

MSF

**YOUR PARTNER FOR
CUTTING AND AUTOMATION**

MicroStep[®]
South Africa



The **MSF machine** is a powerful laser cutting system for cutting materials with a fiber laser. The machine is designed for the production of highly accurate parts at high cutting speeds, with surprisingly low maintenance and operational costs. The outstanding dynamics of **MSF** is achieved by a low-seated gantry, digital AC drives and precise planetary gears. The machine is by default equipped with an automatic shuttle table.

1. MicroStep CNC fiber laser machine

The **MSF machine** is a powerful laser cutting system for cutting materials with a fiber laser, or a combination of fiber laser and plasma. The machine is designed for the production of highly accurate parts at high cutting speeds along with surprisingly low maintenance and operational costs. Cutting of non-ferrous metals such as copper or brass is also possible. The outstanding dynamics of **MSF** is achieved by a low-seated gantry, digital AC drives and precise planetary gears. The position of all axes is measured by incremental encoders. Due to the wavelength, the complete system is enclosed in a security cabin which provides good accessibility while preserving the necessary protection required. For convenient material handling, the machine is equipped with a MicroStep shuttle table that significantly reduces the idle time during loading and unloading and increases the productivity of the machine.

2. Construction of the MSF machine

It has an impressive gantry construction with double-sided drives through ground rack and pinions with helical gears. The machine frame consists of thick welded profiles, while guidelines of exchangeable grates are embedded on the frame inside, and guidelines for the gantry and drive racks on the outside.

2.1 Gantry

The gantry of the machine is created from a steel carrier beam of square section, into which a tube for increased torsion rigidity is welded. The cross support traverses on the carrier beam, while the drive is realised through a gear rack with helical gearing. The gantry and rack guidelines are covered by accordion bellows. The drive motion for lifting the cutting head is realised through a gear rack with helical gearing.



The machine drives use AC synchronous motors with Panasonic servo drivers. The extension of grates during exchange is driven by asynchronous motors with frequency converters.

The cabin interior contains optimal illumination of the entire working area through the use of LED stripes. The electrical cabinet also contains internal lights.

2.2 Automatic lubrication system

Proper lubrication of the racks and linear guidelines is performed by an automatic lubrication system with a progressive lubrication dispenser. Frequency of the lubrication period is controlled from the control system; the parameters are adjustable to suit the machine usage.

To avoid unplanned delays the control system only signalizes the requirement for lubrication, but the operator decides when the lubrication cycle should be started.

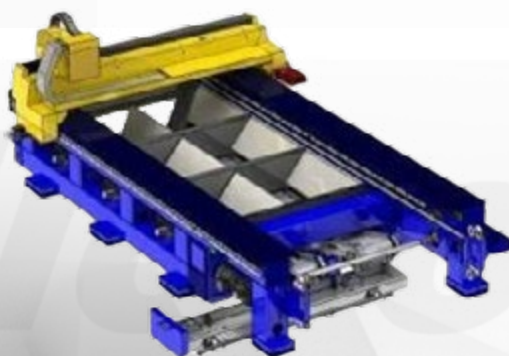


2.3 The fume extraction table

Integrated into the frame bottom sides are the channels for the machine exhaust system, divided into zones by cross rails installed directly to the frame construction. The length of any 1 zone is 890mm and the width of the zone depends on width of the working area divided by two (two parallel lines of zones e.g. for 1500mm the working width of the zone is 836mm). Each zone is automatically activated when the cutting torch enters its area to achieve high efficiency of fume extraction. The cutting table is separate from the machine (gantry and track).

