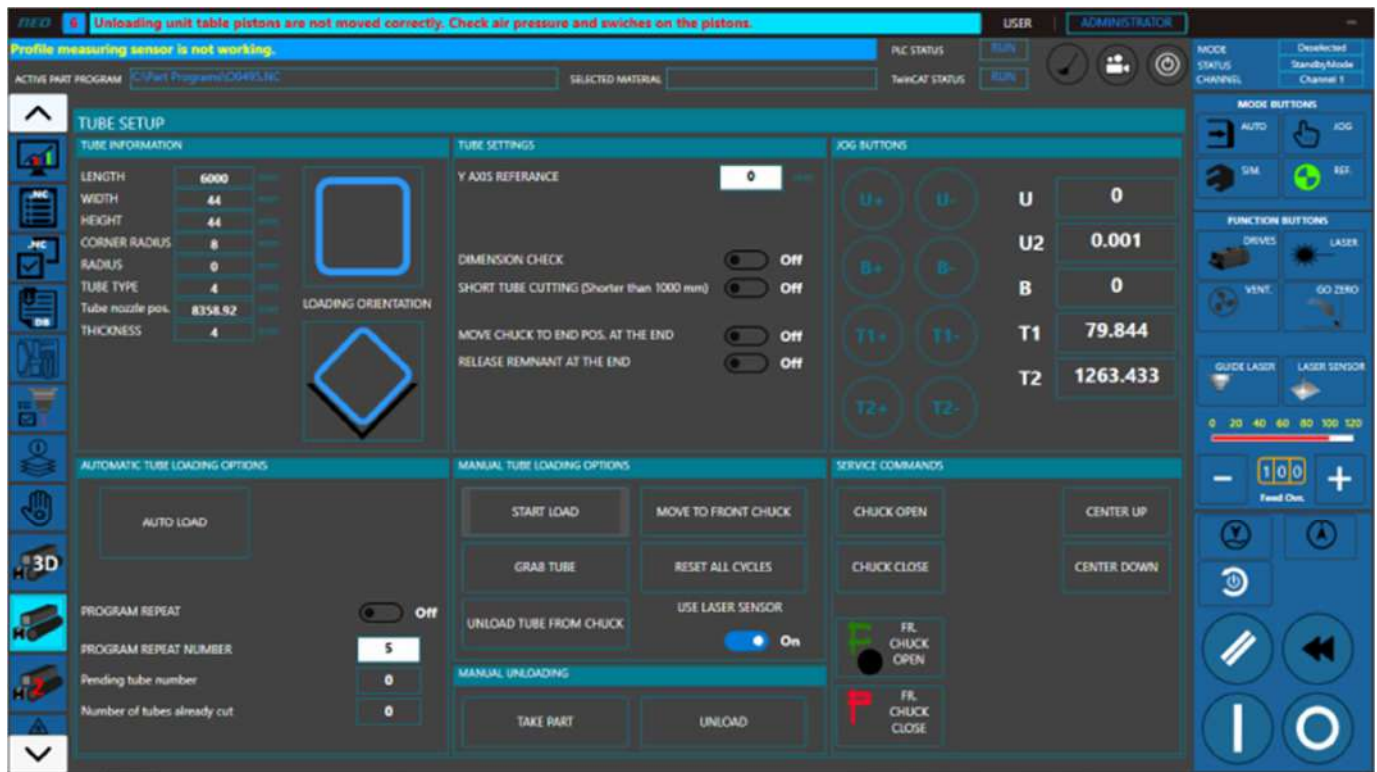


3D view page helps operator to monitor current cutting position on the tube, in case of interruption of program execution, continue program from interruption point visually.

In the left side of the page, there are following controls.

	Show Block Numbers This checkbox enables the visulisation of the line numbers of each contour. Show Cutting Simulation This checkbox enables the real time cutting simulation on the tube. Operators can watch current cutting contour. Curent Block Current cutting line number. Part No Current cutting part number. Search Block The line number to be continued after interruption.  Block search start button after interruption.  See previous and next contour on the tube.
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3.p TUBE PAGES 2. TUBE OPERATOR PAGE 1



Operators can do following functions on this page;

LOADING UNIT CONTROLS

- Tube starting position in Y axis can be changed here. Y-Axis reference is the top surface center point of the tube. If the contours are not centered (off to one side), this parameter must be changed.



- “Dimension check” enables profile dimension function using 3D Profile sensor. Before starting each program, this sensor checks the dimensions of the profile.



- “Move Chuck to the end position at the end” option enables automatic move of of main chuck to the loading position.



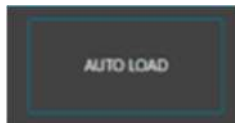
- “Release remnant at the end” enables releasing remnant tube piece grabbed by the main Chuck to be relased at the end of the program.



- Operator can monitor the type and the size of the current tube. Before starting the program, check if the selected program and the loaded tube is the same or not.



- If the machine is equipped with auto loader, this button loads one tube at a time to the machine automatically.



- Semi automatic loading buttons.



If the machine is equipped with auto loader, operator can load tubes step by step.,

“Start Load” moves the main chuck to the back (loading) position and rotates the chuck to loading angle.

“Grab Tube” moves the chuck in the direction of tube and try to sense the closest tube end using laser sensor. When it find the tube, it grabs the tube.

“Move to front chuck”. After grabbing the tube, main chuck run the tube to the cutting position.

“Reset all cycles”. Cancels all loading steps. Reset automatic and semi-automatic loading.

“Use laser sensor”



There is one laser sensor on the main chuck. Before grabbing the tube, main chuck uses this sensor to find the closest edge of the tube.

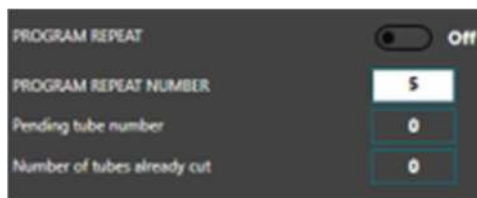
UNLOADING UNIT CONTROLS



“Take Part” moves the unloading table to the cutting position.

“Unload” moves the unloading table to the conveyor position and drops the cut pieces on the conveyor.

PROGRAM REPEAT CONTROLS



“PROGRAM REPEAT”. This function automatically load new tube to the machine and cut it without operator interaction.

“PROGRAM REPEAT NUMBER” Operator enters here the number of tube to be cut automatically.

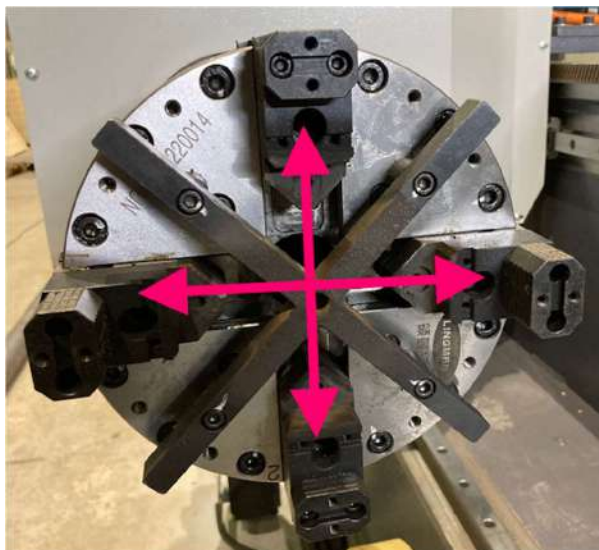
“Pending number” shows remaining tubes.

“Number of tubes already cut” shows the tube number cut currently.

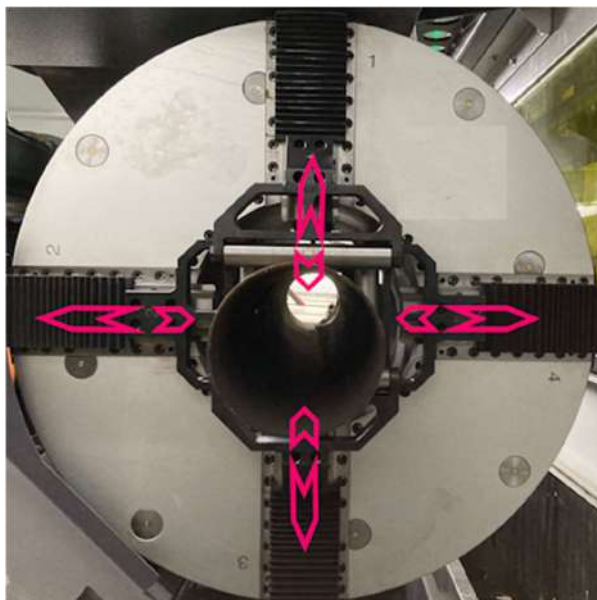
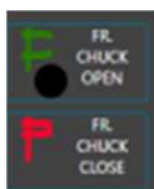
SERVICE COMMANDS



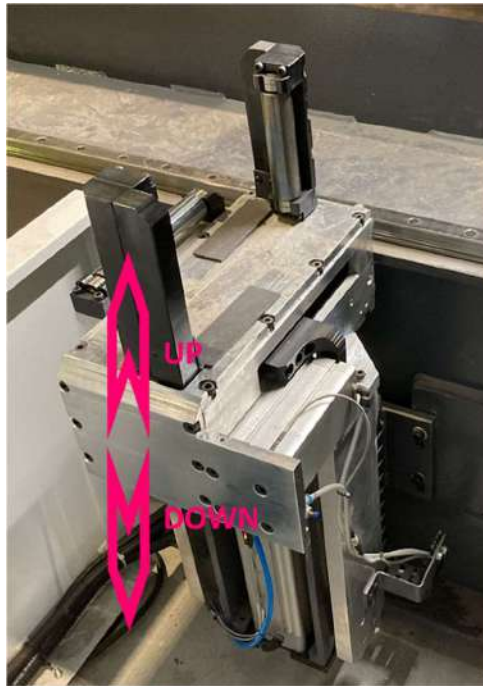
“CHUCK OPEN” and “CHUCK CLOSE” opens and closes the clamps of the main chuck.



