

Operating Manual

BLS-NEO 1530

Fiber Laser Cutting Machine



Serial Number of the Machine: 24154

1. INTRODUCTION

The BLS-NEO 3015 Fiber Laser Cutting Machine is produced two-dimensional contoured shapes from flat material by moving a focused beam of infrared light along a programmed path. The system is a *flying-optics* design that is the laser beam from a fixed laser resonator is directed by feeding fiber cable to a focusing lens, which is moved over a stationary workpiece. Material is removed where the lens concentrates the laser power into a small spot on the material to be cut. Different gases are also emitted with the focused beam from the cutting nozzle; these are used to control the cutting process.

A CNC (Computer Numerical Control) is used to control the servo drives, which turn position of the gantry and the lens to produce the programmed shape. The CNC program is provided by the user. The user is also responsible for the provision of the extraction system, this is connected to the laser system's exhaust ducts and is used to draw air down from the cutting area to assist in the removal of by-products from the cutting process.

The Laser resonator is a fiber laser. It is not required a supply of high purity compressed gases (mixture of helium, carbon dioxide and nitrogen gases) and a connection to clean dry compressed air for purging the beam to cutting lens comparing with *fast axial flow CO₂*. Fiber laser is a maintenance-free, low power consumption and gasless laser unit. The electrical energy is converted a laser beam into the unit which is produced heat. This heat is removed from the system by distilled water which is cooled by a water cooling chiller unit continuously.

1.1 PART QUALITY

BLS-NEO Fiber Laser Cutting Systems is a rugged design and construction. However the quality of the parts produced can be reduced by improper adjustment or lack of maintenance. The laser cutting process is depended on the combination of a laser beam of uniform intensity and adequate power, properly focused on the workpiece with an adequate supply of the correct cutting gas, traveling at a speed that compatible with the removal rate of material. Factors, which influence part quality are:

- 1.1.1 Machine Condition:** Uniform beam quality and power level are most influenced by cleanliness of the optical elements (collimator and focusing lenses, protection glass e.g.). While all the optical elements of the system are protected with good housekeeping and adequate fume extraction along with correct maintenance also play a part in consistent performance of the system.
- 1.1.2 Setup and Programming:** BLS-NEO Fiber Laser Cutting System is employed an easy to use material database within the CNC to store all machine controlled cutting parameters. The CNC's ability to set the majority of cutting parameters greatly is enhanced the system's ability to produce consistent high quality results. But care should still be taken during part programming to determine cut direction, part sequence, part position within the sheet, lead-in length and position, as well as selecting the correct material and cut type. The using of servo motors to control the motion of the cutting system is allowed the position of the cutting head to be very accurately controlled, but overall part accuracy is depended on the correct use of cut width (Kerf = Tool Radius) compensation command rate within the CNC program.
- 1.1.3 Type and Quality of the Material:** The material quality is affected to cut part quality directly. The variations in the repeatability of process cutting parameters will be minimized if the material that has a uniform composition, a smooth clean rust free surface.

1.1.4 Operator Ability: There are 3 manual adjustments that must be correctly and perpetually set to achieve consistent high quality cuts:

- Beam centering
- Protection glass cleaning
- Correct nozzle, gas and parameter using



IMPORTANT NOTE: All operators should be familiar with the procedure to determine and correctly set above mentioned points!

1.2 GAS REQUIREMENTS

Cutting gas is entered the cutting head of the laser below the protection glass and above the cutting nozzle as shown theoretically **Figure 1**. The cutting gas is chemically or mechanically cut the metal producing a kerf. Kerf (Tool radius) is the melted space generated by laser beam and cutting pressure on the surface of the metal. The cutting gas may be air, oxygen or nitrogen. The purpose is to supply a gas clean enough to keep cutting and not shorten the life of the protection glass and the focusing lens. The final workpiece is also needed to have a minimal amount of unexpected angularity.

The metals most commonly cut by using laser beams are aluminium, brass, copper, galvanized, mild/carbon and stainless steels. Each of these metals are reacted differently to the chemistry of the cutting gas.

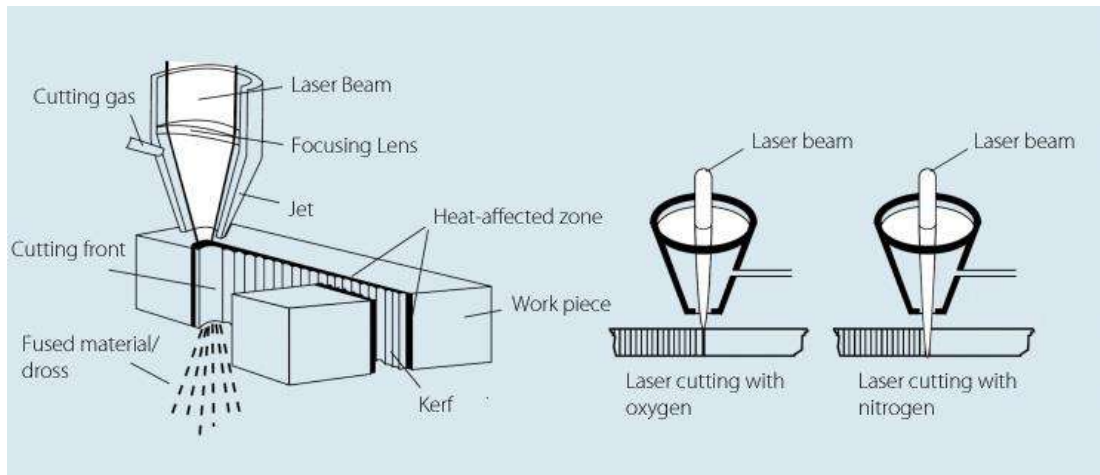


Figure 1

> Air (Low pressure up to 6 bar)

Air is used to cut aluminium, brass stainless steel, some thinner sections of mild steel and it is frequently used to cut galvanized steel as well. Typically, air pressure from a compressor is limited to about 5 bar, which means is limited for cutting thickness. Stainless steels are cut poorly with air, because the oxygen is attacked the chromium and nickel in the alloy to form oxides that might be reduced the corrosion resistance of the metal near the cut.

The air is used to cut any metal must have maximum purity. Of course, the air is a mixture of oxygen and nitrogen. In shops, it is frequently produced using an air compressor. Compressed air has excessive water and oil which can dirty the protection glass. This contamination is reduced total energy carried by the laser and

defect the focused spot quality which have a critical role in laser cutting. It is also limited the amount of energy passing through the protection glass, which is contributed to glass overheating and breakage. In general, protection glass breakage may be caused lens breakage and in some cases collimating lens breakage. Untreated compressed air may also be caused this to occur within a few minutes/hours, depending on the season, company location, and your compressed air system.

To clean and oil-free air a refrigeration type air dryer to reduce the water and micron level active carbon filters to reduce oil content of the air. Water content is dropped from a high limit of 20000 parts per million (ppm) to 2000 ppm. Oil, commonly called total hydrocarbon or THC, should be less than 2 ppm. Use of an air dryer is reduced the water content to less than a -40°F pressure dew point (PDP) or less than 100 ppm of water. Oil should be managed by asking your air compressor serviceman to maintain less than 2 ppm of THC as a vapor and zero droplets. It is common for compressor service people to be unaware of your need for a very low THC content in your air supply.

Before using compressed air in the cutting process test reports should be obtained from the compressor supplier which should be included clearly the water and THC content of the air.

> Oxygen (Low pressure up to 6 bar)

Oxygen is used as a cutting gas mainly for non-alloyed and low-alloyed steels. The jet of cutting gas is oxidized the material melted by the laser beam and blown away the melt and slag from the cutting groove. Oxidation is an exothermic (heat generating) process, which is generated extra heat on the metal. This action is speeded up the cutting process and enabled the laser to cut thicker materials.

When material thickness is increased the pressure of oxygen must be reduced to prevent a too vigorous oxidation reaction. When the material thickness is 12 mm or more, the pressure of oxygen must usually be less than 1 bar. At such low pressures, the process is highly sensitive to variations in pressure. This can be overcome by using accurate and fast pressure control. Oxygen gas consumption is depended on the nozzle diameter can be seen in **Figure 2**.

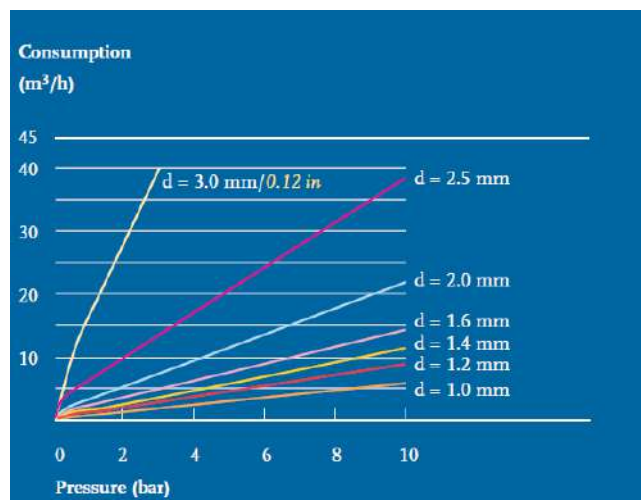


Figure 2

The quality of oxygen is also affected the cutting speed. Impurities slow down the oxidation this result in a slower cutting speed. Consequently the higher purity of oxygen is brought faster cutting speed. The cutting speed is increased markedly when the purity of oxygen increases as shown **Figure 3**.

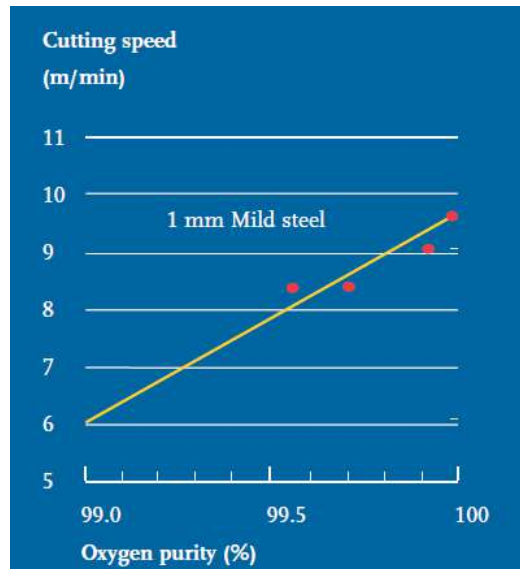


Figure 3

The surface condition of mild and low-alloy steels is quite important in laser cutting. For example oxygen cutting of sheets with rust may be caused dross and notches. Likewise painted surfaces can also be caused some problems. This applies particularly to sheets coated with zinc primer and iron oxide primer. When oxygen-cutting, problems only occur when the painted layer faces the gas nozzle. The cuts then often exhibit dross and notches.

Zinc coated mild or galvanized steels are caused considerable problems when cutting with oxygen. There is always dross formation and the cut surfaces may be quite rough. High-pressure nitrogen cutting is therefore used in industry to cut zinc-coated steels. The cutting quality is acceptable and free of adhering dross.

> Nitrogen (High pressure up to 25 bar)

Laser cutting with nitrogen is intended for applications where oxidation is not wanted. For example, an oxide layer can be caused paint to adhere less strongly on non-alloy steel. If non-alloy steel is painted after cutting, the cutting gas should be nitrogen.

Weldable steel components laser cut with oxygen will not be passed the bending test. Stainless steel is lost its corrosion resistance when cut with oxygen, and aluminum pieces cut with oxygen have an uneven and burred cut surface.

When nitrogen is used as the cutting gas, the laser beam is melted the material, and the nitrogen is blown away the molten material from the cutting groove. To ensure a burr-free cut surface, the laser beam must be focused on the bottom surface of the plate.

The cutting gas pressure is much higher than when cutting with oxygen. When the piece to be cut is thicker, the higher nitrogen pressure is needed to transport the molten metal away efficiently. When using nitrogen, the focal point is on the bottom surface of the plate, whereas when cutting with oxygen the focal point is on the top surface. Cutting with nitrogen is needed a larger nozzle than oxygen which results in a much higher gas consumption than when using oxygen. The consumption table can be seen in **Figure 4**.

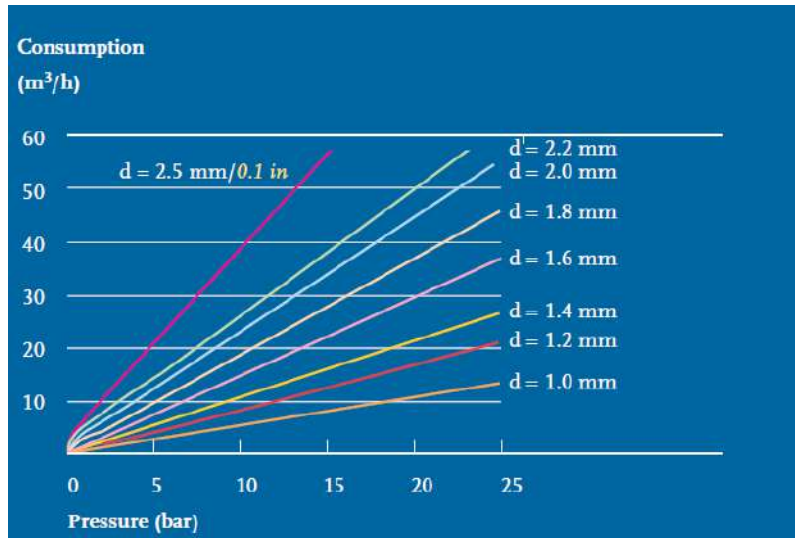


Figure 4

When cutting stainless steel, nitrogen must be as pure as possible, since even a trace amount of oxygen in the cutting nitrogen can be destroyed the corrosion resistance of steel. Even a slight discoloration on the cut surface is indicated that oxygen has been reacted with the cut surface which can be seen in **Figure 5**. An expensive additional treatment is needed to re-establish the corrosion resistance.

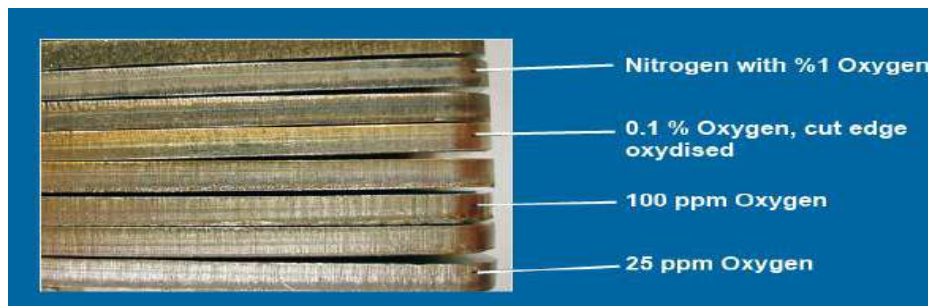


Figure 5

In industry, both oxygen and nitrogen are used as cutting gases for stainless steel and other high alloy steels. The disadvantage of oxygen-cutting is that the cuts always exhibit burrs and that the cut surfaces are discolored due to chromium and iron oxides. These oxides are obstructed the subsequent welding procedure. For example TIG welds have black oxide spots on the root side, which are sometimes caused incomplete penetration. Beyond that, the oxidized cut surface are facilitated corrosion of the cut edges. These in oxygen-cutting are serious, as they often require expensive finishing operations.

Oxide-free and burr-free cut can be obtained by high-pressure nitrogen-cutting. Higher cutting speeds can be used with higher power lasers. Today, the maximum sheet thickness range where burr-free cuts are possible is about 16 - 20 mm. The focal point must be close to the bottom surface of the sheet during high-pressure nitrogen-cutting in order to assure burr-free cuts. The Kerf then is become wider. So that a larger part of the nitrogen flow can be penetrated into the Kerf line and flush out the molten material. The lower focal position is resulted in a larger cross-section of the laser beam inside the nozzle than in oxygen-cutting. The diameter of the nozzle must also be enlarged in order to allow the laser beam to pass through the nozzle without being clipped. The diameter of the nozzle is usually required at least 1.2 mm for high-pressure nitrogen-cutting. The

purity of the nitrogen is affected a little to the cutting speed, at least as long as nitrogen purity is better than 99.5 % as Baykal recommended. Even small amounts of oxygen can be decreased the purity of the nitrogen it mixed somehow due to an oxidizing effect. In stainless steel this means a discoloration of the cut surface. Corrosion resistance of the workpiece may also be impaired. The oxygen impurity level must be below 20 ppm (0.002 %) in order to avoid all traces of oxidation. However this specification is desirable when laser cutting stainless steel, but normally does not required in other industrial applications.

The oxygen impurity level is important when using gaseous nitrogen in cylinders or bottle packs as there are various purity grades available. On the other hand, the use of liquid nitrogen in tanks, which generally has a very low impurity level does not lead to discoloration of cut surfaces.