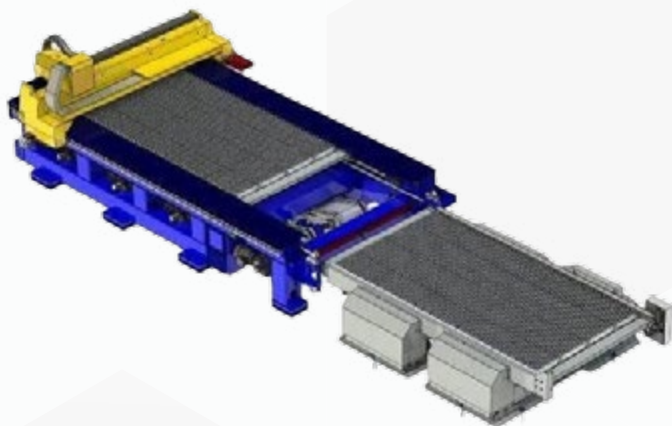
2.4 Conveyor for scrap removal

The table has a built in integrated conveyor for scrap removal. The bottom part of the exhaust sections are closed by a belt conveyor, designed for the transportation of waste and small cut parts that may fall down through the working table grate slats after cutting. The machine has two conveyors in parallel that are embedded in the machine. Cutting waste is transported by the conveyor to a container placed under the gantry parking position. The container can be manually pulled out and emptied. The conveyor can be run in the opposite direction for service purposes. The removal of any remaining fumes after cutting completion is ensured by an over-run on the filtering unit (TEKA or Donaldson).



2.5 Shuttle table system

The shuttle table is equipped with a grid manipulator that automatically exchanges the table in working zone/material manipulation zone. The exchangeable system consists of container hydraulics and a chain drive for grate insertion into the working position. When the grate is in the working position and also in the lifting container parking position, it is fixed by a lock, controlled by pneumatics.



2.6 Safety protection by light guards

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2.7 Manual control panel for table change control (CB-EXC)

The CB-EXC panel is located on the back side of the machine. Machine operator can use it to easily and safely control the table change. He can start and stop the table change cycle or he can also block the table change during material loading.

2.8 Side air blow unit

The side air blow unit is directed at the nozzle. This is used to re-direct anti-spatter compounds with high pressure air to keep particles off the material, lens and nozzle during high speed piercing operations. The side jet improves the piercing process. It blows molten material away and so protects the nozzle and cutting head against spatter.



2.9 Positioning laser diode

The position of the nozzle on the plate is indicated by a red dot laser diode. It is an optical aid when shifting the zero point to another random point on the sheet.



2.10 Camera on the cutting head

To enable users to inspect the cutting process, a bullet camera is mounted on the cutting head. Its feed, showing the cutting area, can be viewed on the screen of the machine's MMI console (Man-Machine Interface) in real time.

Because of hardware limitations, only one cutting head camera can be used in the basic configuration and its feed is not recorded. Recording, cameras on more cutting heads and surveillance of the whole interior of the work cabin, are enabled with the option of a separate camera system.



2.11 Automatic plate alignment via capacitive sensor in the cutting head

The automatic plate alignment feature in the control system allows the operator to set the starting point and rotation of the plate. It is also capable of checking the dimensions (length and width) of a plate.

Measuring is performed by the capacitive sensor of the cutting head in several steps, depending on the chosen detection mode.

There are three plate detection modes to choose from:

- corner detection (without rotation)
- corner and angle detection
- corner, angle detection and verification of plate dimensions

In order to clean the nozzle from possible spatter after piercing, the cutting head will automatically perform a nozzle cleaning cycle after a programmed number of piercings and also, if required, perform cleaning on the request of an operator. After automatic cleaning of the nozzle the machine will automatically continue its cutting program.

The calibration of the capacitive height sensor can be executed automatically after every cleaning cycle, or on the request of the operator. The cutting head positions itself above the small plate and moves down to touch it. Then it performs the measurement and linearization of the voltage / distance curve in the capacitive sensor electronics.

The nozzle camera is used for checking the status of the nozzle. After positioning above the camera, the magnified picture of the nozzle is shown on the LCD of the MMI console. Then it is up to the operator to decide if a nozzle change or another cleaning cycle is necessary.

2.12 Cleaning and calibration station for nozzles (LU3K)

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2.13 One-button centring

To achieve optimal cutting process the laser beam must be centred with the gas nozzle. If the beam is not aligned with the centre of the nozzle it results in decreased stability of the cutting process due to uneven distribution of cutting gas.