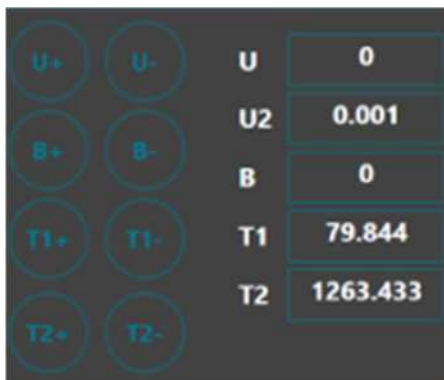
“FR. CHUCK OPEN” and “FR. CHUCK CLOSE” opens and closes the 4 clamps on the front chuck.



“CENTER UP” and “CENTER DOWN” moves centering unit up and down.



AXES CONTROLS



Following axes positions can be monitored here and in jog mode, they can be moved by a labeled button.

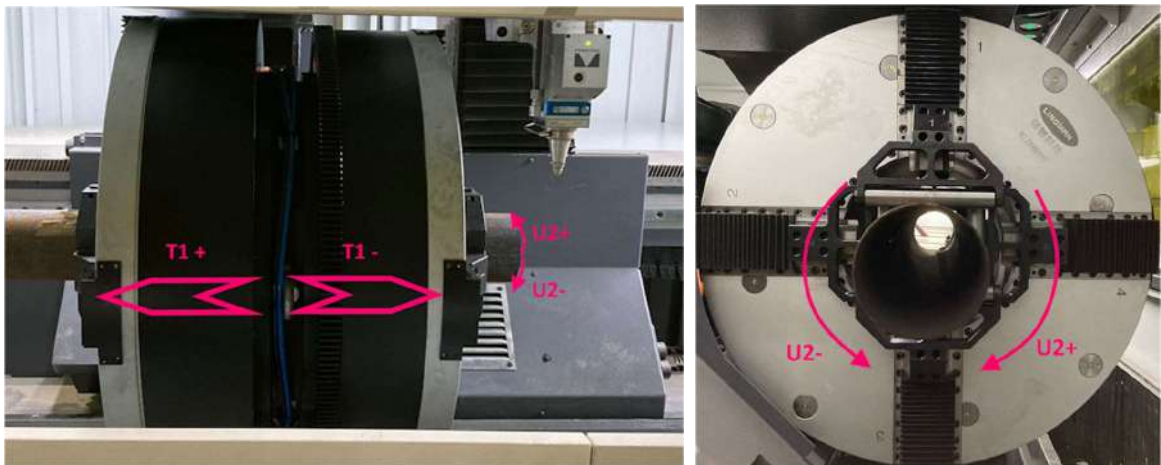
“U” main chuck rotary axis.

“U2” secondary chuck rotary axis.

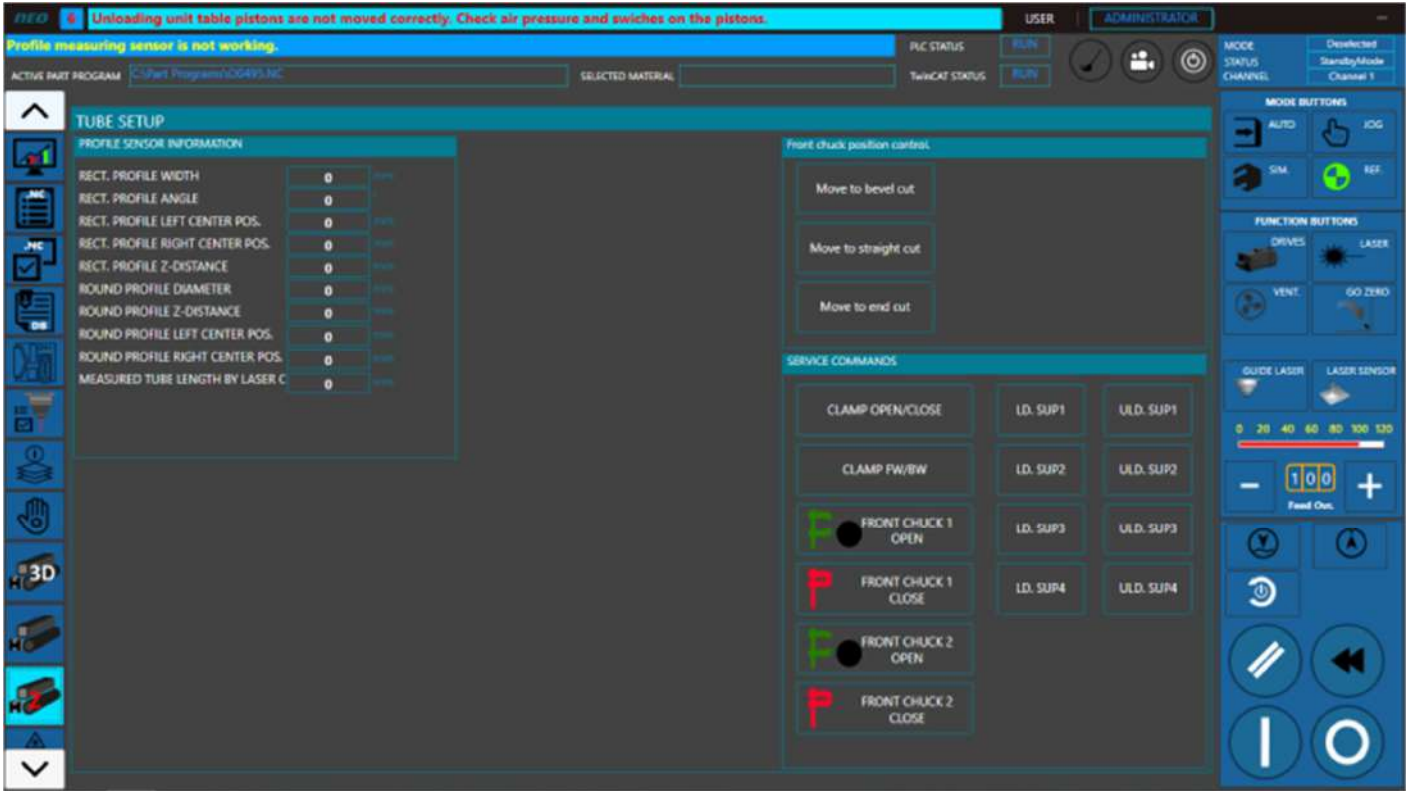
“B” bevel axis in the direction of X.

“T1” the axis which moves the secondary chuck to left and right.

“T2” the axis which moves the unloading table to left and right.



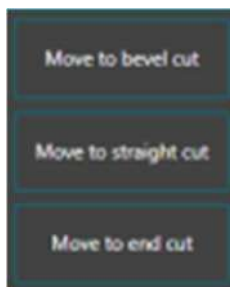
3.r TUBE PAGES 3. TUBE OPERATOR PAGE 2



PROFILE MEASUREMENT SENSOR VALUES

RECT. PROFILE WIDTH	0	mm
RECT. PROFILE ANGLE	0	°
RECT. PROFILE LEFT CENTER POS.	0	mm
RECT. PROFILE RIGHT CENTER POS.	0	mm
RECT. PROFILE Z-DISTANCE	0	mm
ROUND PROFILE DIAMETER	0	mm
ROUND PROFILE Z-DISTANCE	0	mm
ROUND PROFILE LEFT CENTER POS.	0	mm
ROUND PROFILE RIGHT CENTER POS.	0	mm
MEASURED TUBE LENGTH BY LASER C	0	mm

SECONDARY CHUCK AUTOMATIC MOVE CONTROLS



“Move to bevel cut” moves the secondary chuck to bevel cutting position.

“Move to straight cut” moves the secondary chuck to straight cutting position.

“Move to end cut” moves the secondary chuck to end cutting position.

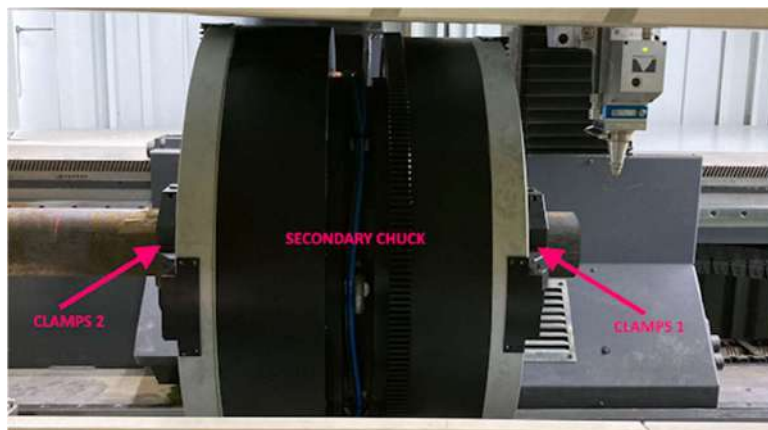
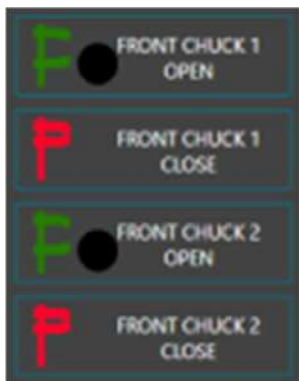
TUBE END CUT PIECE UNLOADING FROM FRONT CHUCK



SECONDARY CHUCK CLAMPS

Clamp 1 shows the clamps in the right (close to the head)

Clamp 2 shows the clamps in the left (close to the main chuck)

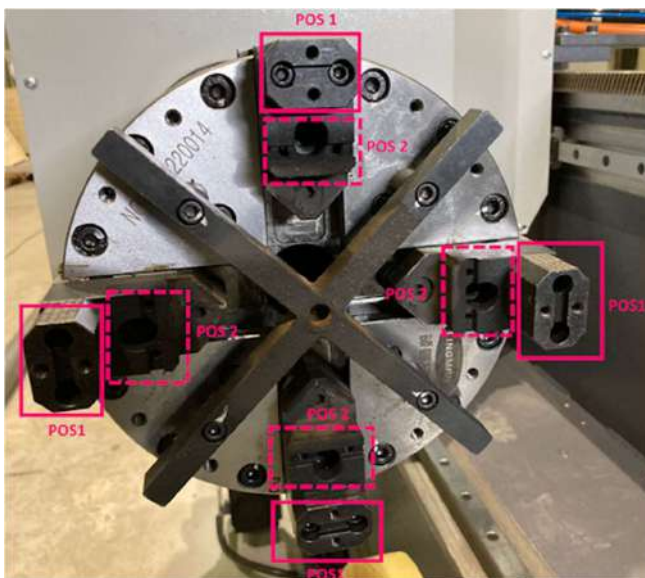


These buttons opens and closes the clamps on the secondary chuck.