“Aluminium” is a term used for both pure aluminium and aluminium alloys. Pure aluminium is soft, and it is often alloyed with small amounts of magnesium, copper, manganese, silicon or zinc to improve its mechanical strength. Aluminium cutting with Fiber lasers is considered difficult on account of its high reflectivity and thermal conductivity. However aluminium alloys are usually somewhat easier to cut than pure aluminium and cutting speed is higher. High laser output power over 2 kW is helped to improve the cutting suitability of aluminium.

Aluminium can be cut with both oxygen and nitrogen as cutting gases, but cutting speed with oxygen is not significantly higher than with nitrogen. This can be attributed to aluminium oxide’s extremely high melting point, which is 2072 °C (3762 °F). Solid or viscous aluminium oxide is formed a seal on the cut front, which is prevented oxygen from penetrating into the metal itself. The oxide seal is frequently bursted as a result of turbulent melt flow, and the oxidation reaction may be still proceeded, although at a lower rate. Nevertheless Low pressure oxygen (less than 6 bar) is frequently used for aluminium cutting. The laser beam must be focused on the upper surface of the aluminium sheet. Standard oxygen purity (= 99.5 %) is sufficient, as higher oxygen purity does not improve cutting speed. The disadvantages of low pressure oxygen cutting are cut edges with dross and a rather rough cut surface.

Dross-free cuts can be obtained by using high-pressure cutting with nitrogen or oxygen. It is appeared that nitrogen is the better alternative when cutting aluminium alloys, whereas oxygen is better for pure aluminium. When aluminium is cut with high pressure, the laser beam should be focused close to the lower surface of the sheet.

Low pressure oxygen cutting (less than 6 bar) can be used to obtain high cutting speeds, but the cut edges are exhibited a dross and the cut surfaces are oxidized. Although burr-free and oxide-free cuts may be achieved with high-pressure nitrogen, the cutting speed is reduced significantly compared with oxygen-cutting. The focal point should be positioned deep within the material, below the upper surface of the sheet.

Copper is one of the most reflective material in the World. The high reflectivity rate and thermal conductivity of the copper are made cutting of this material quite a challenge. Precautions must be taken to avoid back reflections of the laser beam and subsequent damage to the cutting head or resonator. **Brass** is one of the important copper alloys (copper-zinc alloy), and has lower reflectivity and thermal conductivity than copper. 1 micron fiber laser wavelength is more really absorbed and less reflected. It is therefore easier to cut with Fiber Lasers. Very high laser power and a short focal length of the lens (5”) are beneficial for good cutting. High pressure nitrogen cutting up to 25 bar is preferable when cutting brass and other copper alloys with fiber lasers.

2. IMPORTANT SAFETY INSTRUCTIONS

This chapter must be read carefully by the operator who has any involvement with the Fiber Laser Cutting System. The Fiber Laser Cutting System must not be set-up, operated or maintained until safety information completely understood and known definitely!

2.1 COMPLIANCE

This machine is designed and constructed in accordance with the following International and preliminary standards.

- ❖ AS4024.1 - 1996 Safeguarding of Machinery
- ❖ AS/NZS 2211.1:1997 Laser Safety – Classification
- ❖ User Guide PREN954 - 1 and 2 Safety related parts of control systems PREN999 positioning of protective equipment with respect to approach speeds
- ❖ Electrical AS3000-1991

2.2 INTRODUCTION TO FIBER LASER SAFETY

The laser is an intense, highly directional beam of light, which if directed, reflected or focused upon an object, will be partially absorbed. This raises the surface and/or the interior temperature which can potentially cause an alteration or deformation of the object. These properties while the basis of laser material processing can also have an adverse effect on human tissue. The fiber laser operates in the far-infrared region, which is invisible and has high heat energy.

The beam emitted from the laser source has a wavelength of 1.064 μm and has been assigned a Class IV laser hazard classification by the manufacturer. Basically, the classification scheme is used to describe the capability of the laser or laser system to produce injury to personnel. Higher classification number is a greater the potential hazard. The classifications range is starting from Class I to Class IV, where the Class I is considered to have the lowest potential risk.

Baykal Fiber Laser Systems are classified as a Class IV laser product. As an option on some laser resonators when a second laser is fitted, it produces a visible red beam. This beam is emitted when the safety shutter is closed, is considered as a Class II laser product.

2.3 LASER HAZARD CLASSIFICATION

As previously indicated, laser systems can be grouped into at least 4 primary categories to indicate relative potential risk:

- **Class I** - A class I laser is considered as safe based upon current medical knowledge. This class includes all lasers or laser systems that cannot emit levels of optical radiation above the exposure limits for the eye under any exposure conditions inherent in the design of the laser product. There may be more hazardous laser embedded in the enclosure of the Class I product, but no harmful laser radiation can escape from the enclosure.
- **Class II** - A class II laser or laser system must emit a visible laser beam, which by its very bright nature will be too dazzling to stare into. Momentary viewing is not considered to be hazardous through the upper radiant power limit on this type of device is above 1 mW. This power level corresponds to the

total beam power entering the eye for a momentary exposure of 0.25 second that is just safe (i.e., the Maximum Permissible Exposure [MPE] for a 0.25 second exposure).

- **Class III** - A class III laser or laser system can emit any wavelength, but it cannot produce a hazardous diffuse reflection unless focused for extended periods at close range. It is also not considered to be occur a fire hazard or a serious skin hazard. Any CW (continuous wave) laser which is not class I or class II is, a class III device if its output power value is 0.5 W or less. Since the output beam of such a laser is definitely hazardous for intrabeam viewing, control measures center on to eliminating this possibility.
- **Class IV** - A class IV laser or laser system is any system that exceeds the output limits (Accessible Emission Limits, AEL's) of a class III device. As would be expected, these lasers may be either a fire and skin hazard or a diffuse reflection hazard. Very stringent control measures are required for a class IV laser or laser system.

2.4 EXPLANATION OF LASER RADIATION

Lasers are emitted beams of optical radiation (beams of light). Optical radiation (ultraviolet, visible and infrared) is termed non-ionizing radiation as distinct from ionizing radiation such as X-rays gamma rays and other associated forms of atomic radiation, which are known to cause different biological effects.

HAZARDS

- **EYE HAZARDS:** Laser radiation in the far-infrared region will be absorbed in the front surface of the eye. Thus, if the eye is not protected, it may receive damage to the cornea and lens from direct or reflected laser beam exposure. Therefore, eye protection must be worn in all operation, maintenance and service personnel working with or in the vicinity of the laser system.

In general, laser eye protection should be selected on the basis of affording the protection required to protect the eye against the exposure anticipated while still permitting the greatest amount of light to enter the eye for the purpose of seeing. Eye protection's primary objective is to provide a similar degree of protection to the eye as that of the skin. Normal safety glasses with side shields used in metal working shops will provide all the protection necessary.

Laser standards have never suggested that protective eyewear should be the primary means of protection against laser radiation. In most instances, engineering controls (i.e. beam path enclosures, shields, baffles and door interlocks) are considered far more important and reliable safeguards than reliance on eye protection. Therefore, under normal operating conditions these **safety features should not be removed or bypassed**. If any of these are found to be faulty should be reported to relevant officer for immediate repair. It is the user's responsibility to establish and enforce an eye protection program.

- **SKIN HAZARDS:** Laser radiation which is striking the skin is reflected, absorbed, and transmitted, and the percentage of each depends upon the characteristics of the skin at the wavelengths of concern. Effects of laser radiation on the skin range from mild redness to blistering and/or charring, depending on the total energy and the rate at which it is absorbed. Unnecessary exposure of the skin to laser radiation should be avoided occur from the regardless level of radiant energy.

Baykal Laser Systems are engineered to provide protection from these hazards for personnel, while using the equipment in the correct manner. If used incorrectly the consequences range from severe burns, lacerations to possible amputations, if any parts of the body come in contact with the direct beam (focused and/or unfocused) or close to reflected beams of high energy.

Any part of the body should never enter the beam path while the 'safety shutter' is under machine control. **The 'safety shutter' key switch should be in the off position and key should be removed before any operation (involving the focused or unfocused beam) attempted.**

WORKWEAR

Another hazardous case is related to skin hazards, the issue of workwear. In general, the contact with high power of direct and reflected laser beams will cause most fabrics to combust. Natural fibers such as cotton and wool will offer a greater degree of protection than synthetics due to their higher ignition temperature, and their tendency to burn is occur only when the ignition source is present. Therefore drilled cotton workwear is highly recommended as suitable for the personnel operating, servicing and maintaining lasers and laser systems.

Burns cause from laser radiation should be considered in the same manner as any “normal” heat source.

ASSOCIATED HAZARDS

- **ELECTRICAL HAZARDS:** Because of the high electrical energies used to generate the laser beam in Laser resonator, electrocution hazards are possibly a far greater danger to personnel than those of the laser beam itself. This is why there is no possible access to high electrical energy without going through a safety-interlocked door or panel. Before any maintenance or repair is undertaken, you should ensure that the laser component has been isolated from the electrical service and all other precautions taken as prescribed in this manual and the other component manuals provided.
- **MAGNETIC FIELD:** Cutting machines featuring the linear motor axis drives present a major magnetic field hazard. Person's reliant electronic equipment by reason of health issues must not approach the machine. During maintenance operations, when the axis covers are removed, personnel shall take care of the tools as they can be suddenly twisted and drawn to the open pole faces with substantial force.
- **FIRE HAZARD:** Fire hazards presence in the processing area through interaction with the laser beam and materials present in the workpiece. Additional fire hazards exist in the enclosed electrical controls in the Laser Center cabinets. Appropriate fire equipment should be provided and available, and the purpose and use of such equipment should be understood by operating personnel. This equipment should be provided to extinguish or control small fires only and personnel shall follow basic firefighting procedures.
- **FUME AND DUST:** The BLS-N Laser System is suitably equipped with ducting for connection to an extraction system. This will cause air to be drawn down from the cutting surface. Thereby removing fumes generated during the cutting process. The optimal exhaust rate for your specific application should be determined by a professional qualified person to assess ventilation systems.

The OSHA-required Material Safety Data Sheet for the material being processed should be reviewed to aid in determining the nature and composition of the fumes being released. A professional qualified person to evaluate control devices should be consulted on the design of a device to eliminate poisonous emissions from the ventilation exhaust.

Finally, the presence of personnel exposures due to fumes should be determined by a professional qualified to evaluate workpiece exposures to chemical and physical hazards. Operation of the BLS-N Laser System and ventilation system/control device may subject the user to local state and federal environmental and occupational protection laws and regulations. A professional qualified to assess environmental and occupational protection laws and regulations must be consulted before the Laser System is installed and operated.

WARNING: LASER CUTTING MAY FORM POISONOUS FUMES. DO NOT BREATHE FUMES!!!

2.5 GAS STORAGE

Various gases are used in the laser cutting process to assist in the actual cutting or to perform auxiliary functions. The gases that most commonly used are oxygen, nitrogen and compressed air. These gases are commonly available in compressed gas cylinders. Oxygen and nitrogen are also available as cryogenic liquid. Carbon dioxide, while not classified as a cryogenic, is also widely available in liquid form. The discussion below will address safety consideration when storing and handling compressed gas cylinders. Later in this section, there will be a discussion on safety precautions concerning cryogenic liquids.

2.6 COMPRESSED GAS CYLINDERS

▪ HANDLING

Serious accidents may result from the misuse or mishandling of compressed gas cylinders. Workers assigned to the handling of cylinders under pressure should be properly trained and should work only under a competent person's supervision. Observing a few basic rules will help to control hazards in the handling of compressed gas cylinders.

- Because of their shape, smooth surface and weight, cylinders are difficult to carry by hand. Cylinders may be rolled on their bottom edge but shall never dragged. Cylinders weighing more than 18.0 kg (total) shall be transported on a hand or motorized truck, suitably secured to keep them from falling.
- Do not lift compressed gas cylinders with an electromagnet. Cylinders must be handled by a crane or fork-truck and they must carried in a cradle or suitable platform and take extreme care due to drop or bump hazards. Do not use slings.
- Do not drop cylinders or let them strike each other violently.
- Do not use cylinders for rollers, supports, or any purpose other than to contain gas.
- Do not tamper with safety devices in valves or on cylinders.
- When empty, cylinders are to be returned to the vendor, mark them EMPTY with chalk. Close the valves and replace the valve protection caps, if the cylinder is designed to accept a cap.
- Always consider cylinders as being full and handle them with corresponding care. Accidents have resulted when containers under partial pressure were thought to be empty.

▪ STORING

Cylinders should be stored in an upright position in a safe, dry, well-ventilated place prepared and reserved for this purpose. Flammable substances, such as oil and volatile liquids, should not be stored in the same area. Cylinders should not be stored near elevators, passageways, stairwells, or other places where they can be knocked down or damaged.

- Oxygen cylinders should not be stored within around 6 meters of cylinders containing flammable gases or near the location of other highly combustible materials.
- Cylinders are not designed for temperatures in excess of 54°C (130°F). Accordingly, they should not be stored near of sources of heat, or near of highly flammable substances.
- Cylinder storage should be planned, so those cylinders will be used in the order in which they are received from the supplier. Empty and full cylinders should be stored separately, with empty cylinders being plainly identified in order to avoid confusion. Group together empty cylinders, which have held the same contents.

▪ USING

Safe procedures for the use of compresses gas cylinders include that:

- Use cylinders in an upright position and secure them against being accidentally knocked over.
- Unless a recess in the head protects the cylinder valve, keep the metal cap in place to protect the valve when the cylinder is not connected for use. A blow on an unprotected valve might cause to leakage of gas under high pressure.
- Make sure the threads on a regulator or union correspond to those on the cylinder valve outlet. Do not force connections that do not fit.
- Open cylinder valves slowly. A cylinder which is not equipped with a hand wheel valve should be opened with a valve key or a spanner or other tool provided or approved by the gas supplier.
- Except where cylinders are attached to a manifold, in which case the regulator will be attached to the manifold header, do not use a cylinder of compressed gas without a pressure reducing regulator attached to the cylinder valve.
- Before making connection to a cylinder valve outlet, crack the relevant part of the valve for an instant to clear the opening from particles of dust or dirt. Always point the valve and opening away from the body or other persons.
- Use regulators and pressure gauges only with gases for which they are designed and intended. Do not attempt to repair or alter cylinder valves or attachments. This intervention should be made by the manufacturer only.
- Unless the cylinder valve has been closed tightly first, do not attempt to stop a leak the cylinder or regulator by tightening union nut.
- Do not permit sparks, molten metal, electric currents, excessive heat, or flames to come in contact with the cylinder or attachments.
- Never use oil or grease as a lubricant on valves or attachments of oxygen cylinders. Keep oxygen cylinders and fittings away from oil and grease and do not handle such cylinders or apparatus with oily hands, gloves, or clothing.

- Never use oxygen as a substitute for compressed air. Use it only for the purpose for which it is intended.
- Before the regulator is removed from a cylinder valve, close the cylinder valve and release the gas from the regulator.
- Cylinder valves shall be closed when work is finished.

▪ REGULATORS

Pressure regulators must be used on cylinders to maintain a uniform gas supply at the correct pressure. The oxygen regulator should be equipped with a safety relief valve or be so designed that, should the diaphragm rupture, broken parts of regulator will not fly. Workers should stand to one side and away from regulator gauge faces while cylinder valves are opening.

- High-pressure oxygen dial gauges should have safety vent covers to protect the operator from flying parts in case of an internal explosion. Each oxygen dial gauge should be marked with "OXYGEN USE NO OIL OR GREASE".
- Serious, even fatal, accidents have resulted when oxygen regulators have been attached to cylinders containing fuel gas, or vice versa. Cylinder valve outlet threads have been standardized for industrial and medical gases mostly. Different combinations of right-hand and left-hand threads, internal and external threads, and different diameters to guard against wrong connections are now become standards.
- The regulator is a delicate apparatus and should be handled carefully. It should not be dropped or strike to an obstacle. Regulators should be repaired only by qualified persons or sent to the manufacturer for repairs.
- Leaky regulators are a source of the danger and should be withdrawn from service immediately for repairs. If a regulator shows a continuous leakage, indicated on the low pressure (delivery) gage by a steady build-up of pressure when demand is off, the cylinder valve should be closed and the regulator removed for repairs.
- If the regulator pressure gauges have been strained so that the hands do not register properly, the regulator must be replaced or repaired before it is used again.
- When regulators are connected but not in use, the pressure-adjusting device should be released. Cylinder valves should never be opened until regulator is drained of gas and pressure-adjusting device on the regulator is fully released.

These procedures should be followed in detail when regulators or reducing valves are being attached to a gas cylinder.