The alignment test is done with a low-power laser pulse on a sample (paper sticker or adhesive tape) glued directly to the cutting nozzle and is triggered by clicking one button (also during a CNC program break).

The change of the alignment is done manually by turning adjustment screws on the laser cutting head.

2.14 Smart Z Movement (SZM)

Increasing cutting efficiency by employing function that performs the cutting head moves in an optimal manner from point to point for piercing various holes and cuts on the worksheet. Torch lifting/lowering simultaneously with torch travel in the X- and Y-directions.

2.15 Specifications of MSF

Specification	Value
Working area	(Error! Reference source not found. mm + 150 mm*) × (Error Reference source not found. mm +100 mm)
Guides	Liner guidelines Rexroth
Racks, Drives	High-precision racks on both axes ATLANTA, double side driven gantry
Gears	STÖBER
Drive motors	Service-free, processor controlled AC-Servos Panasonic
Positioning speed	Up to 130 m/min in one axis, 180 m/min in both axis
Acceleration	10 m/s ²
Positioning speed of Z axis	50 m/min
Stroke of Z axis	150 mm
Acceleration in Z axis	0.75 G
Positional deviation Pa**	0.,07 mm in compliance with VDI/DGQ 3441
Positional scatter (repeatability) Ps**	0.03 mm in compliance with VDI/DGQ 3441
Ambient operating temperature	+10 °C to +35 °C
Time of changing pallets	31 seconds (3m x 1.5m); 65 seconds (6m x 2m); 100 seconds (12m x 2m);
Relative air humidity	0 to 90 %

*The real working length is approx. 150 mm longer than the declared length.

**The attainable accuracy depends on, among other things, the work piece type, its pre-treatment, sheet size and the position in the working area. It is in compliance with VDI/DGQ 3441, measured length 1 m.

PROMINENT FEATURES:

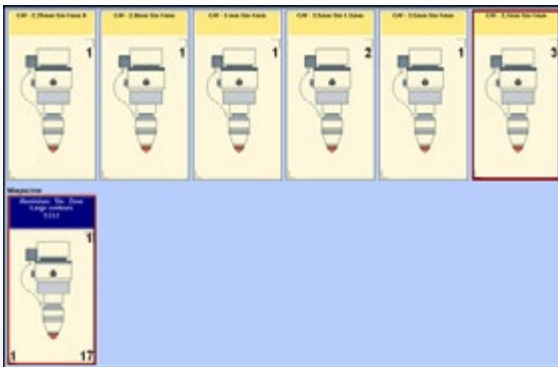
- Low required space
- High efficiency
- Requires no heating period
- The entire machine is nearly maintenance-free
- Only gases for the cutting process are required
- Excellent cost/performance ratio and
- Excellent cutting results
- The closed cabin design ensures maximum entrance and highest safety features

3. MicroStep control system iMSNC®

Figure 14 MMI with an operator panel MicroStep's in house developed control system iMSNC® is one of the most advanced control systems in CNC cutting machinery. The system provides easy, user friendly and thus reliable operation of CNC cutting machines via modern user interfaces: an operator console with 24" TFT touch screen and one control panel with LCD display. The removable control panel allows the operator to go over the plate and precisely set the starting point for cutting. To achieve maximum utilization and flexibility of the machine operation, the operator console offers the possibility to prepare and edit cutting plans simultaneously with the cutting process. Easy operations are available by the integral keyboard and mouse.



Along with the standard features (automatic setting of cutting parameters, test run, mirroring, scaling, rotation of cutting plans...) iMSNC® incorporates advanced functions: preparation of cutting plans during machine operation, jog mode, reverse motion, global marking, parametrical dynamic piercing, kerf compensation, restart of cutting from point of interruption, virtual tool magazine – customized database of parameters for all technologies. The zone management (batch cutting) feature allows division of the cutting table into independent zones with pre-defined cutting plans for each zone. This prevents delays when switching programs and increases production efficiency.