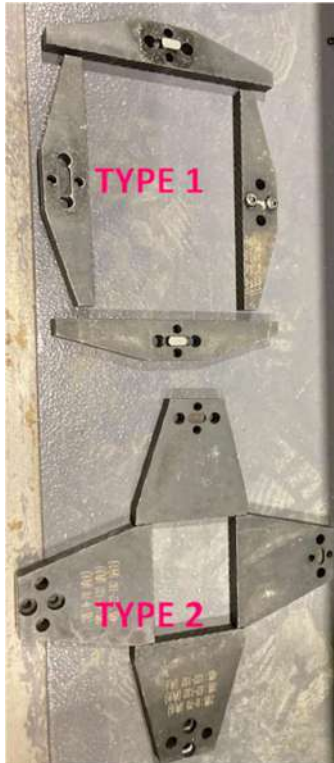
3.t TUBE SETUP BEFORE CUTTING

These buttons opens and closes the clamps on the secondary chuck.

- Check the main chuck clamp holders. The clamp holders have 2 positions.



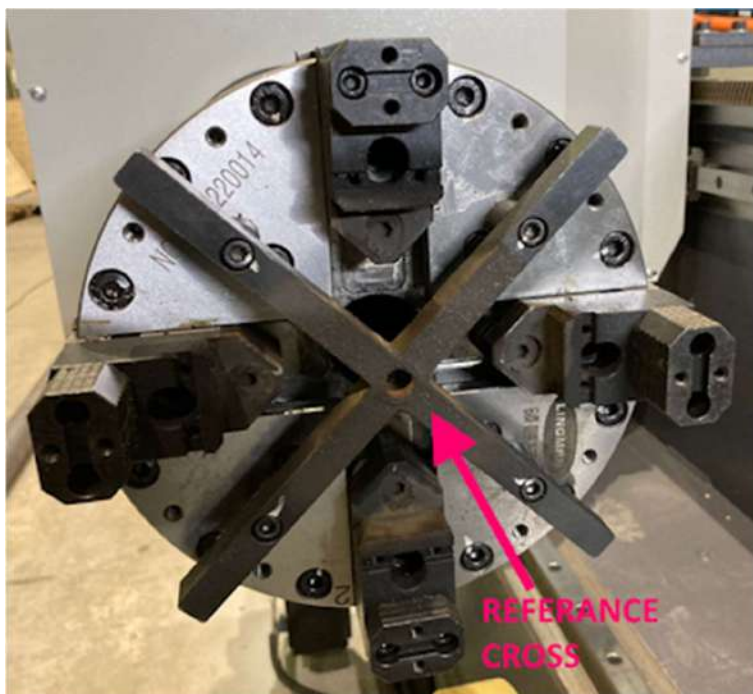
- Find the appropriate clamps for your tube. There are two types of clamps. Type 1 and Type 2.



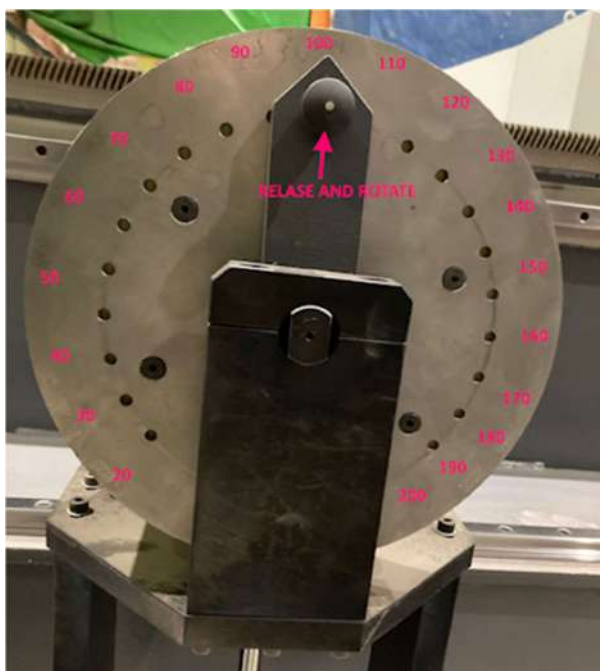
- Use proper combinations of the clamps according to the size and type of the tube.



- Tube end in the main chuck side must be pushed against the reference cross. This is very important. Because this point is our tube reference.



- Adjust the tube cutting supports size according to the tube size and type. If the tube is round tube, support size will be the radius of the tube.
- If the tube is rectangular, support size will be the half of the diagonal distance. For adjustment, release the pin and rotate the support head.



4. MAINTENANCE AND INSPECTION LIST



Please make sure all gases, air and hydraulic systems are completely switched OFF, and depressurized, and all the systems have no power. Also all systems must be Isolated with safety tags by the representative for safety prior to beginning any maintenance!

- The maintenance service only be carried out by trained personnel.
- Complete maintenance training may be offered by Baykal if requested.
- No maintenance should be carried out without all safety requirements in place.

MOTION SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Emergency stop buttons	Inspect visually and test for proper operation	Daily
Front gate safety interlock switch	Inspect visually and test for proper operation	Daily
Automatic lubrication pump	Inspect visually and test for proper operation	Daily
Lubrication points	Inspect visually and test for proper operation	Daily
Axes bellows	Inspect visually and test for proper operation	Daily
X axis linear guideways	Inspect visually and test for proper operation	Weekly
Y axis linear guideways	Inspect visually and test for proper operation	Weekly
Z axis ball screw nut	Inspect visually and test for proper operation	Weekly
Tooted racks and pinions	Inspect visually and test for proper operation	Weekly
Main Chuck Clamps	Inspect visually and test for proper operation	Daily
Secondary Chuck Clamps	Inspect visually and test for proper operation	Daily

TRANSFER SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Scrap bins under palettes	Inspect visually and test for proper operation	Daily
Wheels + rollers and their paths	Inspect visually and clean or replace if required	Daily
Chain system and gears	Inspect visually and lubricate if required	1 month
Grating sheets	Inspect visually and replace if required	3 months

GAS SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Gas regulators and flexible lines	Inspect visually and test for proper operation	Daily
Gas leaks	Inspect visually and fix or replace if required	Daily
Pipes, fittings and connectors	Inspect visually and fix or replace if required	Daily

OPTIC SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
General cleaning	Inspect visually and clean if required	Daily
Protection glass	Inspect visually and replace if required	Daily
Nozzle and ceramic part	Inspect visually and replace if required	Daily
Collimator lens temperature	Inspect visually and report to Baykal Laser department if temperature reaches 50 °C	Hourly
Focusing lens temperature	Inspect visually and report to Baykal Laser department if temperature reaches 50 °C	Hourly
Head housing temperature	Inspect visually and report to Baykal Laser department if temperature reaches 50 °C	Hourly

CHILLER SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Water leaks	Inspect visually and fix or replace if required	Daily

Water level	Inspect visually and fill the tanks if required	Daily
Water quality	Inspect visually and replace if required	6 months

HYDRAULIC SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Oil leaks	Inspect visually and fix or replace if required	Daily
Oil level	Inspect visually and fill the tank if required	Weekly
Oil quality	Inspect visually and replace if required	2 years

VENTILATION SYSTEM	INSPECTION AND ACTION TO BE TAKEN	INTERVAL
Air leaks	Inspect visually and fix or replace if required	Daily
Ventilation covers	Inspect visually and fix if required	Daily
Filters	Inspect visually and replace if required	Daily
Scrap bin	Inspect visually and clean if required	Weekly

5. ELECTRICAL DIAGRAM

Please see the attached documents. Every machine is delivered with electrical diagram.

6. INSTALLATION DIAGRAM

This diagram is given to customer before shipment.

7. INSTALLATION REQUIREMENTS

This diagram is given to customer before shipment.

8. ALARMS, WARNINGS AND INFORMATIONS

ALARMS		
651-2	Tip touch! Press alarm reset to continue	The nozzle touched the plate during cutting. Push the start button to continue cutting. For clearing this alarm, press the clear alarm button in the right side of the alarm window.
651-3	Laser fault. Check laser screen for more information	There is an alarm in the fiber laser source. To see what is the alarm, go to the Laser Menu.
651-4	Nozzle lost. Check nozzle and ceramic part	The nozzle is removed or the ceramic holder is broken or the capacitive sensor cable is broken.
651-5	Cable cut. Check cutting head sensor cable for connection or visual damage.	The capacitive sensor cable is broken.
651-6	Body touch.	The cutting head main body touched or crashed the plate.
651-7	Front door opened	The front door of the machine is opened.
651-8	Distance control. Set position already active	When the head is moving down for piercing, the distance control is active.
651-9	Set1 cutting height is bigger than pierce start height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than piercing height. Please check the first column in the cutting database.
651-10	Set1 cutting height is bigger than pierce finish height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than pierce finish height. Please check the first column in the cutting database.
651-11	Set1 finish height is bigger than pierce start height. Please correct the parameter	Wrong piercing parameter setting. Piercing start height can not be bigger than pierce finish height. Please check the first column in the piercing parameter section in cutting database.
651-12	Set2 cutting height is bigger than pierce start height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than piercing height. Please check the second column in the cutting database.
651-13	Set2 cutting height is bigger than pierce finish height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than pierce finish height. Please check the second column in the cutting database.

651-14	Set2 finish height is bigger than pierce start height. Please correct the parameter	Wrong piercing parameter setting. Piercing start height can not be bigger than pierce finish height. Please check the second column in the piercing parameter section in cutting database.
651-15	Set3 cutting height is bigger than pierce start height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than piercing height. Please check the third column in the cutting database.
651-16	Set3 cutting height is bigger than pierce finish height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than pierce finish height. Please check the third column in the cutting database.
651-17	Set3 finish height is bigger than pierce start height. Please correct the parameter	Wrong piercing parameter setting. Piercing start height can not be bigger than pierce finish height. Please check the third column in the piercing parameter section in cutting database.
651-18	Set4 cutting height is bigger than pierce start height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than piercing height. Please check the fourth column in the cutting database.
651-19	Set4 cutting height is bigger than pierce finish height. Please correct the parameter	Wrong cutting parameter setting. Cutting height can not be bigger than pierce finish height. Please check the fourth column in the cutting database.
651-20	Set4 finish height is bigger than pierce start height. Please correct the parameter	Wrong piercing parameter setting. Piercing start height can not be bigger than pierce finish height. Please check the fourth column in the piercing parameter section in cutting database.
651-21	Back door can not be opened. Check air pressure, valve and switches	Back shuttle table door can not be opened. Check the air pressure. Air pressure must be minimum 6 bar. Check the position sensors on the pneumatic piston moving the door. Check the valve driving the pneumatic piston. Check the electrical wiring against any wear, loose connection.
651-22	Back table is not at upper or lower position. Check upper and lower switches	Back hydraulic table is not at the top or bottom position. The hydraulic system stays the mid position of the pistons or one or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the hydraulic pistons against loosing oil and check the hydraulic pump and motor driving the pump and the electric valves driving the pistons.