3. TECHNICAL DATA

Model	BLS-NEO 1530 / 2 kW	
CNC Control Unit	Beckhoff CNC	
X Axis (Rack & Pinion)	3000 mm	
Y Axis (Rack & Pinion)	1500 mm	
Z Axis (Ball Screw)	105 mm	
Workpiece Dimensions	1525 x 3050 mm	
Rapid Traverse (X and Y axis)	105 m/min	
Acceleration	1.5G (15 m/s ²)	
Vector Speed	148 m/min	
Absolute Positioning Accuracy	± 0.08 mm	
Repeatability (X and Y axis)	± 0.03 mm	
Feedrate	Programmable up to 50 m/min (Actual feedrate depends on material type and its thickness)	
Programmable Cutting Gases	Closed loop CNC control of the following gases:	
	Air	0,4 - 5 Bar (max)
	Oxygen	0,4 - 5 Bar (max)
	Nitrogen	0,4 - 25 Bar (max)
Focusing Lens	150 mm	
Transfer Table	Motorized control / Automatic Exchange	
Maximum Loading Capacity	2000 kg	
Fume Extractor	4000 m3/hour	
Laser Power	2 kW / nLIGHT Photonics	
HMI Processor	Intel Corei5 2.7 GHz	
RAM	4 GB DDR 3	
Network Connection	RJ45 10/100 Mbps	
Disk Drives	320 GB	
Operating System	Microsoft Windows 7 Professional 32 bit, English	
Extra Features	Your machine is equipped with auto nozzle cleaning and calibration system as well	

4. OPERATOR SCREEN

The operator screen is allowed to access the machine functions and software menus, realize the axes positions, the status of the laser and other connected units etc.

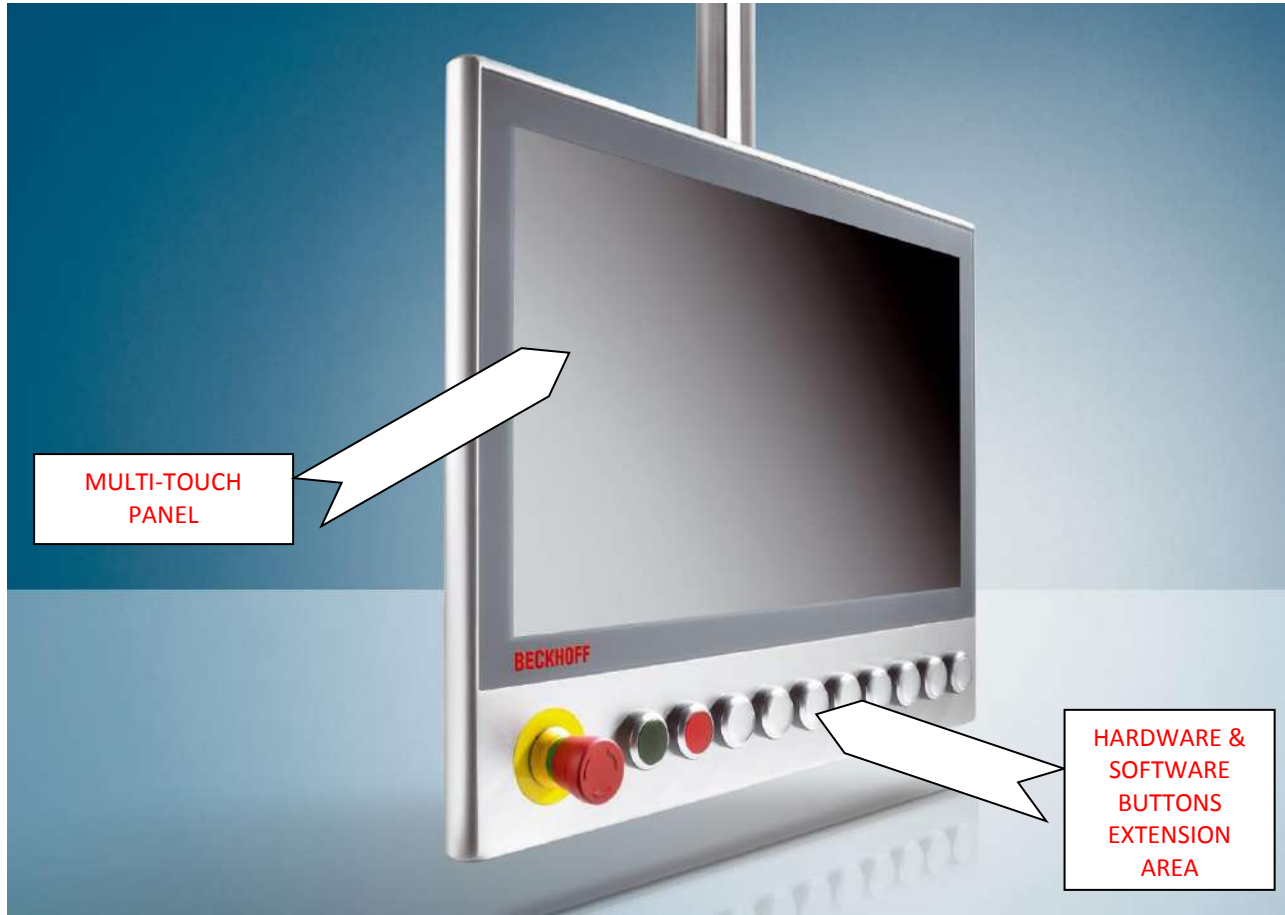


Figure 6

5. ACTIVE PARAMETERS PAGE

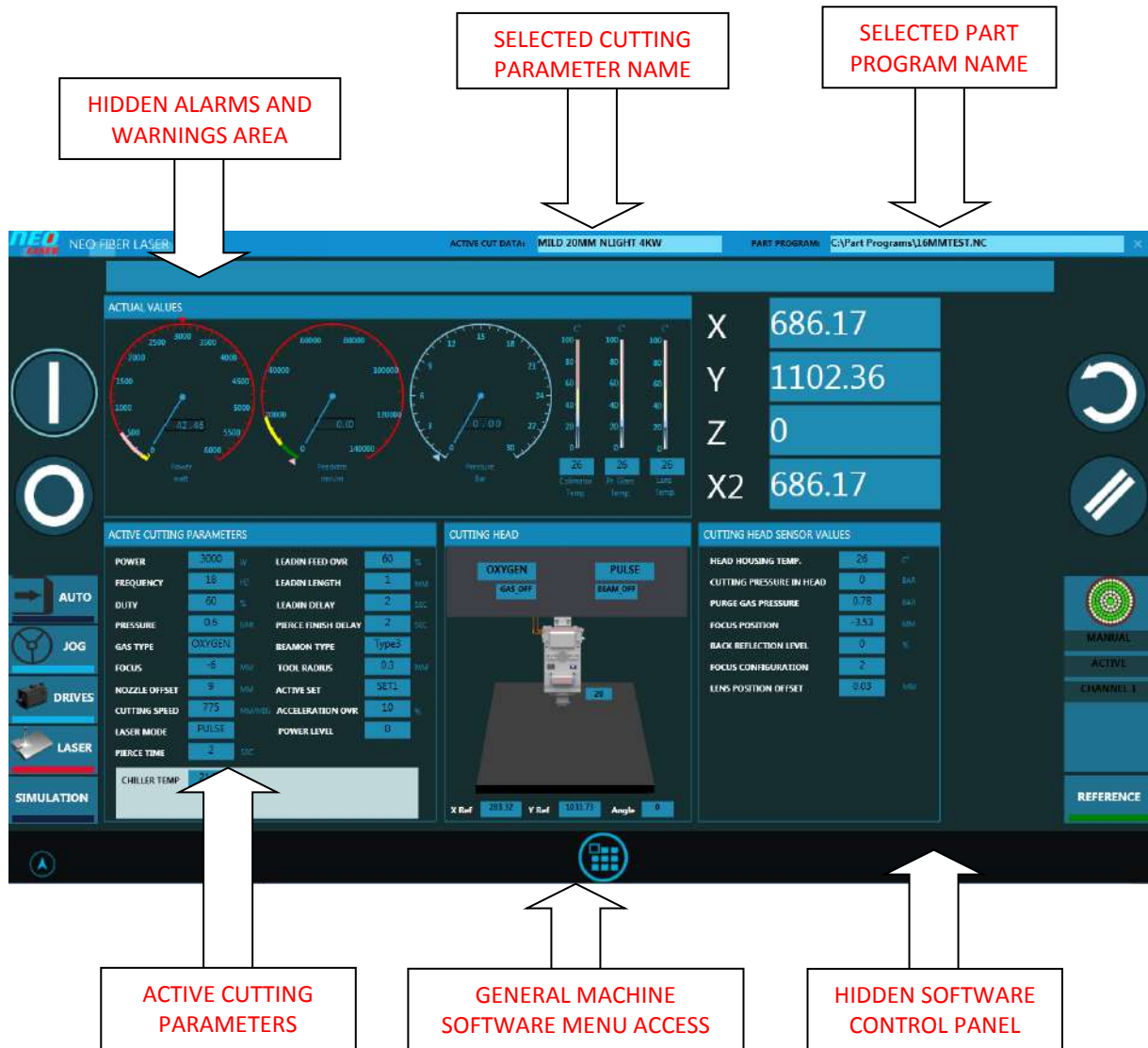


Figure 7

By pressing the middle button on the black area at the bottom as shown **Figure 8** the "General Machine Software Menus" will be opened in the new window as shown **Figure 9a** or **Figure 9b**.



Figure 8



IMPORTANT NOTE: To change the menu pages between **Figure 9a** and **Figure 9b** the screen must be swiped to left or right direction!

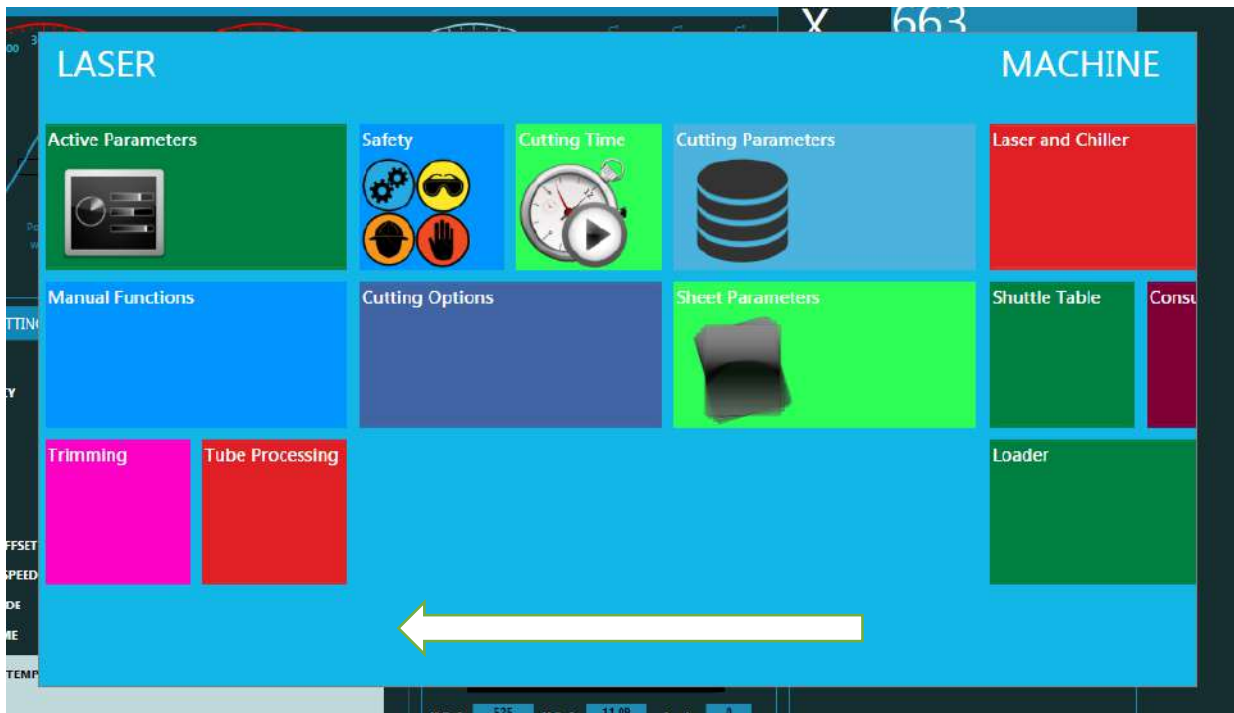


Figure 9a

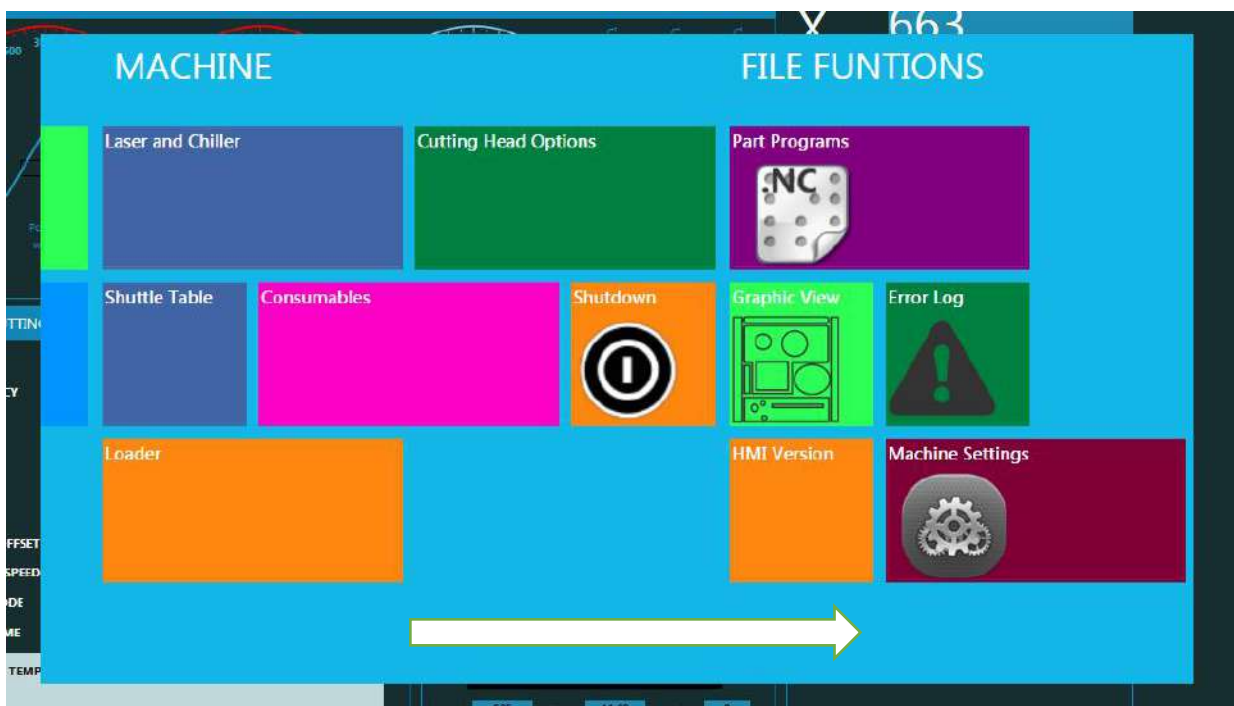


Figure 9b

By pressing anywhere) on the black area (except on the middle one) at the bottom as shown **Figure 7** the "Hidden Software Control Panel" will be opened automatically as shown **Figure 10**.



Figure 10

2.1 HIDDEN SOFTWARE CONTROL PANEL

The means of the Hidden Software Control Panel keys are shown as **Figure 11** and detailed descriptions the following. These keys are accessible in every software page as well.

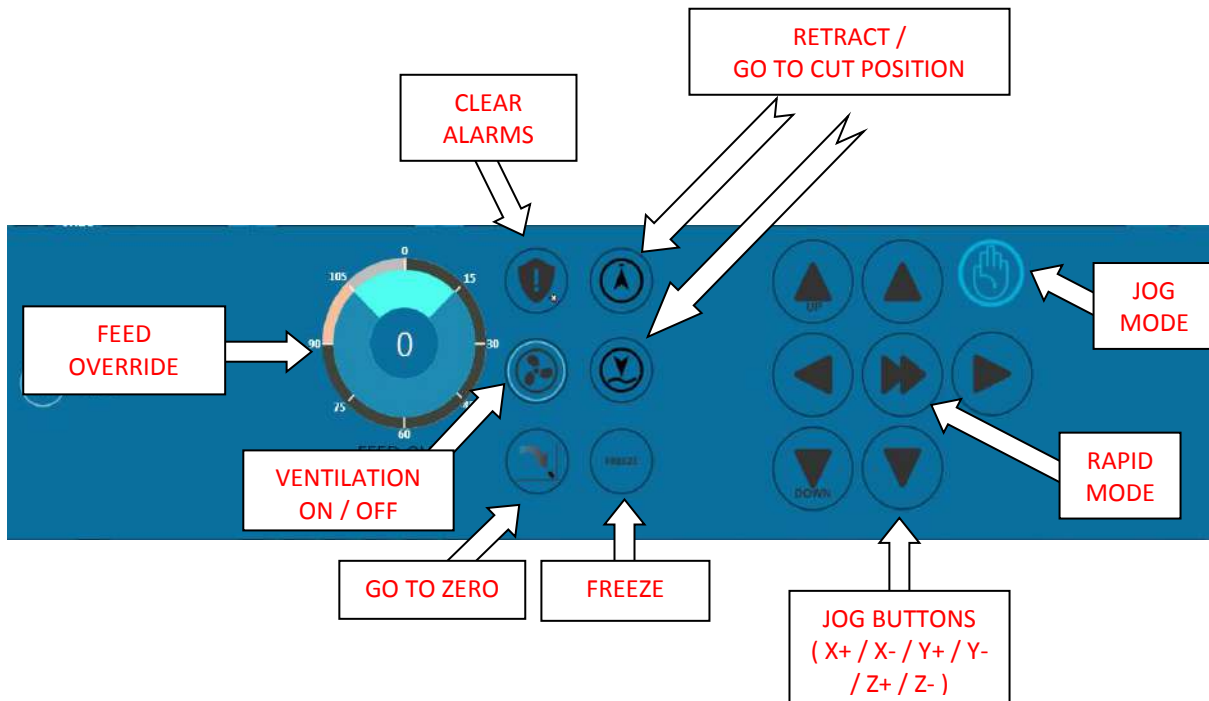


Figure 11

- **FEED OVERRIDE:** This value is affected the axes movement speed actively. If this value is **100%**, the machine axes are moved with exact cutting speed while cutting what was set the by operator. (For example; if cutting speed is set to **2000 mm/min** and feedrate override value is **75%** by 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 value can be adjusted from 5% to 105% by the operator.