3.1 Integrated parameter databases

Integrated parameter databases for different technologies ensure high efficiency and stable quality of cuts while interactive elements with bubble help allow convenient real-time control of the machine.

Parameters of some technologies are organised in five sets enabling more accurate setting of parameter values for different technological operations. Some parameter groups are identical but their values might be different.

The parameter system provides the means for having different settings for different entities in the cutting program. The particular choice of technological operation is selected according to tool application:

- Large contours
- Medium contours
- Small holes
- Laser marking
- Laser punching

Tool name	Aluminium 5in 2mm (Active)					
Parameter group	Large contours					
Parameter	Large contours	Medium contours	Small holes	Laser marking	Laser punching	Unit
* Torch type	/ (Laser)					
Kerf width	0.2	0.2	0.2	0	0.2	[mm]
Lens	0 (Lens 5")					
Focus correction 5"	-3					[mm]
Focus correction 7.5"	-0.5					[mm]
Max. ATHC rising speed	3000	3000	3000	1000	3000	[mm/min]
Max. ATHC falling speed	100					[mm/min]
ATHC speed correction	0	0	0	100	0	[mm/min]
Alternative THC	0 (No)					
Traverse height	0 (Standard)					
Acceleration	1000					[mm/s ²]
Deceleration	1000					[mm/s ²]
Radial acceleration	500	500	500	300	500	[mm/s ²]
Creeping length						[mm]
Cutting off advance	0	0	0	0.1	0	[mm]
Ignition height (II)						[mm]
Piercing height (PII)	0.8	0.8	0.8	3	0.8	[mm]
Piercing time (PT)	0.5	0.1	0.1	0	0.5	[s]
Process sensor level						[%]
Focus offset for piercing	-1	-3	-2	3	-1	[mm]
Piercing mid focus						[mm]
Piercing end focus						[mm]
Piercing focus stop time						[s]
Piercing focus increment						[mm]
Piercing mode	0 (CW)	0 (CW)	0 (CW)	1 (Gated Pulse)	0 (CW)	
Piercing start power						[W]
Piercing end power	2000	2000	2000	0	2000	[W]
Piercing power step time						[s]
Piercing power increment						[W]
Piercing frequency						[Hz]
Piercing start duty cycle						[%]
Piercing end duty cycle						[%]

Parameters for tools are split into several sets (screens) for more convenient and comfortable viewing/editing. The stored parameters and processes make it possible to increase the quality of cuts and process reliability; as well they increase the productivity of the machine.

- Automatic compensation of the cutting kerf in order to achieve required dimensions of parts.
- Constant distance between the nozzle and material during piercing and cutting is guaranteed by using a capacitive sensor. This also produces a consistent focusing position even on uneven material.
- Fast cutting on thin material through cutting and piercing on the fly.
- Cutting small pieces of non-metals without a special distance sensor by disabling the height control of the cutting head.
- Generation of small bridges (micro-tags) that prevent small parts from falling out, also on existing cutting programs.
- Increased cutting stability during high pressure cutting through the use of special cutting start parameters (Creeping length, Lead in speed, Lead in power).
- Reduction of piercing times for thicker material by using a cw-program and an additional shield gas.
- The focus position is automatically adapted to the material type and thickness of material – the result: maximum cutting speed and edge quality without manual adjustments over the whole working area and the whole range of material.
- To keep the cutting quality of sharp corners and small contours to an optimum, we can automatically adjust the laser power to the cutting speed (if the speed reduces in the corner, the power reduces in sync).
- Detection of missing or bad mounted parts around the cutting head, and in case of a problem, receiving of a message. This increases process safety.

An extensive macro library with a database of parameters directly on the CNC-control system enables fast transfer of set parameters for different materials and thicknesses. This remarkably reduces the preparation time for the cutting process.

The database includes the cutting parameters for standard materials (steel, stainless steel, aluminium) for all common thicknesses and ranges. Based on these references values, the operator can easily improve the cutting quality for different types of material or can themselves create new parameter sets for special materials and save in the library.