651-23	Lower table is not at back position.	The lower table is not at the back position or front (work) position. It may stay at a mid position or one or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the shuttle table motor driving the table forward and backward. Before moving the table forward and backward, hydraulic back table must be at the top position.
651-24	Upper table is not at position	The upper table is not at the back position or front (work) position. It may stay at a mid position or one or some of the sensor are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the shuttle table motor driving the table forward and backward. Before moving the table forward and backward, hydraulic back table must be at the bottom position.
651-25	Upper and lower tables are not in the position	The upper and lower table are not at the back position or front (work) position. They may stay at a mid position or one or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the shuttle table motor driving the table forward and backward. Before moving the table forward and backward, hydraulic back table must be at the bottom position.
651-26	Both tables are at position and there is a table in work position. Possibly switch errors.	One or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any short connection.
651-27	There is no table in the table changer. Check switches and table position	One or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any short connection.

651-28	Ventilation error. Please check filter unit (dust collector)	Turn on the power of the fume extractor. Turn the control switch to the process position on the fume extractor electrical panel. Check the electrical wiring against loose or missing connection.
651-29	Lens or protection glass removed. Laser beam and gas flow blocked	Lens or protection glass removed. The machine can not be started. Insert the lens and protection window. Check the control cable is connected to the cutting head.
651-31	Emergency Stop	One or more emergency stop button is presses. Release all the emergency stop buttons and press the reset button. Safety PLC may be started or safety PLC program may have internal error or one of the safety IO modules are faulty.
651-32	Distance control error. Reset program	Distance sensor has some positioning error. Press reset button to clear the fault and restart program again.
651-33	SetPos error. Tolerance more than 0.2 mm	The cutting head stays at the piercing position but the position is out of acceptable range. Press the start button to continue program.
651-36	Table can not be changed. Light barrier is interrupted. Reset light barrier.	The light safety curtain protecting the back table area is interrupted and table changing is not possible. If this happens during table is changing, the movement will stop.
651-38	Front Door is not locked. Please check the doors	The safety switch locking the front door during table change or cutting is not locked. Check the switch functionality and electrical connections.
651-41	Block search error	Block search can not be executed. Select correct block number in the NC program. Block search must be started from a cutting block, not from the sub-program.

651-42	Set to cut error. Set position error. Reset program	The cutting head can not be positioned to the piercing or cutting height. Internal PLC function error. Reset the program and continue with block search.
651-43	Set to cut error. Retract is active. Reset program	Retracting the cutting head from the sheet and setting the to the sheet run at the same time. Internal PLC function error. Reset the program and continue with block search.
651-45	Mode change not possible. Please stop the program or reset the the machine	Selection jog or automatic mode is not possible when the machine is cutting or executing a program. Reset the program first, then change the machine mode.
651-46	High following tolerance error. Check the ceramic part	Sheet following during cutting can not be done in tolerance. The ceramic holder can be broken or the capacitive sensor is not calibrated or capacitive sensor fault or capacitive sensor cable is broken or loose. Reset the program and check the items above.
651-47	PLC Z Axis error	Z axis movement error. The cutting head may be crashed to the sheet or the head moved to mechanical limits or Z axis servo drive or the motor has fault. Check the servo drive inside the electrical panel and mechanic faults. Press the reset button to clear the error.
651-48	Retract error	Z axis movement error. The cutting head may be crashed to the sheet or the head moved to mechanical limits.
651-52	Critical error. Check log file. Start is blocked. Reset program	System error. Check the log file for details.
651-53	Critical error. Z axis error. Start is blocked. Reset program	System error. Check the log file for details.

651-54	Critical error. Z1 sai axis error. Start is blocked. Reset program	System error. Check the log file for details.
651-55	Inverter fault	The frequency inverter driving the shuttle table motor has an error. Please open the electrical panel and check the error code in the inverter display.
651-56	Inverter fuse off	The circuit braker protecting the frequency inverter driving the shuttle table motor has tripped. Please open the electrical panel and turn it on.
651-57	Light barrier interrupted. Reset the barrier when its safe to do so.	The light safety curtain protecting the back table area is interrupted and table changing is not possible. If this happens during table is changing, the movement will stop. Press the light barrier reset button in back side of the machine.
651-58	Front door opened	The front door of the machine is opened.
651-59	Hydraulic pistons are not in position	Back hydraulic table is not at the top or bottom position. The hydraulic system stays the mid position of the pistons or one or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the hydraulic pistons against loosing oil and check the hydraulic pump and motor driving the pump and the electric valves driving the pistons.
651-60	Hydraulic thermal fuse is off	The circuit braker protecting the hydraulic pump motor has tripped. Please open the electrical panel and turn it on.
651-61	Z axis should be minimum -10 mm position	When changing the shuttle table, Z axis must be at the top position. Retract to the top and start the table changing again.
651-62	Channel is active. Reset the program	Cutting or one of the manual operator functions are active. Press the reset button to continue.

651-63	There is position difference between X1 and X2 axes. Please check drives. In case of repeat error, power cycle the machine.	X-X2 gantry system must have the same axis position in X and X2 axis. This may be a real mechanical difference (one of the axes moved more than other) or one of the axes is not referenced correctly or the PLC can not read the parameter file in the start up.
651-64	Inlet pressure too low. Check the bottles and air inlet pressure.	Cutting gas pressure is dropping. Please check bottles and gas regulators. For high pressure cutting, gas pressure must be set around 30 Bar, for low pressure it must be 12 bar.
651-65	Automatic lens holder error.	Focal position can not be set because of the error in the automatic lens holder system.
651-66	Lens position is bigger than positive limit.	Lens position limit is exceeded.
651-67	Lens position is smaller than negative limit.	Lens position limit is exceeded.
651-68	X hardware limit switch. Emergency stop is activated.	X axis reached the hardware limit switch.
651-69	Y hardware limit switch. Emergency stop is activated.	Y axis reached the hardware limit switch.
651-70	Z hardware limit switch. Emergency stop is activated.	Z axis reached the hardware limit switch.
651-71	Head breakaway switch is triggered. Emergency stop is activated.	Cutting head is not mounted correctly or the head crashed to the plate and the brakable bolts (brass bolts) holding the head are broken or loose. Fix the bolts or change them if necessary.
651-72	Axes are not referenced. Please check drives and power cycle the machine again.	Parameter file can not be read by PLC in start up. Check the parameter file if it exists.
651-73	Z axis error during set to cut.	Z axis can not move. It can be PLC problem, motor problem, servo drive may have a error or the head may have crashed to the plate. Press reset button and continue with block search.
651-74	Z1 axis error during set to cut.	Z1 axis can not move. It can be PLC problem, motor problem, servo drive may have a error or the head may have crashed to the plate. Press reset button and continue with block search.
651-75	High following not off during set to cut.	The head tries to move down for finding the plate but the distance control is on. System error. Press reset button and continue with block search.

651-76	Emergency stop button in transfer panel is pressed.	The emergency stop button in the back side of the machine is pressed. Release the button and then press reset button.
651-77	Emergency stop button in control panel is pressed.	The emergency stop button in the control panel of the machine is pressed. Release the button and then press reset button.
651-78	Emergency stop button in IPG laser is pressed.	The emergency stop button in the IPG laser panel of the machine is pressed. Release the button and then press reset button.
651-79	Incorrect lens. Please insert 5 inch lens.	Incorrect lens holder is inserted. Please remove the current lens holder and insert the correct lens holder.
651-80	Incorrect lens. Please insert 7.5 inch lens.	Incorrect lens holder is inserted. Please remove the current lens holder and insert the correct lens holder.
651-81	Oil level is low. Please top up the oil.	Automatic lubrication system error. Oil tank of the lubrication system is empty.
651-82	Chiller fault. Please check chiller display for more information.	The chiller unit has a fault. Please check the display on the chiller for error code. Stop the running program and shut down the laser.
651-83	Back table not in its position. Check upper and lower limit switches.	Back hydraulic table is not at the top or bottom position or one or both cassettes do not stay at their positions. Check position switches. The hydraulic system stays the mid position of the pistons or one or some of the sensors are faulty or not setted correctly. Check the electrical wiring against any wear, loose connection. Check the hydraulic pistons against losing oil and check the hydraulic pump and motor driving the pump and the electric valves driving the pistons.
651-84	Inverter 1 fault.	This error comes if double inverter system exists in the machine. The frequency inverter driving the shuttle table motor has an error. Please open the electrical panel and check the error code in the inverter display.
651-85	Inverter 1 circuit breaker off.	This error comes if double inverter system exists in the machine. The circuit breaker protecting the frequency inverter driving the shuttle table motor has tripped. Please open the electrical panel and turn it on.
651-86	Inverter 2 fault.	This error comes if double inverter system exists in the machine. The frequency inverter driving the shuttle table motor has an error. Please open the electrical panel and check the error code in the inverter display.