- **CLEAR ALARMS:** This key is used to clear the occurred system alarms while cutting process (tip-touch alarm etc.) from the screen. Some of alarms cannot be deleted until by pressing “NC Reset” button such as Body Touch alarm etc.
- **GO TO CUT POSITION:** This key is used to go down the cutting head for cutting start position. When it is pressed the cutting head is gone down quickly to find and detect the sheet metal.



IMPORTANT NOTE: To use this key safely the cutting head must always be onto the sheet metal. Otherwise the cutting head can be hit to somewhere on the cassette and the cutting can be damaged due to the collision!

- **RETRACT:** This key is used to raise up the cutting head to default retract position. When it is pressed the cutting head is raised up quickly to zero position by system.
- **VENTILATION ON / OFF:** This key is used to turn the ventilation system ON or OFF position manually. If the associated circular animation is flashing this means the ventilation system will be stopped by the system in a next few minutes. If the animation is constant this means ventilation system has been working without any problem.



IMPORTANT NOTE: If the ventilation system is failed somehow the warning message will be appeared on the screen as shown **Figure 12**.

Ventilation error. Please check filter unit Alarm

Figure 12

- **GO TO ZERO:** This key is used to move back to the cutting head to the last sheet zero position which has been found and saved by system before. When it is pressed the cutting head is moved to the last zero position in low speed and at the same time the machine mode is changed to JOG mode automatically if it is in AUTO mode already.



IMPORTANT NOTE: Before using this key the front gate must be closed!

- **FREEZE:** This key is used to disable the height following function while in “TRIMMING” cutting mode. This key is only activated while it is depressed by operator. When the cutting head is reached the edge of sheet metal due to height following function the head is tried to go down more to find any kind of metal on the cassette and this action can be very dangerous for the head. To avoid this movement “Freeze” key must be used by operator. When this key is pressed continuously the cutting head position will be stable even the head is not onto the sheet metal. When it is depressed the cutting head is raised up to retract position quickly. At the same time the laser beam and cutting gas are closed by system automatically.
- **JOG MODE:** This key is used to change the machine’s mode to JOG mode. In this mode the machine axes can be moved manually by pressing any axis key from JOG Buttons Area (X+, X-, Y+, Y-, Z+ or Z-). The JOG movement speed is 3000 mm/min.
- **RAPID MODE:** This 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.

2.2 FIXED SOFTWARE AND PROGRAM CONTROL KEYS

The means of the Fixed Software and Program Control Keys are shown as **Figure 13** and detailed descriptions the following. These keys are accessible in every software page.

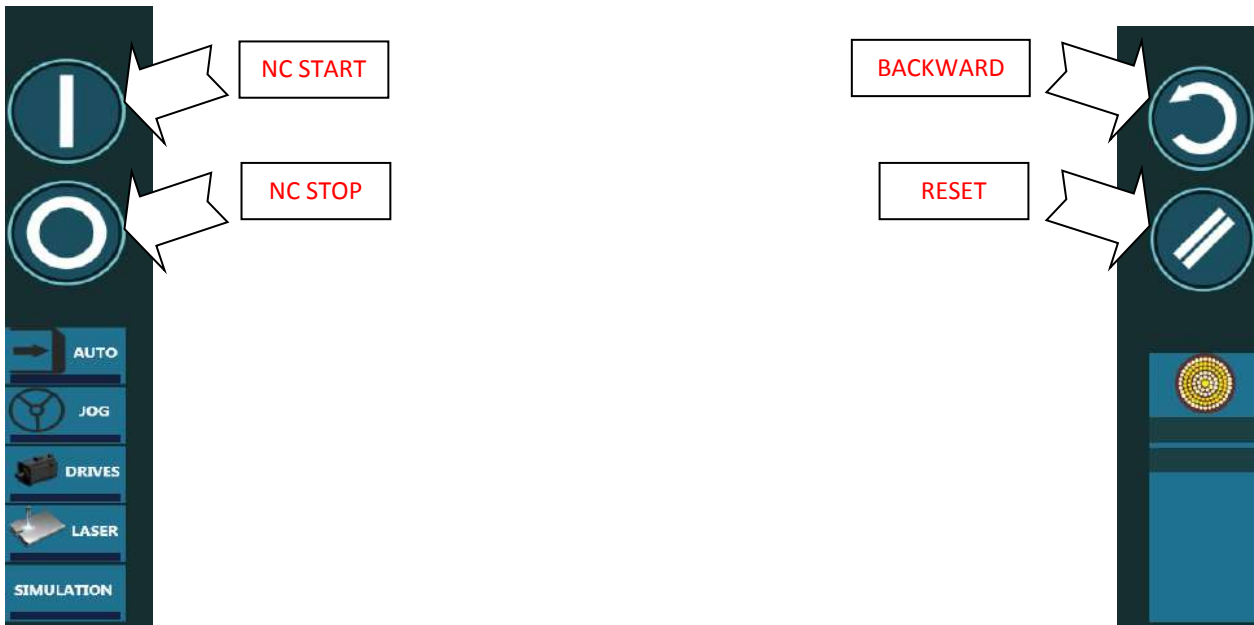


Figure 13

- **NC START:** This key is used to start the selected part program from the beginning or continue at the current block where has been stopped by operator or by system for any reason. When this key is pressed the cutting gas is opened first and then the cutting head is gone down to the find the sheet metal and after the laser beam is activated by system. At the same time the associated **green lamp** is lighted up automatically (Green lamp is located on the Hardware & Software Buttons Extension Area as shown **Figure 14**).



Figure 14

- **NC STOP:** This key is used to stop the processing on the selected part program immediately. When it is pressed the selected part program and the movements of the machine axes are stopped. After movement is stopped the head is raised up to retract position by system. At

the same time the laser beam and cutting gas are also closed by system and the associated red lamp (**NC Stop**) is lighted up and also green lamp (**NC Start lamp**) is started to blinking (Red and green lamps are located on the Hardware & Software Buttons Extension Area as **Figure 9**). To continue the part program the **NC Start** key button must be pressed by operator.

- **BACKWARD:** This key is allowed to return back into the active contour to the operator. When the damaged point is noticed by operator for any reason this key must be used to return back without. To use this key correctly the following instructions must be followed by operator:
 - The part program must be stopped by operator by pressing **NC Stop** button first (as **N70** interruption point in **Figure 15**). When NC Stop button is pressed the described operations in **NC Stop** section are repeated.

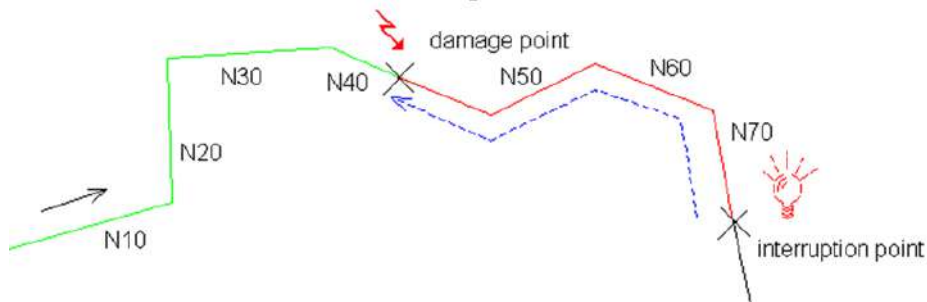


Figure 15

- After the movement is stopped “Backward” key must be pressed by operator to activate the function. After activating the associated animation will be as shown **Figure 16**.



Figure 16

- To return back into the contour “**NC Start**” button must be pressed by operator. After pressing the head is moved back at current block on retract position by using the automatically created inverted NC blocks (as throughout **N70 - N60 - N50 - N40** points in shown **Figure 15**).
- In this movement the operator must be noticed 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 15**).
- After stopping the movement “Backward” key must be pressed for second time to deactivate the function. After 2nd time pressing the associated animation is closed

and the “Block Search” function is started to calculate the continuing position by system automatically as shown **Figure 17**.

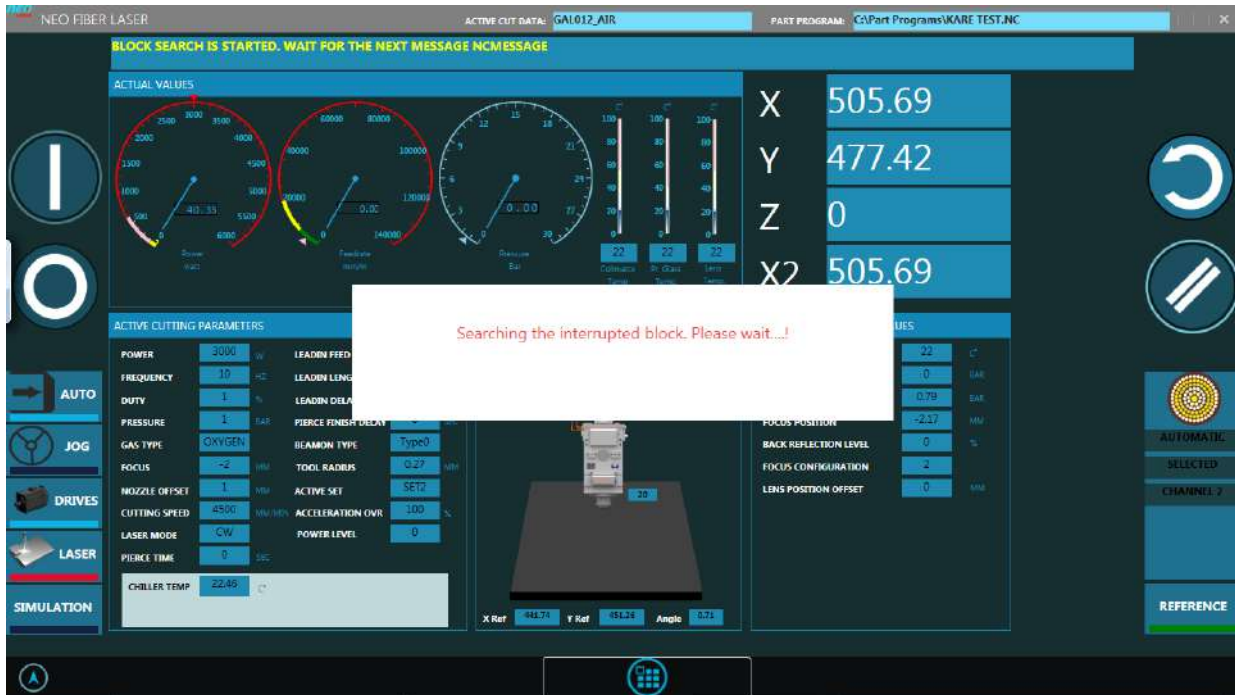


Figure 17

- 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.

- **RESET:** This key is used to cancel the all the cycles into the system such as axes movements, the cutting process, the laser beam, cutting gas, shuttle table palette changing etc. It is also used to clear all the temporary alarms and warnings from the screen (except some acknowledged alarms as emergency stop, laser unit alarms etc.).
- **AUTO MODE:** This key is used to change the machine’s mode to AUTO mode. When this key is pressed the associated animation will be as **Figure 18**. In this mode any kind of part program can be started by the operator if the drives ON already.



Figure 18

- **JOG MODE:** This key is used to change the machine's mode to JOG mode. When this key is pressed the associated animation will be as shown **Figure 19**. 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.



Figure 19

- **DRIVES ON / OFF:** This key is used to turn the servo drivers ON or OFF position which are able to use for axis movement. When the machine is started from the beginning the drivers will always be closed (OFF position) and its animation will be as shown **Figure 20**.



Figure 20

When this key is pressed the drivers are getting energized and its animation is become as **Figure 21**. When the drivers are energized the machine axes will be ready for movement.



Figure 21

- **LASER ON / OFF:** This key is used to turn the connected laser unit ON or OFF position. When this key is pressed the associated animation is started to blinking with blue color first and if there is no missing internal signal on the laser unit after approximately 5 seconds its animation is become to **red** color as shown **Figure 22** which is shown to the operator that the laser is ready to be cut.



Figure 22

When this key is pressed one more time the laser unit is gone to standby position and its animation is become as shown **Figure 23**.



Figure 23

- **SIMULATION MODE:** This key 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.

In **Actual Values** area a few conditions can be seen actually as cutting power (by watt), feedrate (by mm / min), cutting gas pressure (by bar), collimator, protection glass and lens temperatures (by °C) as shown **Figure 24**.



IMPORTANT NOTE: The collimator, protection glass and lens temperature values can be seen only if there is a Precitec ProCutter type of cutting head is installed on the machine. Otherwise all these values are set to 0 (zero) due to missing required signals!

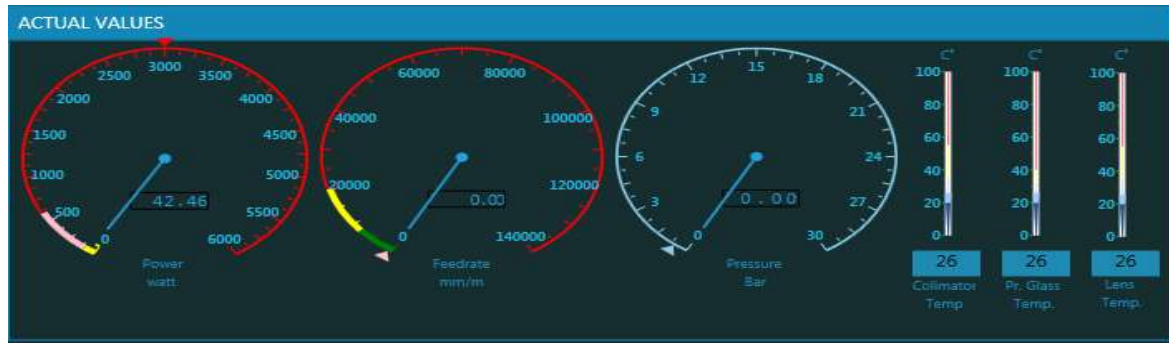


Figure 24

The actual axes positions can be seen and followed by operator all the time as shown **Figure 25**.

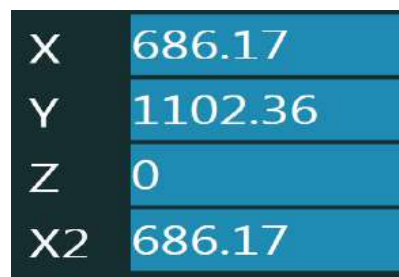


Figure 25

In **Active Cutting Parameters** area the selected and loaded cutting parameters and actual chiller water temperature can be seen while cutting process as shown **Figure 26**. The cutting parameters will be explained in next pages in detail.

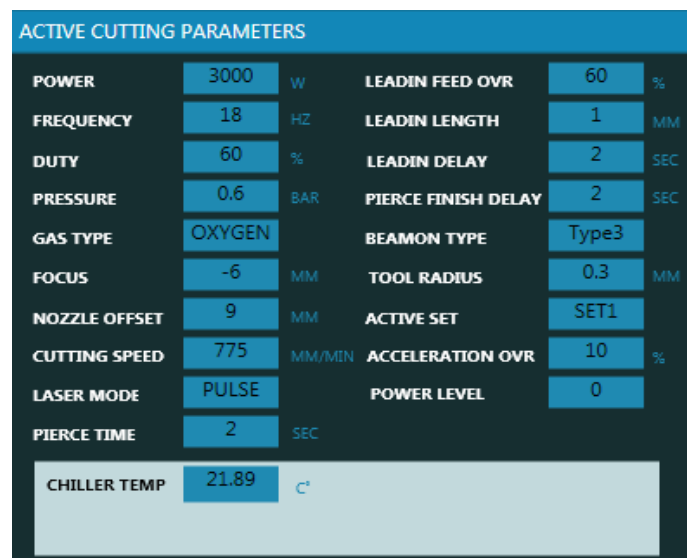


Figure 26

In **Cutting Head** area a couple of statuses can be seen such as which type of cutting gas and mode type of laser (CW or PULSE) are selected by operator. Also the laser beam and gas conditions (ON or OFF position) and standoff distance between nozzle and workpiece and last sheet zero position with angle rate can be seen as shown **Figure 27**.