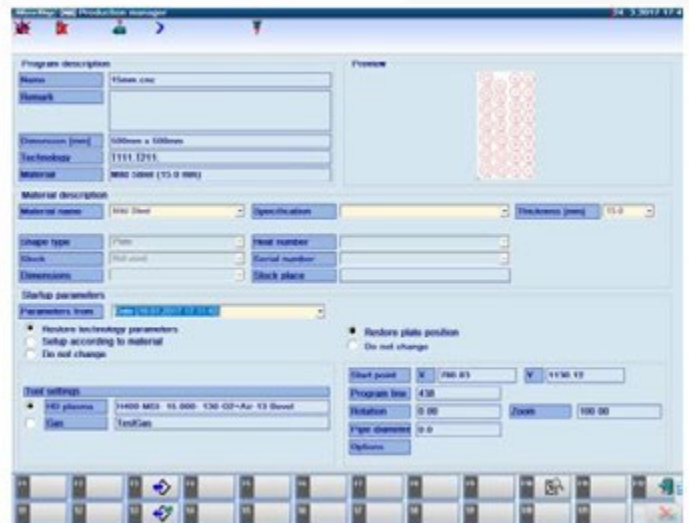
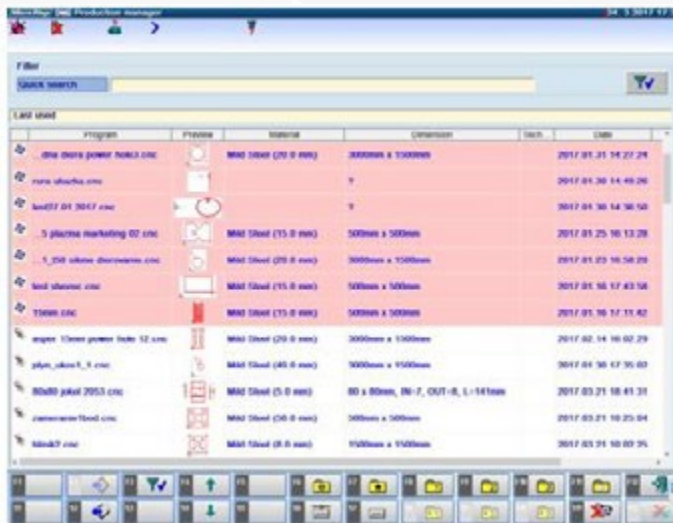
3.2 Load CNC

Starting conditions for loading of CNC programs modules manages two situations:

- Loading CNC program from history list
- Continuing in interrupted CNC program by cutting another CNC program. The position of the original plate cannot not be changed. "Interrupted" – program has been partially completed but remains unfinished. The program will be finished later. Technology parameters are stored and at next loading of the CNC program they are restored.

In both situation the CNC programs are remembering the position of starting point and rotation of program. The history list of CNC programs is displayed in the form of a table.

CNC programs marked as "interrupted" are placed on the top of the table and highlighted by an icon and background colour. Remaining programs in the list are ordered according to the date of processing. Custom ordering of the cutting programs is performed by clicking on corresponding column.



3.3 Function "Start from Selected Part"

When a program is loaded a window can be open with two views: a cutting plan view showing the contour of the whole cutting plan and a CNC code view with a list of part names (or sequential numbers, if name are not available). Each part from the list can be expanded to show the whole CNC program. When moving the cursor in the code view, the nearest part will be highlighted in the plan view.



It is possible to click on a part in any view highlighting it in both views. Then it is possible to start cutting from that highlighted part – either 1 piece or until the end (or interruption) of the program.



3.4 Intranet applications

iMSNC® includes a novel web-based interface for accessing each machine from the company intranet via a web browser. Each machine has its own home page which serves as a gateway for intranet applications. Furthermore, the machine can be integrated into the workflow of the company with a range of Intranet applications and accessed via SQL databases and web services.