651-87	Inverter 2 circuit breaker off.	This error comes if double inverter system exists in the machine. The circuit breaker protecting the frequency inverter driving the shuttle table motor has tripped. Please open the electrical panel and turn it on.
651-88	Inverter 1 NOT ready.	This warning comes if double inverter system exists in the machine. The frequency inverter driving the shuttle table motor is not ready. Please open the electrical panel and check the error code in the inverter display.
651-89	Inverter 2 NOT ready.	This warning comes if double inverter system exists in the machine. The frequency inverter driving the shuttle table motor is not ready. Please open the electrical panel and check the error code in the inverter display.
651-90	Gas console communication error. Check 24V in the bridge and Ethernet cable to the gas console	PLC can not communicate with the gas control. Check 24V supplying gas unit and the communication cable from the electrical cabinet to the gas unit. Check loose sockets and terminals.
651-91	Festo valve communication error. Check 24V in the valve and Ethernet cable to the valve	PLC can not communicate with the air control block (pneumatic control block). Check 24V supplying gas unit and the communication cable from the electrical cabinet to the gas unit. Check loose sockets and terminals.
651-92	Bridge IO communication error. Check 24V in the bridge and Ethernet cable to the EK1100 in bridge	PLC can not communicate with the IO module on the bridge. Check 24V supplying gas unit and the communication cable from the electrical cabinet to the gas unit. Check loose sockets and terminals.
651-93	Cabinet IO communication error. Check 24V in the cabinet and Ethernet cable to the EK1100 in the cabinet	PLC can not communicate with the IO modules inside electrical cabinet. Check 24V supplying gas unit and the communication cable from the electrical cabinet to the gas unit. Check loose sockets and terminals.
651-94	Work position switch state has changed during changing of the table. Please check switch and table end position.	Work position sensor is faulty or sensor is activated intentionally. Press reset button. Find the fault and change table again.

651-95	Upper table position switch state has changed during changing of the table. Please check switch and table end position.	Upper table position sensor is faulty or sensor is activated intentionally. Press reset button. Find the fault and change table again.
651-96	Lower table position switch state has changed during changing of the table. Please check switch and table end position.	Lower table position sensor is faulty or sensor is activated intentionally. Press reset button. Find the fault and change table again.
651-97	Back table top position switch in the left has changed during changing of the table. Please check switch and back table position.	Top hydraulic position sensor is faulty or sensor is activated intentionally or hydraulic table lost position during table change. Press reset button. Find the fault and change table again.
651-98	Back table top position switch in the right has changed during changing of the table. Please check switch and back table position.	Top hydraulic position sensor is faulty or sensor is activated intentionally or hydraulic table lost position during table change. Press reset button. Find the fault and change table again.
651-99	Back table bottom position switch in the left has changed during changing of the table. Please check switch and back table position.	Bottom hydraulic position sensor is faulty or sensor is activated intentionally or hydraulic table lost position during table change. Press reset button. Find the fault and change table again.
651-100	Back table bottom position switch in the right has changed during changing of the table. Please check switch and back table position.	Bottom hydraulic position sensor is faulty or sensor is activated intentionally or hydraulic table lost position during table change. Press reset button. Find the fault and change table again.
651-111	Z axis target position out of limit.	Commanded Z axis position is out of limit. Z axis will not move. Press reset button and continue with block search.
651-112	Distance sensor signal fault. Check ceramic, sensor and perform the height sensor calibration.	Cutting head distance sensor signal fault. Sensor signal has fluctuations. Reset the program. Please check the ceramic and run the head calibration. If the problem is not solved, call Baykal Service.

651-113	Distance signal sampling error.	Cutting head distance sensor signal fault. Sensor signal has fluctuations. Reset the program. Please check the ceramic and run the head calibration. If the problem is not solved, call Baykal Service.
651-114	ProCutter feedback error. 0mA level is not correct.	ProCutter communication interface is not working. Check the communication cable and check the LEDs on the front face of the cutting head.
651-115	ProCutter feedback error. 20mA level is not correct.	ProCutter communication interface is not working. Check the communication cable and check the LEDs on the front face of the cutting head.
651-116	Filter can not be set.	Axes speed filters can not be set. Reset the program and run the block search.
651-117	No gas pressure. Check the bottles and air connections..	Gas pressure can not be set. Check bottles, regulators, air pressure. Oxygen regulator must be set 11-12 bar, Nitrogen regulator must be set 30 bar, air main regulator must be set minimum 6 bar.
651-118	ProCuter. Protection glass cartridge removed.	Lens cartridge is removed intentionally or sensor is faulty.
651-119	ProCuter. Glass cartridge removed.	Protection window cartridge is removed intentionally or sensor is faulty.
651-120	ProCuter. Protection glass temp exceeded.	Bottom protection window temperature exceeded the upper temperature limit. The glass is dirty or damaged.
651-121	ProCuter. Linear lens drive overloaded..	The motor moving the lens has a fault. Check the interface board inside the electrical cabinet. There are two fuses on this board. Check the fuses and 24V supplying this board.
651-122	ProCuter. Linear lens drive limit.	The lens position reached to mechanical limit. Check the interface board inside the electrical cabinet. There are two fuses on this board. Check the fuses and 24V supplying this board.
651-123	ProCuter. Linear lens drive not referenced.	The motor moving the lens has not been referenced. Check the interface board inside the electrical cabinet. There are two fuses on this board. Check the fuses and 24V supplying this board.

651-124	ProCuter. Linear lens drive voltage error.	The motor moving the lens can not be driven. The supply voltage is low. Check the interface board inside the electrical cabinet. There are two fuses on this board. Check the fuses and 24V supplying this board.
651-125	ProCuter. Collimator temp exceeded.	Collimator temperature exceeded the upper temperature limit. The collimator is dirty or damaged.
651-126	ProCuter. Lens temp exceeded.	Cutting lens temperature exceeded the upper temperature limit. The lens is dirty or damaged.
651-127	ProCuter. Head temp exceeded.	Head body temperature exceeded the upper temperature limit. The temperature sensor is faulty or the head is heated by a external source or by the laser.
651-128	ProCuter. Back reflection error.	Laser reflection from the sheet exceeded the upper limit. This level of reflection can destroy optics, feeding fiber, laser. Please check the cutting parameters and the sheet surface.
651-129	ProCuter. Over cutting pressure.	Cutting pressure is more than 25 bar. Check the cutting parameters or the gas valves.
651-130	ProCuter. Over purge pressure.	Optics room pressure inside the cutting head is more than 0.75 bar. Check the sealing of the bottom protection window. The sealing may leak the gas trough optics room or the pressure sensor measuring optics pressure is faulty.
651-131	Tube cutting. Support axis error.	Tube support axis has an error. Check the servo drive inside electrical cabinet.
651-132	Tube cutting. Support axis init error.	Tube support axis has an error. Check the servo drive inside electrical cabinet.
651-133	Tube cutting. Support axis init error.	Tube support axis has an error. Check the servo drive inside electrical cabinet.
651-134	Tube cutting. Support axis hardware limit switch.	Support axis reached hardware limit switch.
651-135	Tube cutting. Tube changing tool not in its place.	The tool used for clamps on the chuck must be removed from the chuck and place to its holder.
651-136	Tube cutting. Tube table not in its place.	Tube cutting table does not stay at work position.
651-137	Tube cutting. Inverter fault.	The frequency inverter driving the tube table motor has an error. Please open the electrical panel and check the error code in the inverter display.

651-138	Tube cutting. Inverter fuse tripped.	The circuit braker protecting the frequency inverter driving the tube table motor has tripped. Please open the electrical panel and turn it on.
651-139	Tube cutting. Back door motor fuse tripped.	The circuit braker protecting the motor opening the door has tripped. Please open the electrical panel and turn it on.
651-140	Tube cutting. Back door can not be opened. Check the door.	The door is not open. Check the motor or the position switches.
651-142	Laser error. Check laser diagnostic page.	Check the laser page for detailed error information.
651-150	Clamp can not be opened or closed. Check air connection to clamp.	Tube table clamps can not be opened. Check the air pressure or the position sensors.
651-151	Safety IO on the arm is not connected.	PLC can not communicate with the Safety IO module in the bridge. Check the communication and power cable.
651-152	X axis is about to crash to chuck. Please check the NC program. There are minus positions.	X axis (Bridge) has a danger to crash the chuck. Axes movement hold. Reset the program and check the machine parameters.
651-153	X and Z axis is in support region. You can not continue the program.	The cutting head is over the tube support. There is a crash danger to the support. Reset the program and check the machine parameters.
651-154	Support axis reach to zero limit.	Tube support axis stays at support software limit. Reset the program and check the machine parameters.
651-156	Support axis is in the clamping region. You can not continue with automatic support.	The tube support reached to the chuck clamps. Reset the program and check the machine parameters.
651-157	Z axis stop at table limit.	Z axis stays at the vertical table limit. Reset the program and check the machine parameters and the slats against wearing.
651-158	Distance control gain can not be set.	Distance control gains can not be set. Reset the program and continue with block search.
651-159	Drives are not ready. Please wait.	Servo drives are not ready. Open the electrical panel and check the status of the servo drives from the small display on the drives.

651-160	Protection glass temperature exceeds the limit. Change the glass.	Protection window temperature exceeded the threshold value in the setup. Check the protection window. It may be dirty or it may heat up because of high power or the setup value is not correct.
651-161	Cut monitoring detected cutting problems. Check cutting parameters and consumables.	Cut lost is detected by cutting sensor. Check the cutting parameters and restart the program.
651-162	Crash danger to support axis.	Crash danger to the tube support axis. Reset the program and check the machine parameters.
651-163	Automatic loader communication error. Loader and table change will not work.	The machine can not communicate to the loading unit. Check the communication cable, check the loader is powered up or check communication module in loader and in the machine panel.
651-164	Automatic loader is busy. You can not change the table.	Loader is loading or unloading the back table. The transfer table can not be changed.
651-165	Automatic loader is not ready. You can not change the table.	Loader is starting up. The transfer table can not be changed.
651-166	Lubrication pump is not working. Please check the pump.	Check the lubrication system oil tank and pump motor. The motor may not be working.
651-167	Light barrier interrupted. You can not move the support up and down.	The light safety curtain protecting the back table area is interrupted. Press the light barrier reset button in back side of the machine.
651-168	Tables are not in position. You can not move the support up and down.	Both table must be at the back position or one table must be at the back and other one must be at the work position. Check the position of both tables and the position sensor functionality.
651-169	Hydraulic back table must be in down position. You can not move the support up and down.	Hydraulic sheet support can not be moved. Because back table is not at the bottom position. Check the back table position and the position sensors.
651-170	Hydraulic support is already moving.	Hydraulic sheet support is moving. You can not change the table.
651-171	Hydraulic support is not in down position. You can not change the table.	Hydraulic sheet support is not at the down position. Table can not be changed. Move the support down or check the position switches of the hydraulic support.
651-172	Highyag error.	Highyag cutting head has an error. Reset the program.