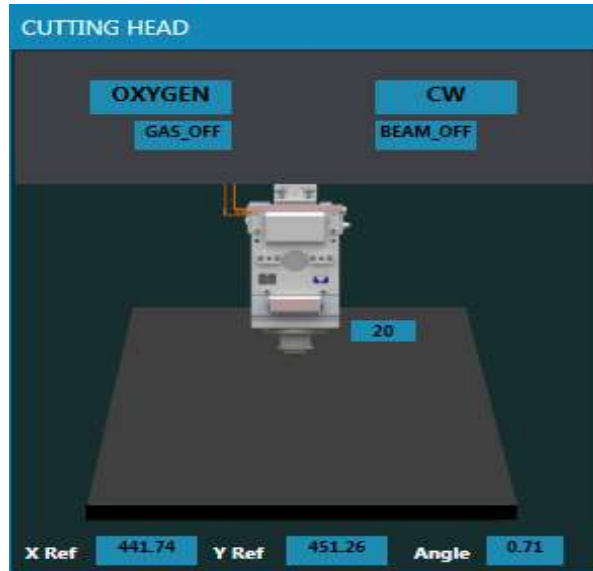


Figure 27

In **Cutting Head Sensor Values** area some of special sensor values which are located into the cutting head can be seen as **Figure 28**.



IMPORTANT NOTE: These values can be seen only if there is a **Precitec ProCutter** type of cutting head is installed on the machine. Otherwise all these values are set to zero due to missing signal.

CUTTING HEAD SENSOR VALUES		
HEAD HOUSING TEMP.	22	°C
CUTTING PRESSURE IN HEAD	0	BAR
PURGE GAS PRESSURE	0.78	BAR
FOCUS POSITION	-2.17	MM
BACK REFLECTION LEVEL	0	%
FOCUS CONFIGURATION	2	
LENS POSITION OFFSET	0	MM

Figure 28

6. SAFETY PAGE

This page is used to check the safety gate switches, light barriers and emergency stop buttons' status. BLS-N laser cutting machines has 3 emergency stop buttons in standard and all of them are connected to system and they can be followed all the time. They are located on the following places:

- On the operator control panel
- On the back side of the machine (next to the shuttle table)
- On the laser unit

If one or more of emergency stop button is pressed all the machine cycles (cutting process, axes movements, shuttle table changing etc.) are immediately stopped by system due to emergency reason and the associated animation will be as **Figure 29** or **Figure 30**. When pushed one is released the associated animation is turned back to normal. To continue to process "NC Reset" button must be pressed first by operator to clear all the alarms on the controller.



IMPORTANT NOTE: The emergency buttons must be used only in case of **EMERGENCY!**

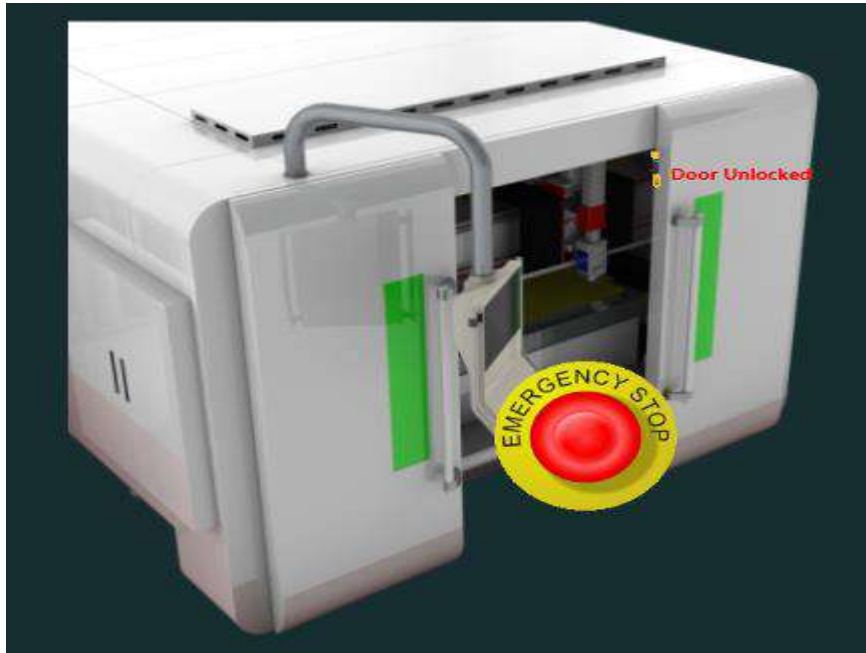


Figure 29

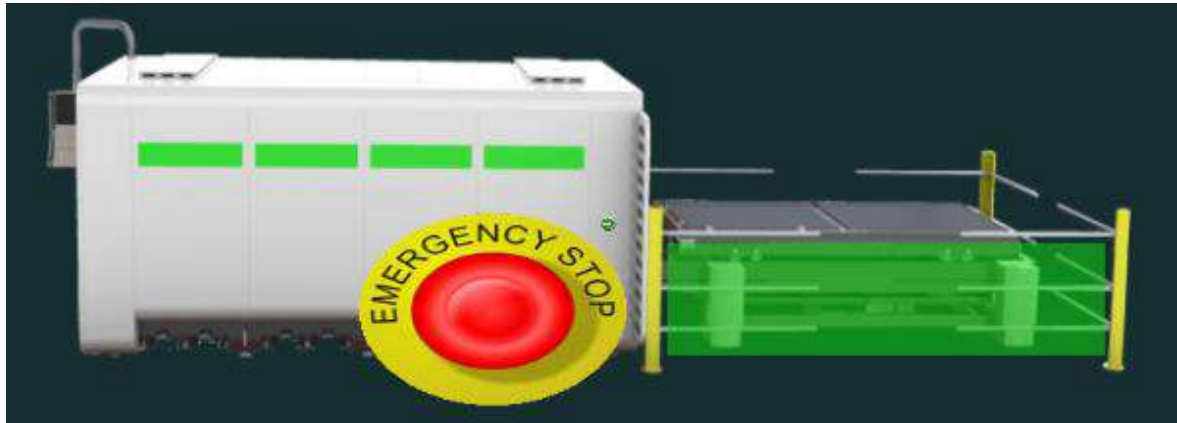


Figure 30

> For example: When the front gate is opened the associated animation will be as shown **Figure 31.**

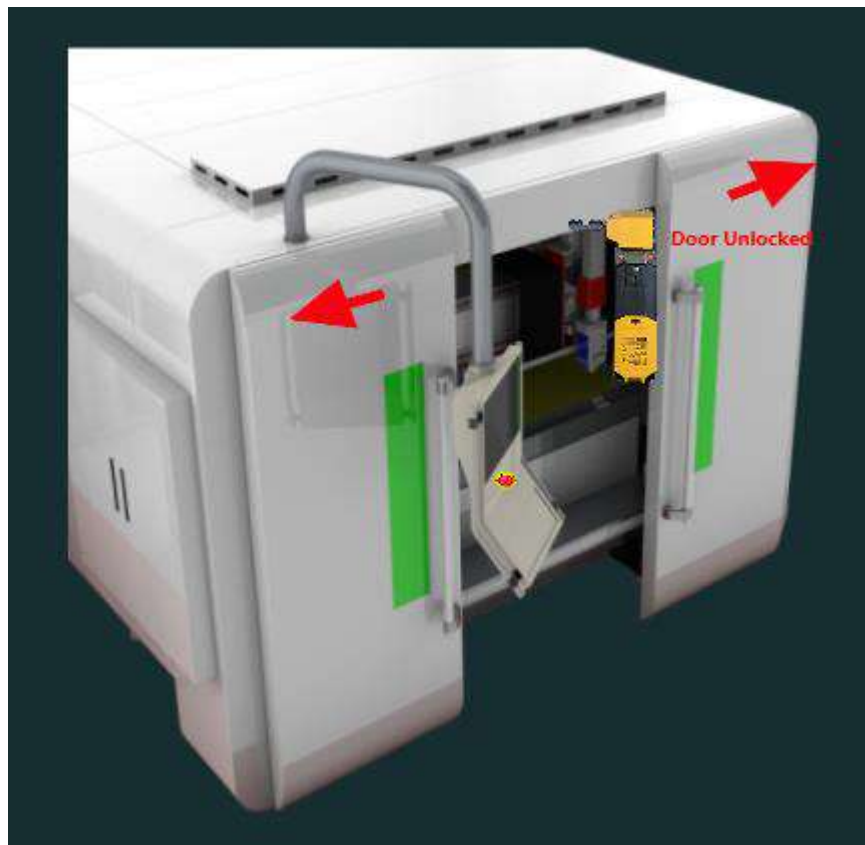


Figure 31

> For example: When something is crossed the light barrier the associated animation will be as shown **Figure 32.**

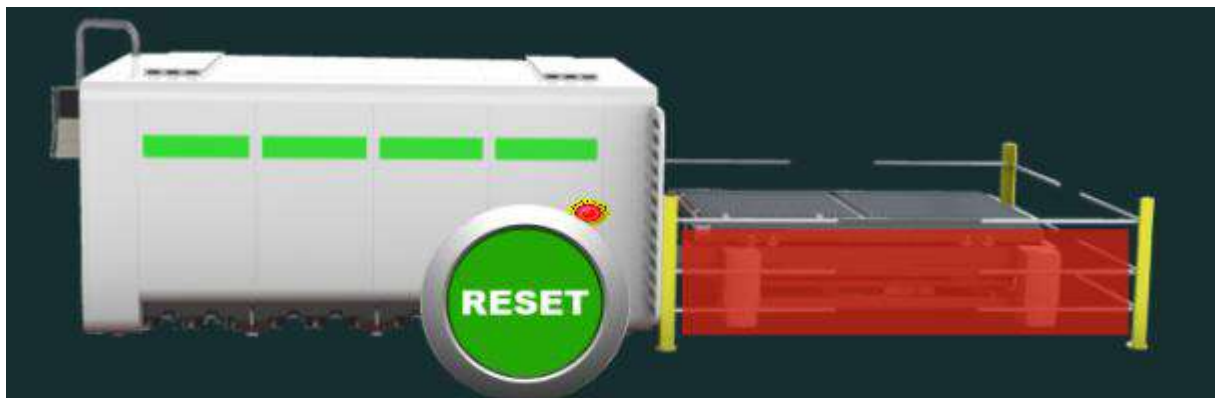


Figure 32

7. MANUAL FUNCTIONS PAGE

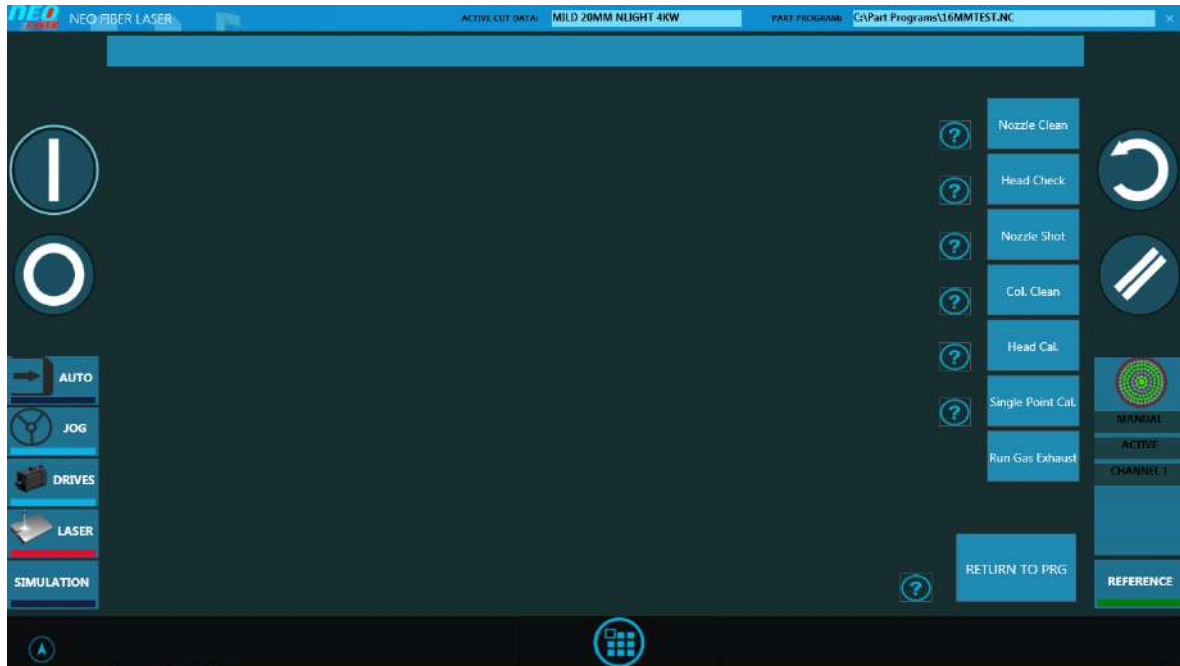


Figure 33

- **NOZZLE CLEAN:** This function is used to perform a nozzle cleaning manually. When this key is pressed the cutting head is moved to the cleaning station as shown **Figure 34** 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.

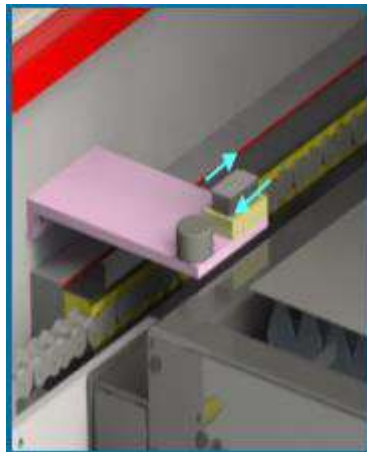


Figure 34

- **HEAD CHECK:** This function is used to move the cutting head to front side of the machine to check its condition by 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 operator to go back to interruption point.
- **NOZZLE SHOT:** This function is used to check the laser beam centering. This beam centering is highly recommended by BAYKAL Machine Tools. It must be checked by operator at least once day before the production!

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 lamp (NC Start) is started to blinking. To check the beam centering the following instructions must be followed by 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 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 lamb (NC Start) is started to blinking as normal start events. To make a shot NC Start button must be pressed by operator.
- After shooting the paper tape must be taken gently from the nozzle surface and checked the shape of painting area by operator. The shooting point where the laser beam has made a shot must be exactly in the center of outer painted round area.

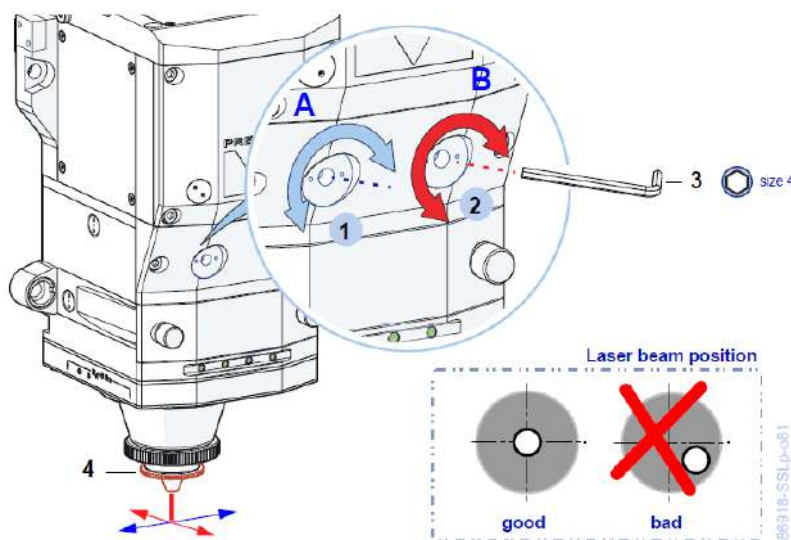


Figure 35

- 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 operator depends on where is the position of the point.