651-173	Highyag error. Collimation drive error.	Collimation system can not be moved. Focus position can not be set. Reset the program and call the Baykal Service.
651-174	Highyag error. Protection window is dirty.	Protection window is dirty. Change the window.
651-175	Highyag error. Capacitive is not ready.	Capacitive height sensor is not ready. Reset the program. Call the Baykal Service.
651-176	Highyag error. Make calibration again.	Capacitive height sensor must be calibrated first. Reset the program. Run the manual calibration.
651-179	SAI Axis not coupled with Z axis.	Z axis simulation axis can not be coupled with Z axis. Press Reset button.
651-184	Axis parameters can not be loaded. Press reset button.	Axis parameters can not be loaded. Press reset button.
651-185	Position gain write error.	Axis positioning gain can not be set. Press reset button.
651-186	Velocity gain write error.	Axis velocity gain can not be set. Press reset button.
651-195	Tube service mode is active.	Tube cutting machine or combined machine service mode is active. Before cutting the tube, turn the service mode off.
651-196	Pierce detection sensor enabled.	Piercing sensor is active. Piercing will be observed by the sensor.
651-201	Top Protection window temperature limit exceeded. It may be contaminated.	Top protection window may be not clean or temperature limit is not set correctly. Check the top protection window and machine settings.
651-202	Bottom Protection window temperature limit exceeded. It may be contaminated.	Bottom protection window may be not clean or temperature limit is not set correctly. Check the bottom protection window and machine settings.
651-203	Cutting lens temperature limit exceeded. It may be contaminated.	Cutting lens may be not clean or temperature limit is not set correctly. Check the cutting lens and machine settings.
651-204	Collimating lens temperature limit exceeded. It may be contaminated.	Collimating lens may be not clean or temperature limit is not set correctly. Check the collimating lens and machine settings.
651-206	Protection window is leaking gas to the lens cavity. Please check the glass and Teflon O-ring.	Bottom protection window sealing loose the cutting gas to the optics room. Check the sealing.
651-207	Humidity inside the head is too high.	Humidity inside the head is too high. Condensing risk is possible.

651-208	Protection window is removed or glass is not seated well.	Protection window is removed or glass is not seated well.
651-209	Air pressure is low.	Air pressure is dropped or air pressure sensor is faulty.
651-210	Nozzle touched to the plate during set to cut.	Cutting nozzle touched the sheet. Machine movement hold. Run manual head calibration.
651-211	Front and back chuck is not in safe state. They are not coupled or there is a position difference more than 0.5 degree or machine is in service mode.	Tube cutting machine and combined machine. The chuck and front chuck must be coupled and synchronised after tube loading. Without coupling, you can continue to cut.
651-212	Front and back chucks are being coupled. Please wait!	Chuck coupling is active. Wait until the coupling is done.
651-213	Front chuck axis error.	Front chuck axis error. Check the U2 drive display for error code.
651-214	Front chuck absolute movement error.	Front chuck axis error. Check the U2 drive display for error code.
651-215	Front chuck jog movement error.	Front chuck axis error. Check the safety sensors and Check the U2 drive display for error code.
651-216	Front chuck axis is not powered.	U2 axis is off. PLC error.
651-217	Front chuck axis is not enabled.	U2 axis is not enabled. PLC error.
651-219	Laser is switched to safe state because the front door is opened.	Laser is off. Close the front door.
651-220	Edge can not be detected correctly.	Sheet edge detection can not be done. Check the sensor and sensor settings.
651-223	U2 axis position can not be initialized.	Front chuck U2 axis initialisation error. PLC system error.
651-224	Block search error. Program can not be started from selected block.	Block search can not be executed. Selected block number is not correct.
651-239	Tube corner radius can not be smaller than 0.2 mm. Please change	Tube corner must be bigger than 0.2 mm. Check the tube design from the CAM

	corner radius in CAM program.	
651-242	Side point and corner point must be different.	Manual sheet reference. Scew point adjustment error. Selected corner and side point must be different.
651-243	Beam index can not be set. Reset the program.	Setting beam index (mode or BPP) from the laser can not be set correctly. Do not continue to cut. Reset the program and restart again.
651-244	LaserMech Cutting Head. Lens positioning timeout. Lens positioning can not be done in 1.5 sec.	LaserMech Cutting Head. Lens positioning timeout. Lens positioning can not be done in 1.5 sec.
651-245	LaserMech head is not ready.	LaserMech head is not ready.
651-246	LaserMech. Top or bottom protection glass temperature error or glass cartridge is removed.	Window cartridge is removed intentionally or window temperature exceeded the treshold value or treshold setup is not correct or sensor is faulty.
651-247	LaserMech. Lens positioning error.	Lens drive error. Change the cutting head.
651-248	LaserMech. Head communication error. Check cable.	Ethernet-IP communication error. Check the connection cable.
651-249	LaserMech. Lens fault. Check temperature or cartridge.	Lens cartridge is removed intentionally or lens temperature exceeded the treshold value or treshold setup is not correct or sensor is faulty.
651-250	LaserMech. Purge pressure fault.	Optics room pressure inside the cutting head is more than 0.75 bar. Check the sealing of the bottom protection window. The sealing may leak the gas trough optics room or the pressure sensor measuring optics pressure is faulty.
651-251	LaserMech. HSU fault. Nozzle module has broke away.	Distance sensor error. Check the ceramic nozzle holder. It may be broken.
651-252	LaserMech. HSU fault. Tip touched	Nozzle touched to the sheet.
651-253	LaserMech. HSU fault. Nozzle removed or cable cut.	Nozzle is removed or sensor cable fault.

651-254	LaserMech. HSU fault. Curve data error.	Re-calibrate the distance sensor. Run manual head calibration or internal error.
651-255	LaserMech. HSU fault. Invalid curve number.	Internal PLC or cutting head error.
651-256	LaserMech. HSU fault. Set curve failed.	Internal PLC or cutting head error.
651-269	Precitec calibration error during calibration active. Repeat the calibration again.	Distance sensor calibration can not be finished correctly. Check the ceramic holder and the calibration plate. Repeat the calibration again.
651-270	Table can not be changed automatically. Try manual change.	Transfer table must be changed manually. The table status does not let automatic change. Change the table manually.
651-271	Hydraulic lost upper position.	Hydraulic back table top position is lost when changing table. Reset the table change and check the position sensors.
651-272	Hydraulic lost lower position.	Hydraulic back table bottom position is lost when changing table. Reset the table change and check the position sensors.
651-273	Upper table lost position.	Upper table is lost the position when changing table. Reset the table change and check the position sensors.
651-274	Lower table lost position.	Upper table is lost the position when changing table. Reset the table change and check the position sensors.
651-276	There is no plate under the cutting head.	Z axis table position is not set correctly in the machine settings or slats (grids) weared and table Z axis position changed.
651-277	Side door is opened. Close the door to continue cutting.	Side door is opened. Close the door to continue cutting.
651-278	Crash Danger!!!. Head is too close to the chuck.	The cutting head will crash to the chuck if the continue to cut. Reset the program and check the settings.
651-279	Crash Danger!!!. Head is too close to the tube support.	The cutting head will crash to the tube support if the continue to cut. Reset the program and check the settings.
651-280	Support in park position. Parameter error. Probably support axis not referenced correctly.	Parameter setting error.
651-281	Cutting with support end limit overrun. Support must be in automatic. Selection error.	Parameter setting error.

651-282	Support end limit overrun. Support must be in automatic. Selection error.	Parameter setting error.
651-283	Head stays over support region. Support must be in automatic. Selection error.	Parameter setting error.
651-284	Support must be in automatic. Selection error.	Parameter setting error.
651-285	Support must be in automatic. Selection error.	Parameter setting error.
651-286	Head jumps over support. Crash danger.	Machine hold. There is a crash danger to the tube support.
651-287	Head jumps over support. Crash danger.	Machine hold. There is a crash danger to the tube support.
651-288	Support axis position can not be initialized after coupling off.	PLC error. Press reset button and continue with block search.
651-289	System error. The error can not be solved. Please restart the machine.	System error. The error can not be solved. Please restart the machine.
651-290	Light Cutter Error. System not referenced or Linear focus drive error.	Light cutter has an error. Power off and power on the machine. If the error is still pending, call the Baykal service.
651-291	Support stays at the limit. Limit positions are 80 mm and 2900 mm. Please move the support in jog mode.	Tube support axis reached to the software limit.
651-293	IPG Laser Interlock	Laser is shut down by a laser interlock. The machine door is opened or there is an internal error in the laser.
651-294	IPG Laser Chiller Error. Check chiller display for more information.	IPG chiller error. Check the chiller display.
651-296	IPG Laser Safety Open	Laser internal safety is not reset or safety circuit prevent the laser power supply from turning on.

651-297	IPG Laser Channel Error	Laser internal error. Check the laser page for details.
651-298	IPG Laser Slot Error	Laser internal error. Check the laser page for details.
651-299	IPG Laser cabinet is Open	Laser covers are opened. This will prevent the laser power supply from turning on.
651-335	IPG Laser Reserved Module Active	One of the laser modules is faulty. Reserved module is active.
651-336	IPG Laser Reduced Module Active	Laser module power reduced. Maximum power can not be delivered.
651-337	IPG Laser High Back Reflection	High back reflection from the plate. Check the cutting parameters.
651-340	Cutting Head is not calibrated.	Calibrate the distance sensor manually. Otherwise the machine will calibrate it automatically after the first program start.
651-341	Raytools head calibration error. Distance signal is bigger than next signal.	Calibration signal problem. One or more distance sampling signal is not correct. Check the ceramic holder, signal cable and cable connector.
651-342	Raytools head calibration error. Distance signal is zero.	Calibration signal problem. One or more distance sampling signal is not correct. Check the ceramic holder, signal cable and cable connector.
651-343	Pressure calibration is not correct. Repeat the gas calibration again.	Gas pressure calibration can not be done.
651-344	Pressure calibration is active. Please wait.	Gas pressure calibration is active and wait for it is done correctly.
651-345	Focus can not be set. Check cutting head, Yaskawa drive, cables and analog IOs.	Focus can not be set. Check cutting head, Yaskawa drive, cables and analog IOs.
651-346	Linear motor chiller fault.	Small chiller for the linear motors has an error. Check the display of the chiller.
651-347	Laser ethercat connection fault. You can not run the laser.	Check the ethercat cable and check the laser is on.
651-348	Analog pressure calibration is not correct. Check the Nitrogen bottle and pressure. Pressure must be 29 bar.	All pressure sensor calibration points must be done correctly. Nitrogen regulator must be set to minimum 29 bar.
651-349	Analog pressure calibration is not correct. Check the pressure steps you entered.	All the pressure steps must be done.

INFORMATION					
651-1	Height sensor calibration is active	Cutting head distance sensor calibration program is running. Do not interrupt the program.			
651-275	SERVO DRIVES ARE OFF.	Servo drives are off. Turn the drives on.			
652-1	Check head and press start to return contour.	This information appears after pressing manual head check button.			
652-2	Waiting for gas pressure in tolerance.	Machine waits for gas pressure to be stable in a pre-defined pressure tolerans window.			
652-3	Tip-Touch restart is active. Resuming the part program from interrupted point.	Automatic restart after tip-touch is active. Machine will start in a few seconds.			
652-38	Press START button to run block search. Front door must be closed.	For starting block search, close the door and press start button.			
652-39	Press START button to return to contour.	After block search, press start button to continue from the contour.			
652-40	Press Block Search Button to cancel block search and Press START button to begin cutting.	After block search, press start button to continue to cut.			
652-41	PREPIERCE ENDED. CLEAN THE PLATE AND PRESS START BUTTON	Prepierce ended. Machine holded. Clean the sheet surface and press start button to continue.			
652-42	HOLD AT CONTOUR END	Stop at the contour end function is active. Press start button to continue.			
652-43	PIERCE TYPE-3 ACTIVE BUT ADVANCED PARAMETER SET IS NOT ENABLED. PIERCING AS TYPE-2 INSTEAD	PIERCE TYPE-3 is selected but advanced parameter set is not enabled. So type-3 piercing will not work.			
652-44	CHECKING 8 MM POSITION	Distance calibration. The head stays 8 mm above the calibration plate and check the distance sensor reading.			
652-45	8 MM IS OK	Distance calibration. The head stays 8 mm above the calibration plate and the sensor reads exactly 8 mm.			
652-46	CALIBRATION ERROR. RESET THE PROGRAM AND PERFORM FULL CALIBRATION	Distance calibration. NC program message. The distance sensor can not be calibrated because of pending errors.			
652-47	CHECKING 4 MM POSITION	Distance calibration. The head stays 4 mm above the calibration plate and check the distance sensor reading.			

652-48	4 MM IS OK	Distance calibration. The head stays 4 mm above the calibration plate and the sensor reads exactly 4 mm.
652-49	CHECKING 1 MM POSITION	Distance calibration. The head stays 1 mm above the calibration plate and check the distance sensor reading.
652-50	1 MM IS OK	Distance calibration. The head stays 1 mm above the calibration plate and the sensor reads exactly 1 mm.
652-51	RETURNING TO THE PART PROGRAM	Machine returns to part program to continue cutting.
652-52	EDGE DETECT ACTIVE	Edge detection is active. Machine is trying to find 3 edges of the sheet.
652-53	HEAD OFF THE SHEET. PRESS RESET AND TAKE TO THE LASER SENSOR OVER THE SHEET	Laser edge detection sensor does not sense the sheet. Move the head over the sheet and see the red spot of laser sensor on the sheet. Then press start button.
652-54	FINDING FIRST POINT	Edge detection function is finding the first side.
652-55	FINDING SECOND POINT	Edge detection function is finding the second side.
652-56	FINDING THIRD POINT	Edge detection function is finding the last side.
652-57	CALCULATING ZERO POINT AND ROTATION	Edge detection function is calculating the sheet zero position and sheet rotation angle.
652-58	CALCULATING ZERO POINT AND ROTATION	Edge detection function is calculating the sheet zero position and sheet rotation angle.
652-59	GAS PURGING IN PROGRESS	Gas purging is in progress. Program will start in 3 seconds.
652-60	HOLD AT PART END	Program holded at the part end. Stop at part end function is active.
652-61	PRESS START TO CONTINUE	PRESS START TO CONTINUE
652-62	CALIBRATION STARTING	Distance sensor calibration is starting.
652-63	PLEASE TOUCH THE NOZZLE TIP TO CHECK IF TIP TOUCH IS WORKING	Touch the nozzle tip to test if tip-touch sensing is working
652-64	TIP TOUCH SUCCESFULL. CONTINUE PROGRAM WITH NC START	Tip-touch function is working fine.

652-65	!!!!!! WARNING !!!!! MOTOR POSITION IS MECHANICALLY CHANGED. PLEASE REFERENCE THE Z AXIS AGAIN	Distance calibration plate position is changed. Machine is started first time or Z reference position changed.
652-66	MOVING TO MINIMUM POS	HighYag distance sensor calibration. Head moved to the first calibration point.
652-67	MOVING TO 2.POS	HighYag distance sensor calibration. Head moved to the 2. calibration point.
652-68	MOVING TO 3.POS	HighYag distance sensor calibration. Head moved to the 3. calibration point.
652-69	MOVING TO 4.POS	HighYag distance sensor calibration. Head moved to the 4. calibration point.
652-70	MOVING TO 5.POS	HighYag distance sensor calibration. Head moved to the 5. calibration point.
652-71	MOVING TO 6.POS	HighYag distance sensor calibration. Head moved to the 6. calibration point.
652-72	MOVING TO 7.POS	HighYag distance sensor calibration. Head moved to the 7. calibration point.
652-73	MOVING TO 8.POS	HighYag distance sensor calibration. Head moved to the 8. calibration point.
652-74	MOVING TO 9.POS	HighYag distance sensor calibration. Head moved to the 9. calibration point.
652-75	MOVING TO 10.POS	HighYag distance sensor calibration. Head moved to the 10. calibration point.
652-76	MOVING TO 11.POS	HighYag distance sensor calibration. Head moved to the 11. calibration point.
652-77	MOVING TO 12.POS	HighYag distance sensor calibration. Head moved to the 12. calibration point.
652-78	MOVING TO 13.POS	HighYag distance sensor calibration. Head moved to the 13. calibration point.
652-79	MOVING TO 14.POS	HighYag distance sensor calibration. Head moved to the 14. calibration point.
652-80	MOVING TO 15.POS	HighYag distance sensor calibration. Head moved to the 15. calibration point.
652-81	MOVING TO 16.POS	HighYag distance sensor calibration. Head moved to the 16. calibration point.
652-82	MOVING TO NOZZLE DETECTION POS.	HighYag distance sensor calibration. Head moved to the nozzle lost programming point.
652-83	MOVING TO FAR POS.	HighYag distance sensor calibration. Head moved to the far signal programming point.
652-84	MOVING TO CLOSE POS.	HighYag distance sensor calibration. Head moved to the close signal programming point.

652-85	CHECKING 15 MM POSITION	Head moved to 15 mm above the calibration plate and measuring the height with the distance sensor.
652-86	15 MM IS OK	Distance sensor measured 15 mm height correctly.
652-87	CALIBRATION ERROR. CALIBRATION START AGAIN	Distance sensor calibration error. Look for the errors and repeat the calibration again.
652-88	RETURN TO PROGRAM?	If the existing part program will be continued, press start button.
652-89	RETURNING TO THE PART PROGRAM	Returning the existing part program.
652-90	NOZZLE LOST PROGRAMMED	Head sensor calibration. Nozzle lost function is programmed.
652-91	NOZZLE LOST ERROR	Nozzle lost function can not programmed. Look for errors.
652-92	FINISHED. CALIBRATION SUCCESSFUL	Head sensor calibration finished successfully.
652-93	CALIBRATION ERROR	Head calibration can not be done. Look for errors.
652-94	CALIBRATION ERROR. AUTOMATIC CALIBRATION ACTIVE	Head calibration can not be done. Look for errors.
652-95	PLEASE STICK PAPER TAPE AND PRESS START TO FIRE. IF IT IS NOT IN AUTO MODE, PLEASE SELECT AUTO MODE.	Nozzle centering function. Stick paper tape to the nozzle and press button. Door must be closed and machine must be in automatic mode.
652-96	PLEASE CHECK THE TAPE. IF IT IS OK!, PRESS RETURN PROGRAM BUTTON TO CONTINUE OR PRESS RESET TO EXIT COMPLETELY	Nozzle centering function. Check the paper tape. If the laser shut spot is in the center, press RETURN PROGRAM button.
652-97	PRESS START TO CHECK THE NOZZLE AGAIN	PRESS START TO CHECK THE NOZZLE AGAIN
652-98	SINGLE POINT CALIBRATION IS ACTIVE	Precitec distance sensor calibration. Sensing point (20 mm) calibration is in progress.
652-99	PROGRAMMING NOZZLE LOST	Head sensor calibration. Nozzle lost function programming is in progress.
652-100	NOZZLE LOST PROGRAMMED	Head sensor calibration. Nozzle lost function is programmed.
652-101	NOZZLE LOST ERROR	Nozzle lost function can not programmed. Look for errors.
652-102	CALIBRATION ERROR	Head calibration can not be done. Look for errors.
652-103	CALIBRATION STARTED	Distance sensor calibration is in progress.

652-104	SIMULATION MODE ACTIVE. PLEASE RESET THE PROGRAM. SWITCH OFF THE SIMULATION AND RESTART THE PROGRAM	Simulation is active. All machine functions except axes movement are blocked.
652-105	BLOCK SEARCH IS STARTED. WAIT FOR THE NEXT MESSAGE	Block search has started. Waiting for the next step.
652-106	BLOCK SEARCH IS FINISHED. MACHINE IS RETURNING TO THE CONTOUR	Block search has finished. Cutting will start in a few seconds.
652-107	WAITING FOR HIGH FOLLOWING OFF	Distance control (sheet following) is active. Machine tries to turn it off.
652-108	CHANNEL NOT INITIALIZED. RESET THE PROGRAM AND PERFORM BLOCK SEARCH	Press reset button and continue with block search.
652-109	START AND END POSITIONS ARE THE SAME	Trimming. Selected start point and end point are the same. Trimming function will not run.
652-110	PLEASE SELECT START AND END POSITIONS	Trimming. Start or end point or both points are not selected. Trimming function will not run.
652-111	ERROR. SUPPORT AXIS IS NOT IN POSITION. CRASH DANGER	Tube support axis error. Reset the part program.
652-112	TARGET POSITION IS ON THE SUPPORT REGION. CHANGE THE SUPPORT POSITION	Next contour position is inside the support region. Reset the program.
652-113	HOLD AT CONTOUR END	Stop at the contour end function is active. Press start button to continue.
652-114	7.5 DEGREE CALIBRATION STARTED	7.5 degree distance sensor calibration is in progress.
652-115	15 DEGREE CALIBRATION STARTED	15 degree distance sensor calibration is in progress.
652-116	22.5 DEGREE CALIBRATION STARTED	22.5 degree distance sensor calibration is in progress.
652-117	30 DEGREE CALIBRATION STARTED	30 degree distance sensor calibration is in progress.
652-118	37.5 DEGREE CALIBRATION STARTED	37.5 degree distance sensor calibration is in progress.
652-119	45 DEGREE CALIBRATION STARTED	45 degree distance sensor calibration is in progress.