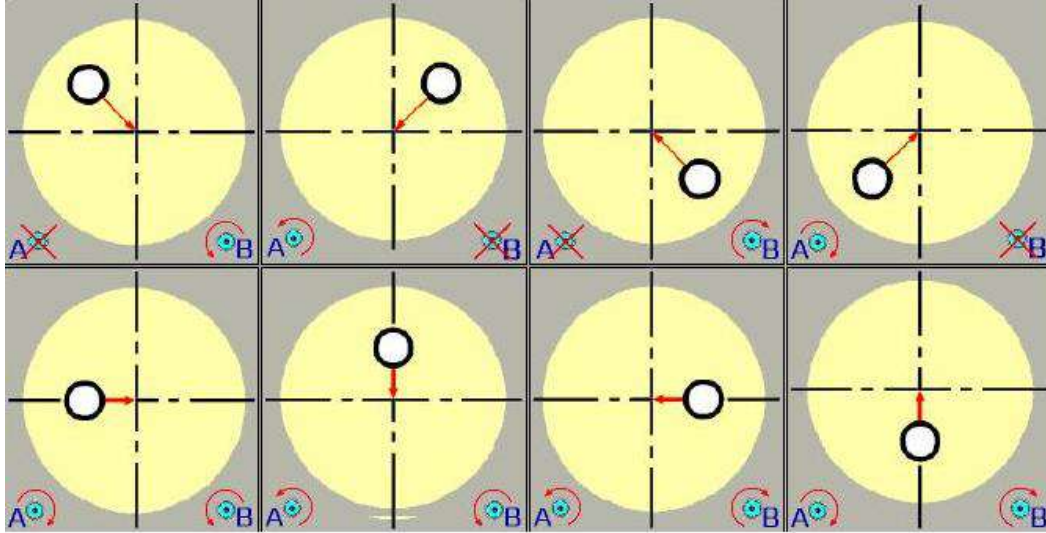


Figure 36

- Above instructions must be repeated to make the exact beam centering by operator.
- **HEAD CALIBRATION:** This function 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 the full head calibration the following instructions must be followed by operator:
 - When this function key is pressed the head is moved to calibration plate and after reaching its calibration position the head is gone down to the plate.
 - The head is stopped by system above 10 - 15 mm the surface of the plate. At the same time red lamp (**NC Stop**) is lighted up and green lamp (**NC Start**) is started 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.
- **RUN GAS EXHAUST:** This function is used to open the gas valve manually which one has been activated by system before (Air, oxygen or nitrogen). Besides this function is helped to operator to release all the gas from the pipes before shut down the system.

8. CUTTING OPTIONS PAGE

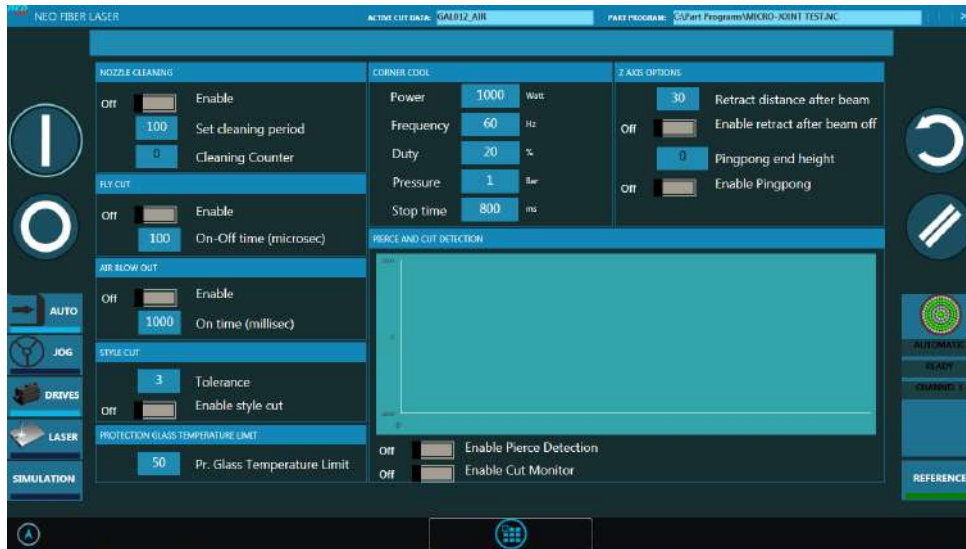


Figure 37

- **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.

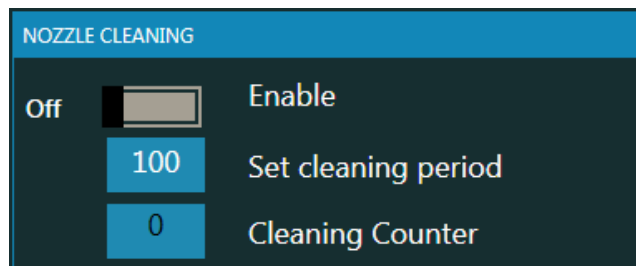


Figure 38

- **FLY CUT:** 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 39** the function will be disabled).

This function is used to cut faster than normal cutting same type of contours. In this function the cutting head is not raised up for retracting. When this function enabled the value into the “On/Off Time (microsecond)” will be taken into account by system. This value adjusts how many micro seconds the laser beam will be “ON” and “OFF”. For example the laser beam will be on for a 0,5 millisecc and next 0,5 millisecc the laser beam will be off if On/Off time adjusted as shown **Figure 39**.



IMPORTANT NOTE: To use this function properly regarding contours/parts have to be determined as will be cut with FlyCut function first in LANTEK CAD/CAM software before cutting on the machine. This function can be used up to 1.5 mm sheet metal.

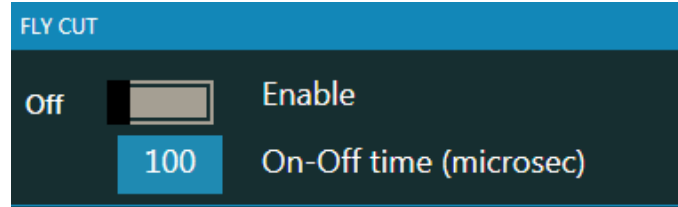


Figure 39

- **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 (millisec)” 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**.

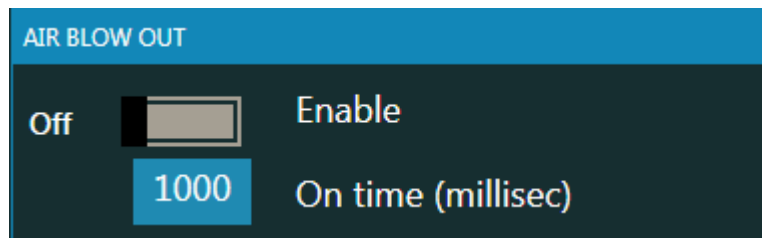


Figure 40

- **STYLE CUT:** 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.

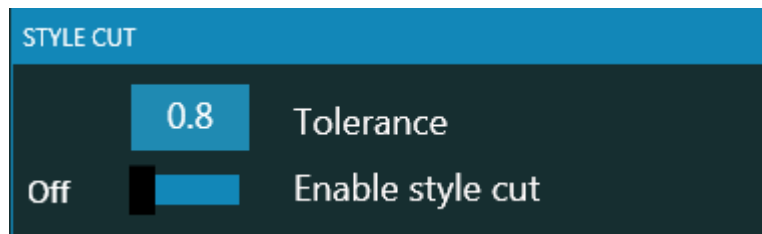


Figure 41

- **PROTECTION GLASS TEMPERATURE LIMIT:** In this area the operator may be set to temperature limit for protection glass as shown **Figure 42**. If the actual temperature reached to set value the axes movement, the laser beam and gas will be stopped by system automatically to protect the cutting head.

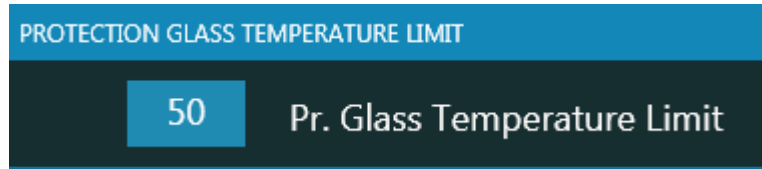


Figure 42

- **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.

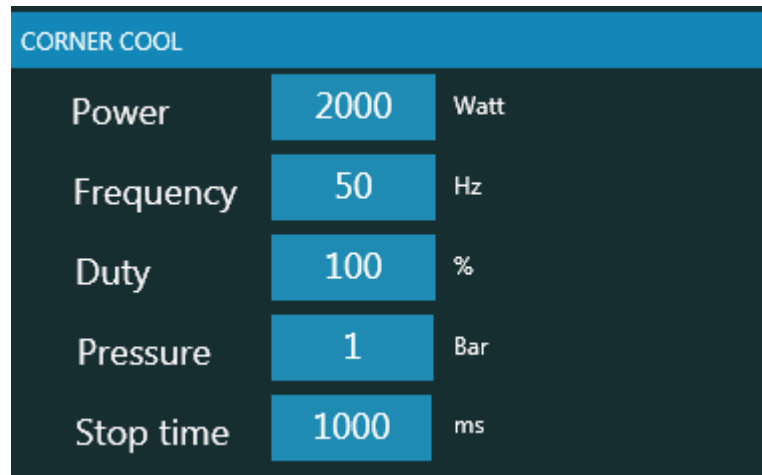


Figure 43



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!

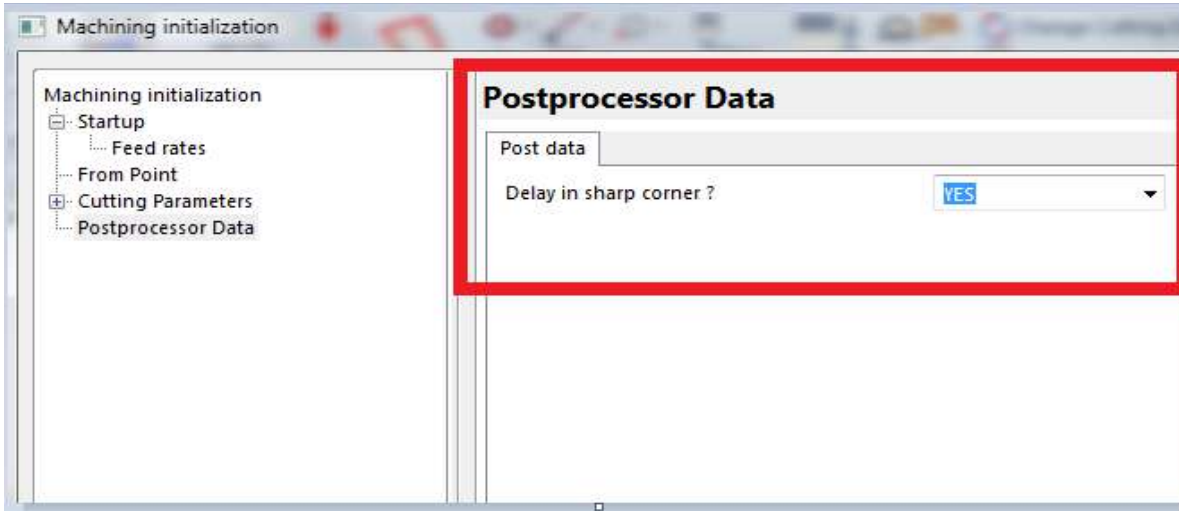


Figure 44

- **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!
 1. 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 **Figure 48**).



Figure 45

2. If “**Enable retract after beam off**” function is enabled as **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**).

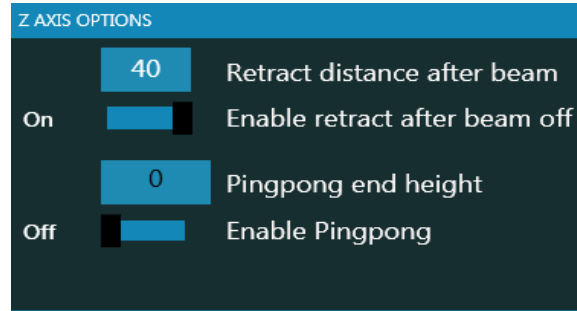


Figure 46

3. If “Enable Ping-Pong” function is enabled as shown **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 raised up too much and if the head hits to the part that might be dangerous!



Figure 47

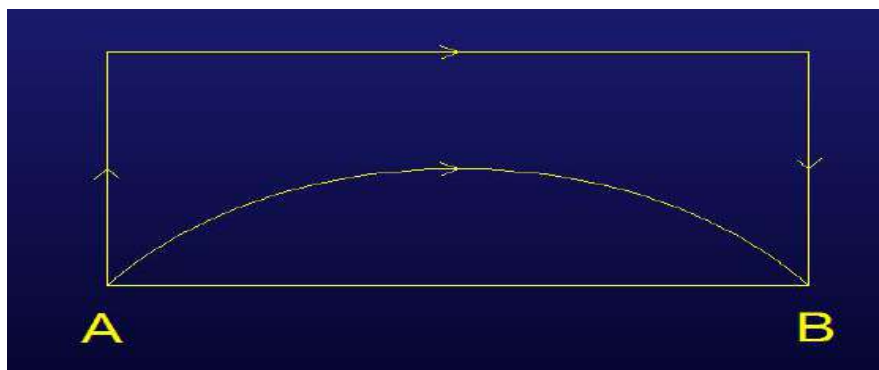


Figure 48

9. SHEET PARAMETERS PAGE

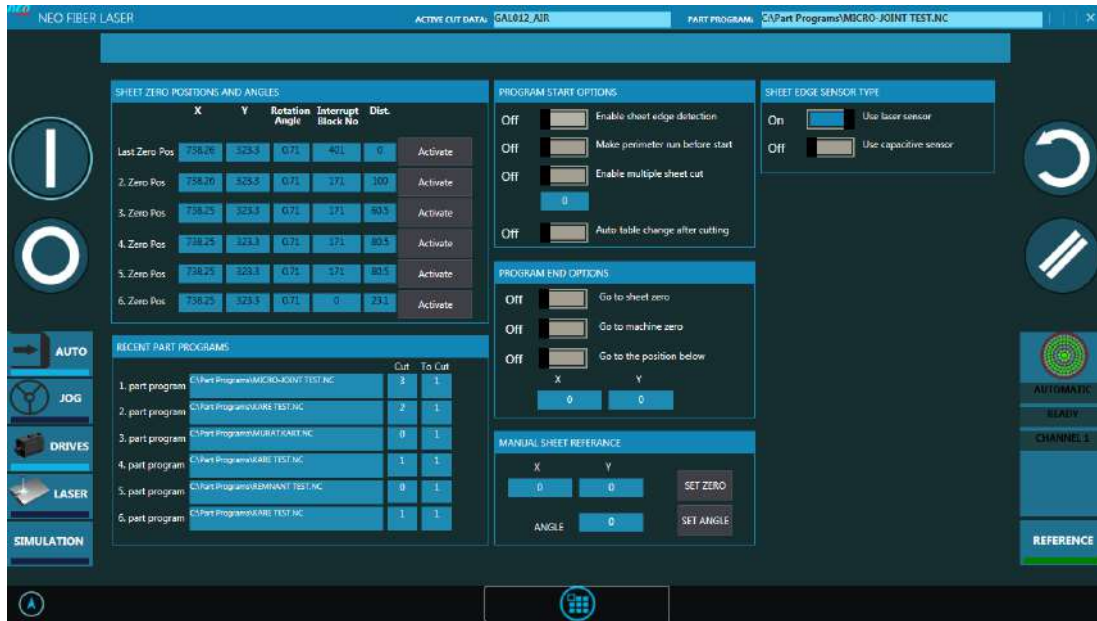


Figure 49

- **SHEET ZERO POSITIONS AND ANGLES:** 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.

SHEET ZERO POSITIONS AND ANGLES						
	X	Y	Rotation Angle	Interrupt Block No	Dist.	
Last Zero Pos	283.32	1033.73	0	281	100	Activate
2. Zero Pos	231.32	355.8	0	221	100	Activate
3. Zero Pos	231.32	355.8	0	221	100	Activate
4. Zero Pos	297.07	687.78	0	611	100	Activate
5. Zero Pos	740.92	1465.77	0	171	100	Activate
6. Zero Pos	740.92	1465.77	0	171	100	Activate

Figure 50

- **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.

RECENT PART PROGRAMS			
		Cut	To Cut
1. part program	C:\Part Programs\16MMTEST.NC	0	1
2. part program	C:\Part Programs\TEST_PART_150X115.NC	0	1
3. part program	C:\Part Programs\SQR75HOLE16.NC	0	1
4. part program	C:\Twincat\CNC\TRIM_YPLUS.NC	0	1
5. part program	C:\Part Programs\20MMTEST.NC	2	1
6. part program	C:\Part Programs\Z_Piercing_Test.NC	0	1

Figure 51

- **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 START OPTIONS		
Off	☐	Enable sheet edge detection
Off	☐	Make perimeter run before start
Off	☐	Enable multiple sheet cut
	100	
Off	☐	Auto table change after cutting

Figure 52

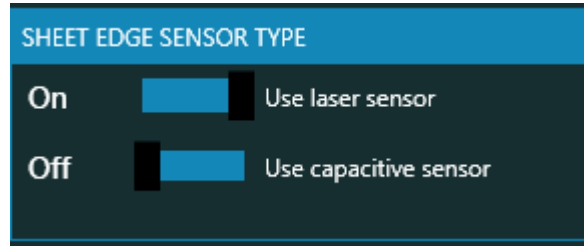


Figure 53

- **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.