WARNING

651-44	Drives are off. Please run the drives	Servo drives are turned off or not turned on. For axes movement, turn on the drives.
651-50	Power ramping min power is bigger than cutting power. Please change the parameter	Check the power ramping parameters under the cutting parameters tab. Minimum power must be smaller than the cutting laser power set in cutting parameters.
651-51	Power ramping min feed is bigger than Power ramping max feed. Please change the parameter	Check the power ramping parameters under the cutting parameters tab. Minimum speed must be smaller than the cutting speed set in cutting parameters.
651-141	Laser interlock. Laser is switched off or door opened or emergency stop button on laser pressed or chiller error or fiber interlock.	Laser is switched off or door opened or emergency stop button on laser pressed or chiller error or fiber interlock.
651-155	Tube length is smaller than 1100 mm. Cancel automatic tube support. Otherwise tube may fall down.	Automatic tube support axis can be used for the tubes bigger than 1100 mm
651-292	IPG Laser warning	There is a warning the laser. Check the laser page.
651-295	IPG Laser Chiller Warning	Chiller has a warning. This warning does not interrupt the laser.
651-338	IPG Laser Module Power Supply Warning	Power supply warning.
651-339	Aiming Laser (RDL) is ON. You can not run the laser. Shut down aiming laser (RDL) first then try again.	Red laser is on. When the automatic mode is selected, the aiming laser will be turned off. This laser is on only in jog mode.
653-1	Inlet pressure is in the lower limit. Bottles are getting empty or air pressure dropping	Gas is running out or gas regulator is not adjusted correctly. Nitrogen regulator must be adjusted to 30 bar and oxygen regulator must be adjusted to 12 bar.

653-2	Auto or Manual table change in progress.	Table change is in progress.
653-3	Air pressure is low. Start is blocked	Check the air inlet and air regulator pressure. Air pressure must be 6-8 bar.
653-4	Table auto change from NC program	Automatic table change at the end of part program is in progress.
653-5	Auto start active. Machine will start in 10 seconds. Operator is responsible for correct sheet position and machine-human safety	Automatic start after table change is in progress.
653-6	Feed override is zero. Axis movement is blocked.	Feed override is zero. Axis movement is blocked.
653-7	Block search must be done in auto mode. Please select AUTO mode and reset the channel.	Block search must be done in auto mode. Please select AUTO mode and reset the channel.
653-8	Door is open. Please close the door before start.	Door is open. Please close the door before start.
653-9	Z axis brake is off. Please power up machine again.	Z axis brake is turned off intentionally. Power off and on the machine.
653-10	Starting region control.	Tube cutting automatic support crash control is starting.
653-11	Region control started.	Tube cutting automatic support observes support region against any crash.
653-12	Stopping region control.	Automatic support control is not active.

653-13	Tube changing active.	Tube loading or unloading is in progress.
653-14	RESUMING THE PROGRAM...	Restarting the program. This warning will appear after block search.
653-15	CALCULATING THE BLOCK...	Calculating restarting block before block search.
653-16	RETURNING THE CONTOUR...	Returning the contour after block search.
653-17	STARTING...	Start cutting after block search.
653-18	BLOCK CALCULATION ERROR. RESET THE PROGRAM AND PERFORM BLOCK SEARCH.	Block search can not be run. Starting point can not be calculated. Block search function only runs for G0, G1, G2 and G3 NC blocks.
653-19	BLOCK SEARCH ERROR. RESET THE PROGRAM AND PERFORM BLOCK SEARCH FROM ANOTHER POINT.	Block search can not be run. Starting point can not be calculated. Block search function only runs for G0, G1, G2 and G3 NC blocks.
653-20	MANUAL FIXTURE REFERANCING IS ACTIVE. YOUR PROGRAM WILL BE ROTATED AS MUCH AS GIVEN ANGLE.	Manual sheet referancing is active. Sheet zero position and the sheet angle will be the values given in HMI.
653-21	MANUAL PLATE REFERANCING IS ACTIVE.PLATE STARTING POINT AND ANGLE WILL BE CHANGED.	Manual sheet referancing is active. Sheet zero position and the sheet angle will be the values given in HMI.
653-22	Loading-Unloading active.	Loading-Unloading unit is busy. Shuttle table can not be changed.

653-23	ANALOG GAS CALIBRATION OK.	Gas valve pressure sensor calibration has been done correctly.
653-124	GAS PRESSURE IS TOO LOW.	Gas pressure too low because the gas is running out or the pressure regulator is not adjusted correctly.
653-25		

AUTOMATIC LOADING ALARMS

Error Code	Message	Reason	Remedy
300 - BLY	Sheet number on cassette is 0	- There is no sheet on the cassette - Sheet numbers are not correct on the HMI screen.	- Put sheet to cassette before operation - Check Sheet numbers on the cassette and correct it on the HMI screen.
301 - BLY	Holding pistons are not lifted up	- There can be delay to reach up due to low air pressure - Check if there is any physical problem cause piston not to move up - If all pistons physically reached to top position check the sensor of the piston which is not detected	- Press BLY reset button and try to continue operation - Correct the physical problem - Align or change not detecting sensor
302 - BLY	Sheet not detected on the pistons	There is no sheet on the vacuum pads	- Sheet couldn't have taken or dropped - Sheet is not correctly placed under vacuum pads

		2. If There is sheet on the pistons sensor is not detecting the sheet	b. Sheet dimension is not correct, vacuum is depend on the sheet size, check and correct the sheet size on the HMI screen c. There is problem on the vacuums, check the vacuum system 2. Check ultrasonic sensor a. If sensor is not detecting the sheet sensor needs realignment b. If sensor is detecting check signal cable for damage
303 - BLY	Shuttle table is not ready	1. Laser machine is changing table 2. tables are not detected on the end	1. Wait until shuttle table change finish before start operation 2. Check Laser machine shuttle table positions and sensors
304 - BLY	Sheet is not released from vacuum pads	1. There is no sheet on the vacuum pads 2. If There is sheet on the pistons sensor is not detecting the sheet	1. a. Sheet may be dropped with a delay , push BLY reset and try to continue operation b. If Ultrasonic sensor is detecting the sheet sensor needs realignment 2. Check vacuum system in on and off state

305 - BLY	Combs Wrong movement direction command : + and - movement direction	1. + , - direction buttons pressed together 2. Electrical problem for +, - buttons inputs	1. Use only one direction button 2. Check direction button wiring and inputs
306 - BLY	Combs Inverter fault.		1. Press BLY reset button and try to continue operation 2. Check "Combs" Inverter for fault
307 – BLY	Combs Inverter power supply fault.		Check "combs" inverter electric supply and thermic
308 – BLY	Combs Complete Wrong movement direction command : + and - movement direction	1. + , - direction buttons pressed together 2. Electrical problem for +, - buttons inputs	1. Use only one direction button 2. Check direction button wiring and inputs
309 – BLY	Combs Complete Inverter fault.		1. Press BLY reset button and try to continue operation 2. Check "Combs Complete" Inverter for fault
310 – BLY	Combs Complete Inverter power supply fault.		Check "Combs Complete" inverter electric supply and thermic
311 – BLY	Cassette Wrong movement direction command : + and - movement direction	3. + , - direction buttons pressed together 4. Electrical problem for +, - buttons inputs	1. Use only one direction button 2. Check direction button wiring and inputs
312 – BLY	Cassette Inverter fault.		1. Press BLY reset button and try to continue operation

			2. Check "Cassette" Inverter for fault
313 – BLY	Cassette Inverter power supply fault.		Check "Cassette" inverter electric supply and thermic
314 - BLY	BLY-Z axis error	Axis Error	1. Press BLY reset button and try to continue operation 2. Stop drives then start drives again on BLY 3. Restart machine
315 - BLY	Combs complete is not in front position	1. "Combs complete" is not in front position 2. "Combs complete" is in front position but sensor is not detecting	1. Move "Combs complete" to front position before operation 2. Check "Combs Complete in front" sensor alignment and signal input for this sensor
316 - BLY	Scrap cassette should be in back position to open combs	1. "Scrap cassette" is not in back position 2. "Scrap cassette" is in back position but sensor is not detecting	1. Move "Combs complete" to front position before operation 2. Check "Scrap cassette in back" sensor alignment and signal input for this sensor
317 - BLY	BLY-Z axis position is not in safe position to open combs	Combs can not be opened while BLY-Z axis is below safe position to prevent crashes	Move BLY-Z axis to safe position firstly.
318 – BLY	BLY-Z axis is not in safe position	BLY-Z axis should be in safe position for operation	Move BLY-Z axis to safe position firstly.
319 – BLY	Table can not move while pistons have not reached the upper position	1. Pistons are down 2. If all pistons are top position check the sensor of the piston which is not detected	1. Move the pistons up 2. Align or change not detecting sensor
320 - BLY		1. Cassette is not in back position	1. BLY- Z axis is not allowed to go down furdur to prevent crash

	BLY-Z axis can not move below scrap release position while cassette is not in back position.	2. Cassette is in back position	2. Sensor is not detecting the cassette, check sensor alignment and signal incheck signal
321 – BLY	Axes are not safe for Z axis movement, Comb assembly should be in front and cassette should be back.		Move Comb Complete to front and Cassette to back position firtsly to able to move BLY-Z axis down
322 – BLY	Button panel axis selection key problem	More than one axis selection inputs are coming from axis selection key	Check wire and connections of axis selection key
323 – BLY	BLY-Z axis not referenced	Axis referencing is not correctly completed	Restart Laser machine while power is on on the BLY.
324 – BLY	BLY is locked from button panel. Not possible to move	Lock button is activated on button panel.	Pres on the Lock button again to allow operation of BLY
325 – BLY	Light guard is not reset from BLY	Light guard is interrupted on BLY	Press on Light Guard Reset button on button panel.
326 - Tower	Cassette number is not defined or Cassette number is 0.		Define sheet cassette and scrap cassette numbers On Shuttle table page