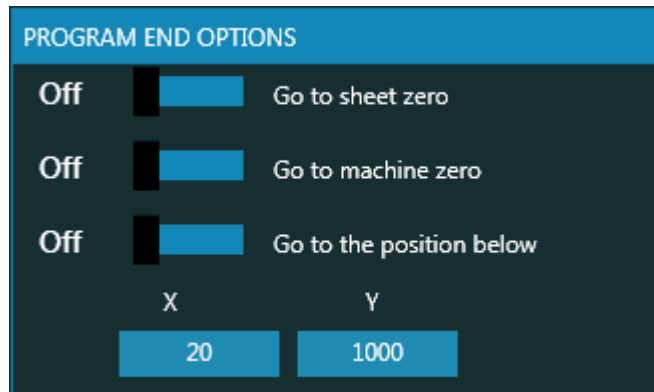


Figure 54

- **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.

MANUAL SHEET REFERENCE		
X	Y	
0	0	SET ZERO
ANGLE	0	SET ANGLE

Figure 55

10. SHUTTLE TABLE PAGE

This page is allowed the access the status of the shuttle table and control it. The machine has two cassettes (upper and lower cassettes) and 4, 6, 8 or 10 hydraulic pistons depending on machine's cutting length.

7.1 STATUS SIGNALS

In **Figure 56** red circular rounds are shown that the signal has not been coming and green ones are shown the signal has been coming actually.

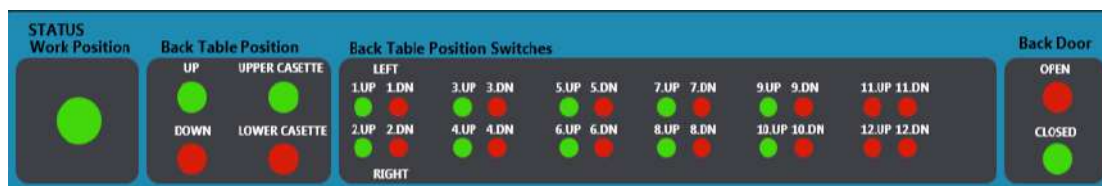


Figure 56

- **WORK POSITION:** In this area the status of work position can be seen by operator. If regarding signal is green as **Figure 56** that means one of cassette is located in the cutting area of the machine.
- **UP POSITION:** In this area the status of up position can be seen by operator. If regarding signal is green as **Figure 56** that means all the hydraulic pistons are at up position. If one or more hydraulic pistons are not at up position that status signal will be red.
- **DOWN POSITION:** In this area the status of down position can be seen by operator. If regarding signal is green as **Figure 56** that means all the hydraulic pistons are at down position. If one or more hydraulic pistons are not at down position that status signal will be red.
- **UPPER CASSETTE:** In this area the status of upper cassette position can be seen by operator. If regarding signal is green as **Figure 56** that means one of cassette is located at the back and upper rail normally.
- **LOWER CASSETTE:** In this area the status of lower cassette position can be seen by operator. If regarding signal is green as **Figure 56** that means one of cassette is located at the back and lower rail normally.
- **BACK TABLE POSITION SWITCHES:** In this area the status of all limit switches for hydraulic pistons can be seen by operator as **Figure 56**.
- **BACK DOOR:** In this area the status of the openable back door can be seen by operator. If CLOSED signal is green as **Figure 56** that means the back door is closed correctly.



IMPORTANT NOTE: The openable back door is connected to compressed air line and controlled by PLC system. If the compressed air pressure is not enough the back door will not be opened correctly!

7.2 CONTROL KEYS



IMPORTANT NOTE: The front gate must be closed and locked first and “Light Guard Reset” pushbutton must be pressed by operator if associated light is blinking before using AUTO or MANUAL keys!



Figure 57

- **AUTO:** This key is used to change the cassettes and hydraulic pistons' positions automatically by system according to the status signals. To use that key one of the cassettes must be placed in the cutting area (Status signal of work position must be green) and other one must be placed on the back area of the machine (Status signal of lower or upper cassette must be green).
- **MANUAL:** This key is used to change the cassettes and hydraulic pistons positions manually by operator according to the status signals. This key button generally uses that if Auto changing mode is cancelled somehow (light barrier fault, pressing the reset e.g.). When this key button is pressed the back cover is opened first.
- **HYDRAULICS ON:** The hydraulic system is activated in AUTO mode by system automatically. When UP key button is pressed by operator in MANUAL mode manually.
- **IN:** This key is used to move the cassette manually from back area to cutting area with lower speed manually. When this key button is pressed continuously the cassette moves forward direction until work position signal turns to green as **Figure 56**. When work position signal turn to green the cassette movement is stopped by system.
- **OUT:** This key button is used to move the cassette manually from cutting area to back area with lower speed manually. When this key button is pressed continuously the cassette moves backward direction until lower or upper cassette signal turn to green. When both cassettes are on back side (upper and lower cassette) signals turn to green the cassette movement is stopped by system.
- **UP:** This key is used to move the hydraulic pistons from DOWN to UP position manually. This key button is connected with Hydraulics On key button. When this key button is pressed continuously Hydraulics On signal turns to green, regarding box starts to blink and hydraulic pistons move up together until UP status signal turns to green. When all pistons are up position, Hydraulics On signal turns to red and movement stops by system.
- **DOWN:** This key is used to move the hydraulic pistons from UP to DOWN position manually. When this key button is pressed continuously hydraulic pistons move down together until DOWN status

signal turns to green. When all pistons are down position, Hydraulics On signal turns to red and movement is stopped by system.

11. LASER & CHILLER PAGE

This page is used to realize some conditions on connected laser unit such as output laser power (Watt) and mean temperature (°C) as shown **Figure 62**. 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 himself Baykal Laser Service Team must be informed by sending an email to the following address:

laser@baykal.com.tr

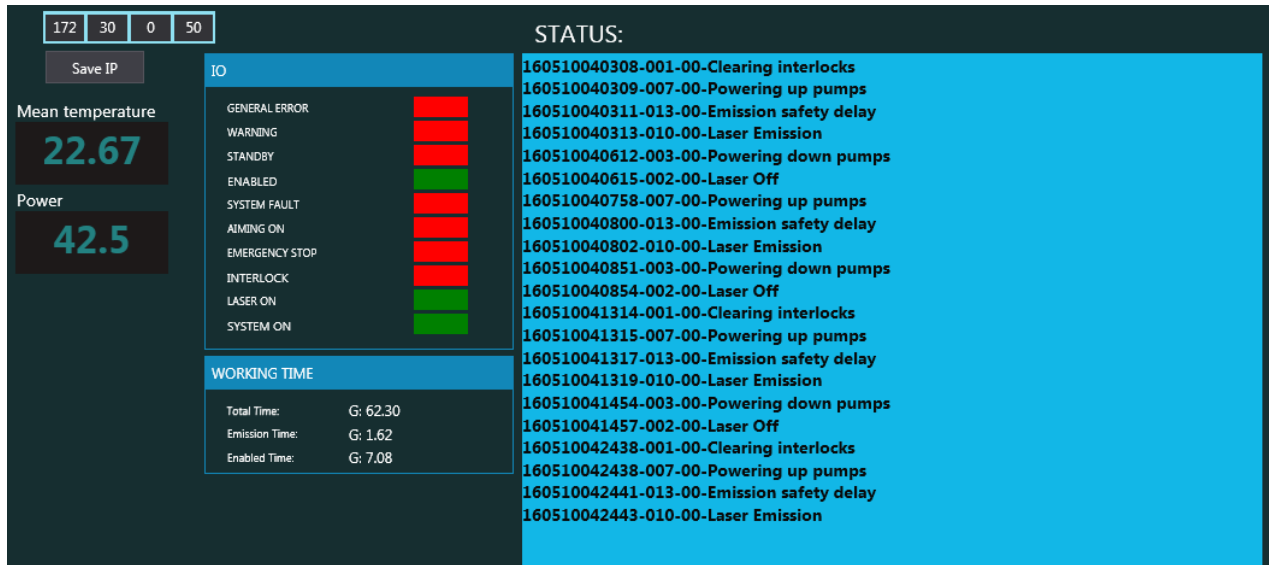


Figure 62

12. GRAPHIC VIEW PAGE

This page is allowed to check and watch the running part program on the controller and make a zoom for more detailed view to the operator.

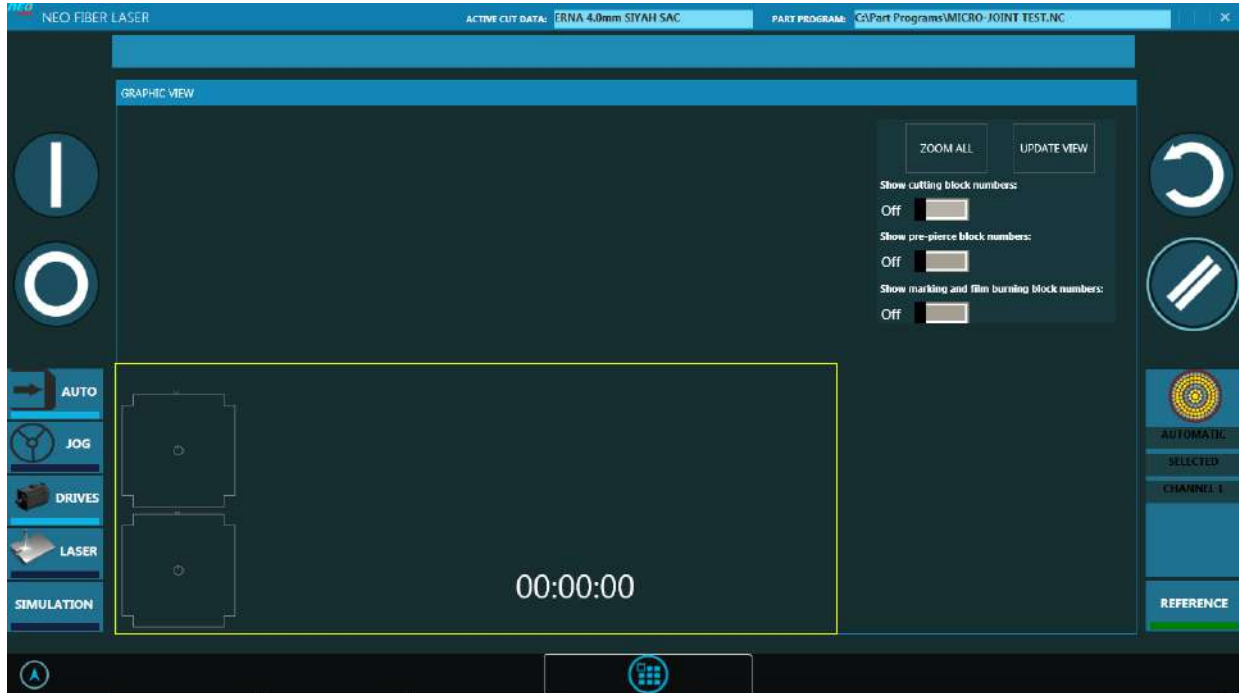


Figure 63

The yellow rectangle area in shown **Figure 64** is shown the sheet plate size which is come from G codes created by LANTEK CAD/CAM software.

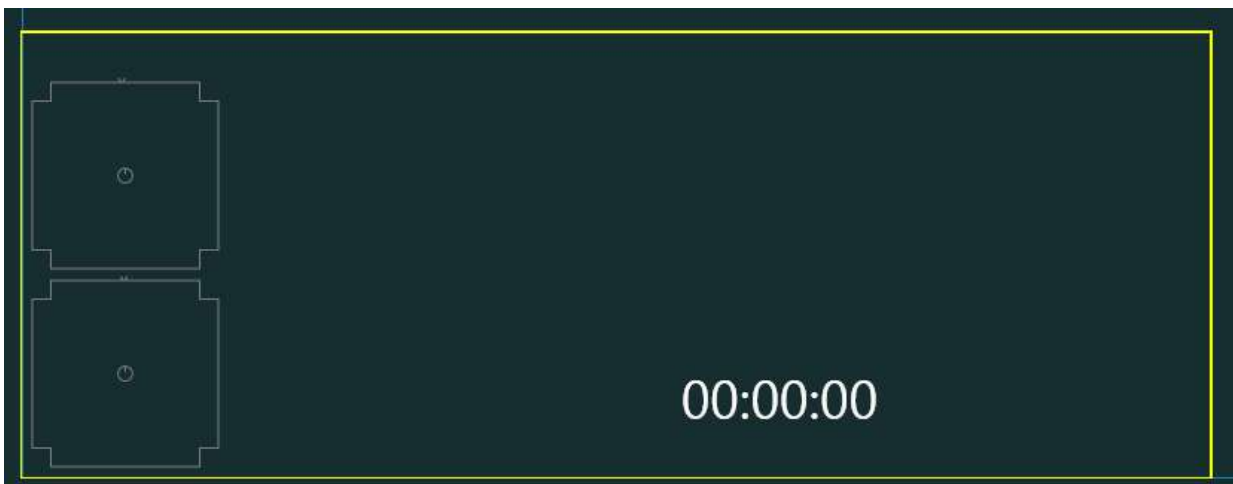


Figure 64

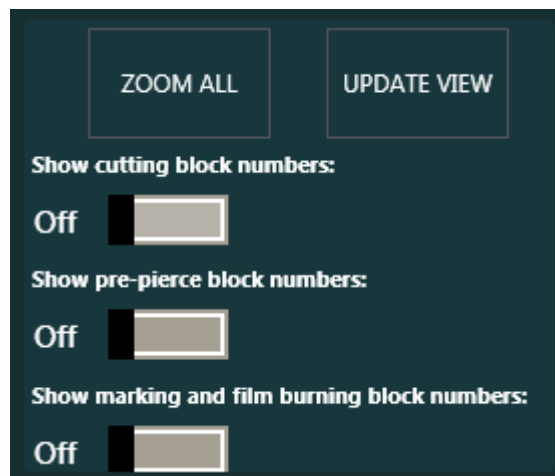


Figure 65

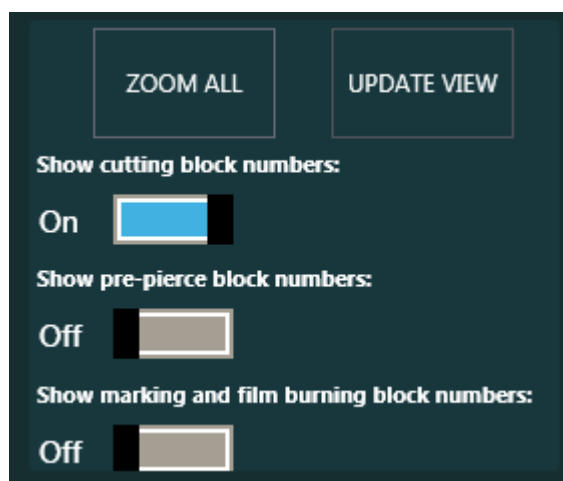


Figure 66

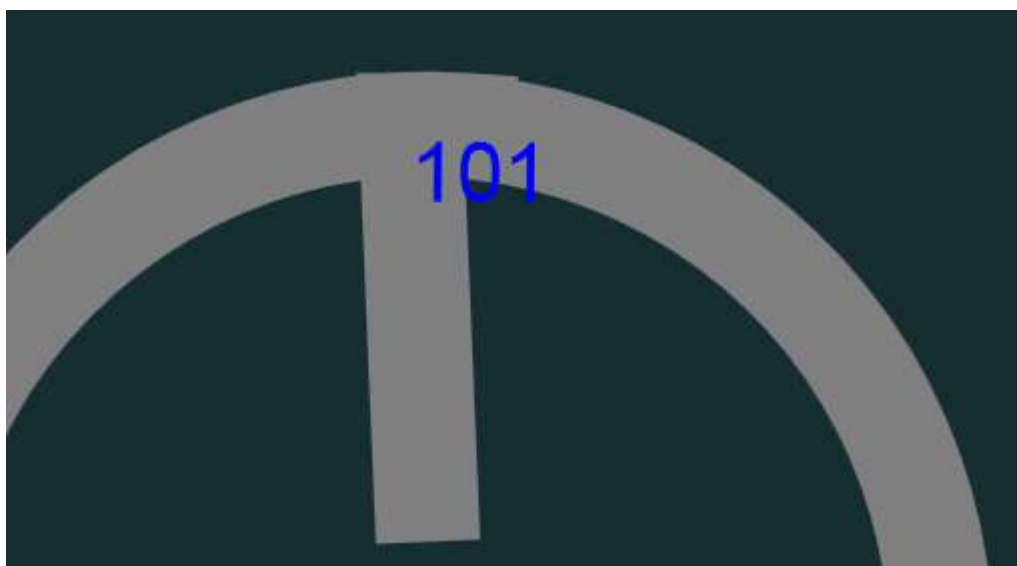


Figure 67

13. PART PROGRAMS PAGE

This page is allowed to copy any part program to be cut on the controller, select already copied part program and modify and save it. It is also used to continue the part program if Reset button is pressed already to the operator.

- **PROGRAM EDITOR:** This is actually simple text editor with basic features such as “SAVE, SAVE AS, FIND, REDO, UNDO, COPY, CUT, and PASTE “. If needed, selected part program can be modified here.
- **PROGRAM LIST:** All part program files with “NC “extension in the selected part program directory is listed in this section. Following fields and buttons can be used to edit part program list and the folder including these programs.
 - **Part program folder** text box shows the last selected part program directory. It can be flash drive, hard drive or any folder in your system.

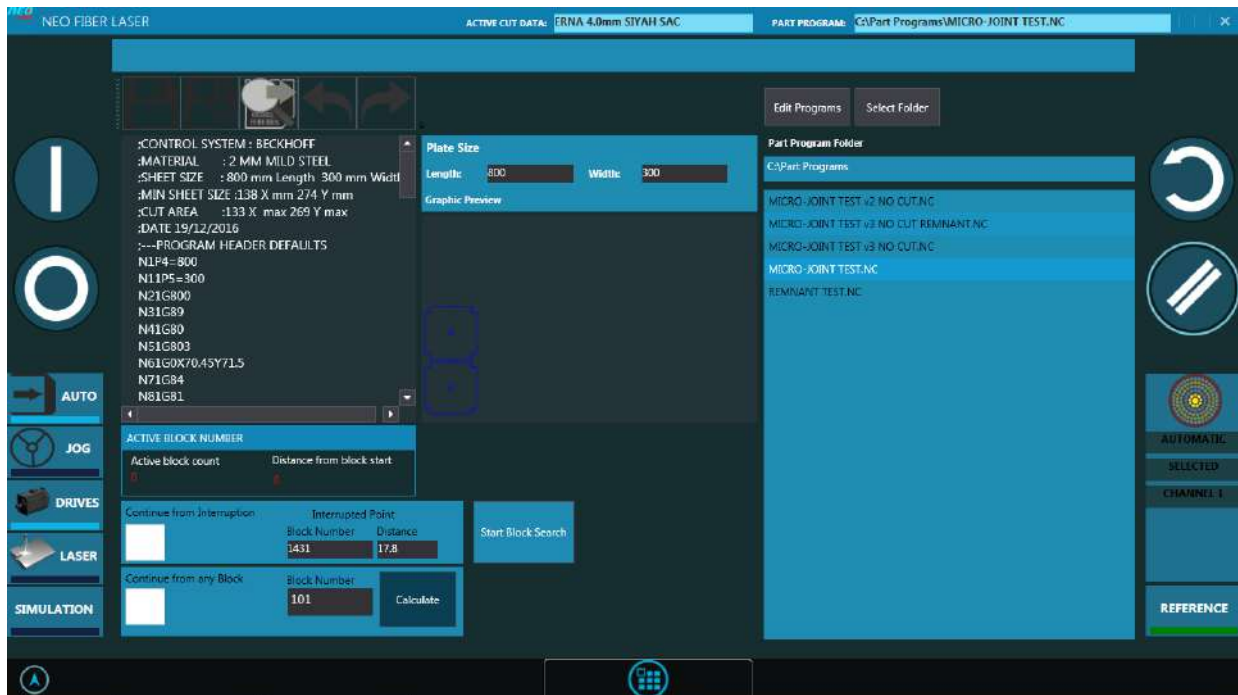


Figure 68

14. CUTTING PARAMETERS PAGE

> **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 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.

	CUTTING SETS				PIERCING SETS	ADVANCED CUTTING SETS	
	FINE (SET 1)	REGULAR (SET 2)	FAST (SET 3)	MARKING (SET 4)			
POWER	2300	2300	2300	1000		W	
LASER MODE	PULSE	CW	CW	PULSE			
FREQUENCY	10	10	10	10		HZ	
DUTY	50	50	50	50		%	
CUTTING SPEED	575	650	1000	25000		MM/MIN	
GAS TYPE	OXYGEN	OXYGEN	OXYGEN	OXYGEN			
PRESSURE	1	1	0.55	6		BAR	
POWER LEVEL	0	0	0	0		%	
CUTTING HEIGHT	1	1	1	3		MM	
FOCUS POINT	5.2	5.2	3.6	1		MM	
LEAD-IN FEED OVERRIDE	60	60	100	100		%	
LEAD-IN LENGHT	1	1	1	1		MM	
ACCELERATION OVERRIDE	10	10	25	100		%	
LEAD-IN DELAY	2	2	0.5	0		SEC	
DISTANCE CTRL REG. TIME	500	500	300	1		MSEC	
TOOL RADIUS	0.3	0.3	0.3	0.17		MM	

Figure 69

> **POWER:** This parameter is used to set the output laser power while cutting 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).



Figure 70

> **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%.

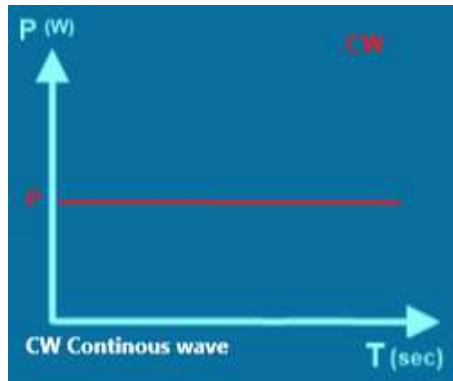


Figure 71

> **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)

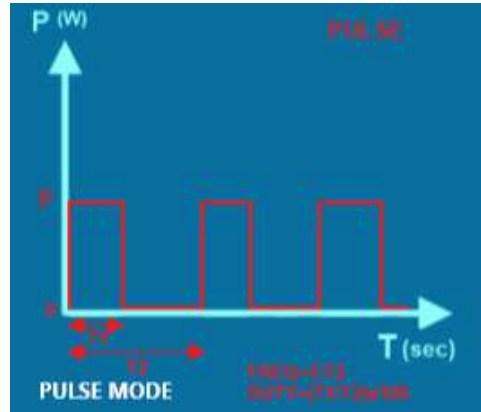


Figure 72

> **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 **Figure 69** T2 value can be calculated as following formula:

$$F = 1 / T2$$

$$10 = 1 / T2$$

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

LASER MODE	PULSE	CW	CW	PULSE	
FREQUENCY	10	10	10	10	HZ
DUTY	50	50	50	50	%

Figure 73

> **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 frequency is set to 10 as **Figure 69** T2 value can be calculated as following formula:

$$D = [T1 / T2] \times 100$$

$$50 = [T1 / 100] \times 100$$

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 between minimum 0.4 bar and maximum 25 bar.
- > **CUTTING HEIGHT:** This parameter is used to define the distance between nozzle and sheet surfaces. This value can be set between 0.5 mm and 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
- > **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 CONTROL REGULATION TIME:** 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.
- > **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

- > **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).



Figure 74

- > **CW (CONTINUOUS WAVE) 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%.

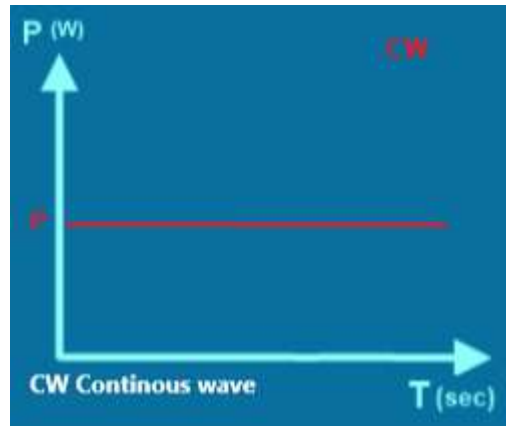


Figure 75

> **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)

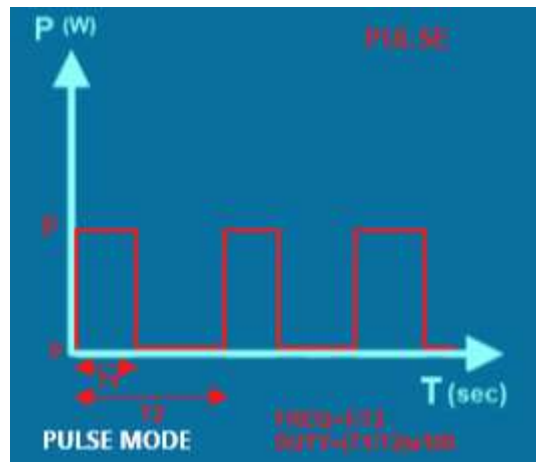


Figure 76

> **FREQUENCY:** This parameter is used to define

> **DUTY:** This parameter is used to define

> **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 END 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 aluminium cutting. It improves piercing and start of cutting. When enabling this function, machine makes a small circular hole after piercing.

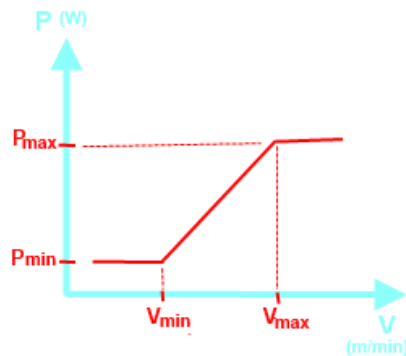


Figure 77

ADVANCED PIERCING PARAMETERS

This function used in thick stainless steel and aluminium 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.

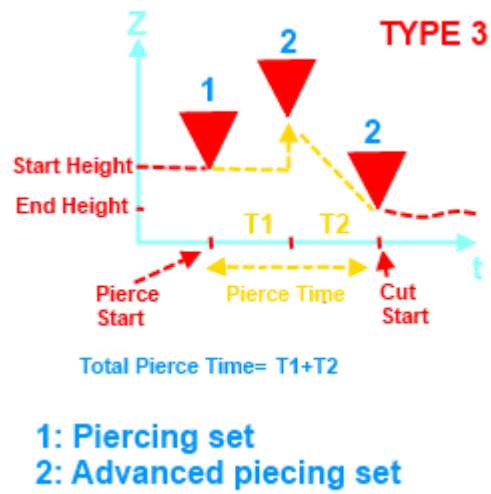


Figure 78

15. AUTOMATIC LUBRICATION SYSTEM

> **Lubricant:** To lubricating rack, and pinion system, and linear guide rails **Mobil Vactra No: 2** type of oil is recommended by Baykal Machine Tools as specified in DIN 51825. More detailed specifications about lubricant can be found in the following link:

<https://www.mobil.com/en/industrial/lubricants/products/mobil-vactra-oil-no-2>



Figure 79

> All the motion system must be had a light smear of oil all the time apparently when the machine is getting energized.

16. MAINTENANCE AND INSPECTION LIST

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

Please Note:



- 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 ACTIONS 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

TRANSFER SYSTEM	INSPECTION AND ACTIONS TO BE TAKEN	INTERVAL
	Inspect visually and test for proper operation	Daily
	Inspect visually and test for proper operation	Daily
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 ACTIONS 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

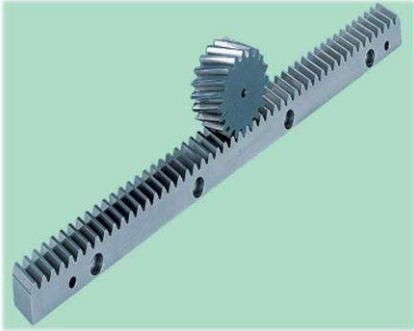
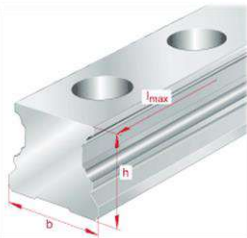
OPTIC SYSTEM	INSPECTION AND ACTIONS TO BE TAKEN	INTERVAL
General cleaning	Inspect visually and clean if required	Daily
Protection glass	Inspect visually and replace if required	Daily
Nozzle and ceramic part	Inspect visually and replace if required	Daily
Collimator lens temperature	Inspect visually and 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 ACTIONS 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

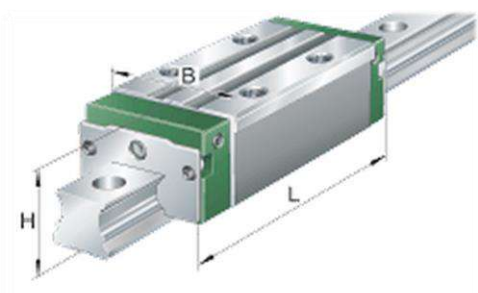
HYDRAULIC SYSTEM	INSPECTION AND ACTIONS TO BE TAKEN	INTERVAL
Oil leaks	Inspect visually and fix or replace if required	Daily
Oil level	Inspect visually and fill the tank if required	Weekly
Oil quality	Inspect visually and replace if required	2 years

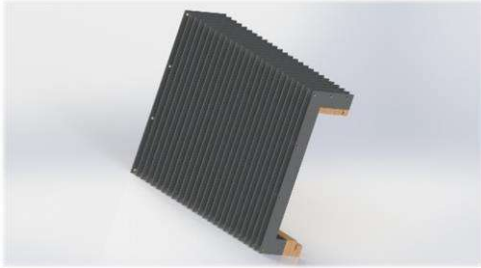
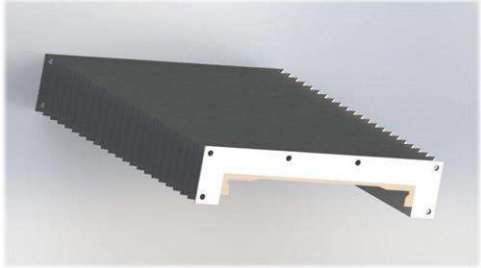
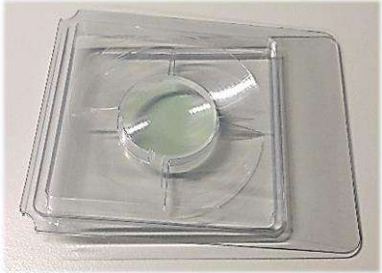
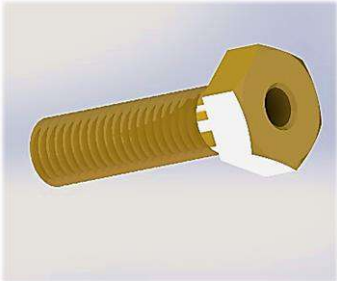
VENTILATION SYSTEM	INSPECTION AND ACTIONS TO BE TAKEN	INTERVAL
Air leaks	Inspect visually and fix or replace if required	Daily
Ventilation covers	Inspect visually and fix if required	Daily
Filters	Inspect visually and replace if required	Daily
Scrap bin	Inspect visually and clean if required	Weekly

17. SPARE PART LIST

	
KRAM ZST200PA5500012R1GS TOOTHED RACK	RULM 6012 BEARING
	
RULM NAF405517 BEARING	REDU NR372-100L-4B REDUCTOR
	
SENS NBN12-18GM50-A2-V1 BACK TABLE LIMIT SWITCH	RULM 6201 BEARING
	
KIZA TKVD15-G3-420-B Z AXIS LINEAR GUIDEWAY	KAPL GS19-98ShA-Q19-Q12 ROTEX COUPLING

	
MOTO AM8042-0F21 Z AXIS SERVOMOTOR	HIDR SILI-50x28x235 HYDRAULIC CYLINDER
	
MOTO AM3072-0P40-0000 X AXIS SERVOMOTOR	MOTO AM8053-0K20 Y AXIS SERVOMOTOR
	
MOTO AM8063-0N20 X AXIS SERVOMOTOR	MOTO AM8553-0K20 Y AXIS SERVOMOTOR

	
PNOM 19210 PNEUMATIC CYLINDER	BMIL R1502-040-85 BALL SCREW NUT
	
KABL E6-62-12-200-0 CABLE DUCT	KABL E6-62-15-200-0 CABLE DUCT
	
KIZA AR-KWVE35-BSL-G3-V1 X AXIS LINEAR GUIDE	KIZA AR-KWVE25-B-S-G3-V1 Y AXIS LINEAR GUIDE
	
KIZA AR-KWVE15-B-S-G3-V1 Z AXIS LINEAR GUIDE	TEKE 150x45-PUR TRANSFER TABLE ROLLER

			
KORUK BLS2040-N9003-R1 Y AXIS BELLOW		KORUK BLS2060-N9009-R0 Z AXIS BELLOW	
			
VALF LGS3VD HOERBIGER GAS REGULATOR		LAZE P0595-58601 PROCUTTER PROTECTIIN GLASS	
			
MS6-LFM-B FINEFILTER CARTRIDGE	MS6-LFM-A MICROFILTER CARTRIDGE	MS6-LFP-C FILTER CARTRIDGE	
			
MS6-LFX ACTIVATED CARBON FILTER CARTRIDGE		BLS1530-E4014-R0 BRASS BOLT	