3.4.1 Management of Cutting Plans (MRP)

MRP Management of cutting plans is an intranet application that contributes to efficient management of machine production and provides information about planned utilisation.

It is closely related to AsperWin CAM software. AsperWin is used to generate CNC programs directly into the application, creating a job list the operator can follow. It improves and simplifies utilization of multiple machines that share a common job list so that when a machine is free it can cut the next applicable program. Such a job list can also be used as an ordering list for material release from stock or later to monitor history of technological processes.



The generated programs contain parameters such as material types, thicknesses, technology requirements e.g. quality of cutting, etc. These parameters are used for automatic configuration of iMSNC. The system makes decisions about assignment of parameters to different processed materials and technological specifications. Recent modifications of technological parameters are backed-up, and default parameters based on energy source manufacturer data are also available.

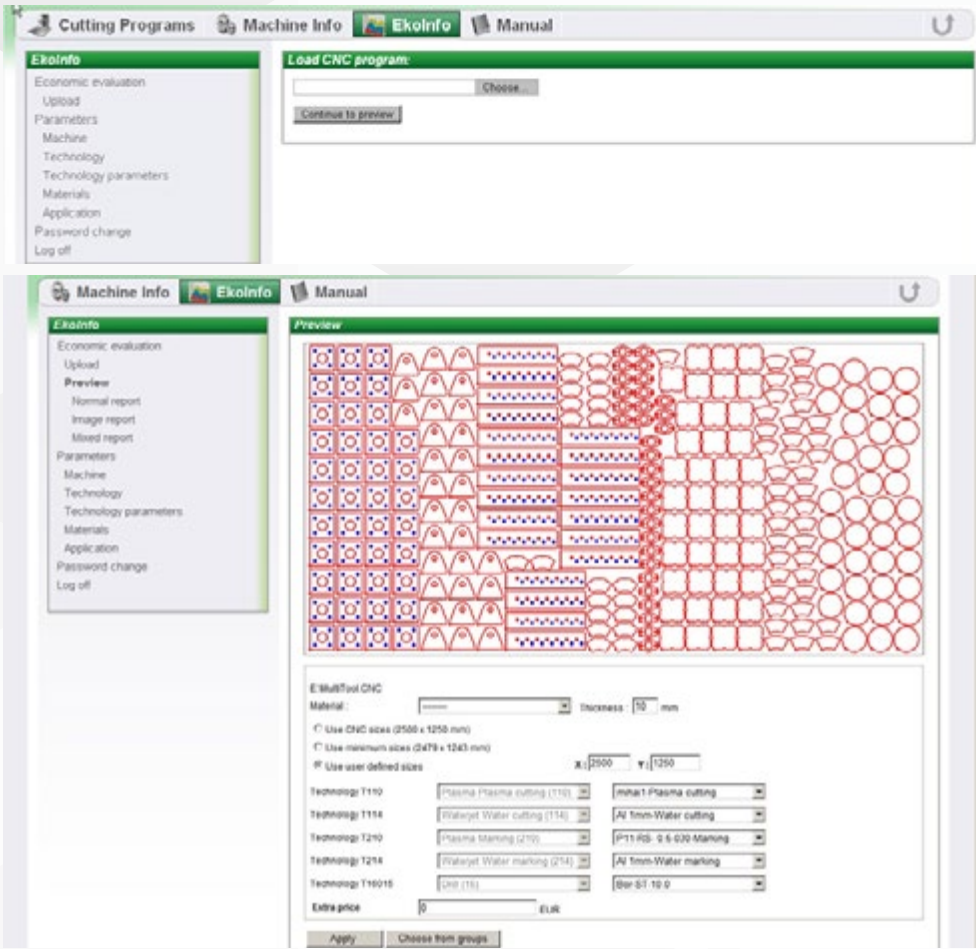
The program is interconnected with EkoInfo for creation of economic reports and involves self-learning features.

3.4.2 EkoInfo

EkoInfo is an intranet application processes production data related to machine operation. It enables its users to evaluate production and analyse its efficiency.

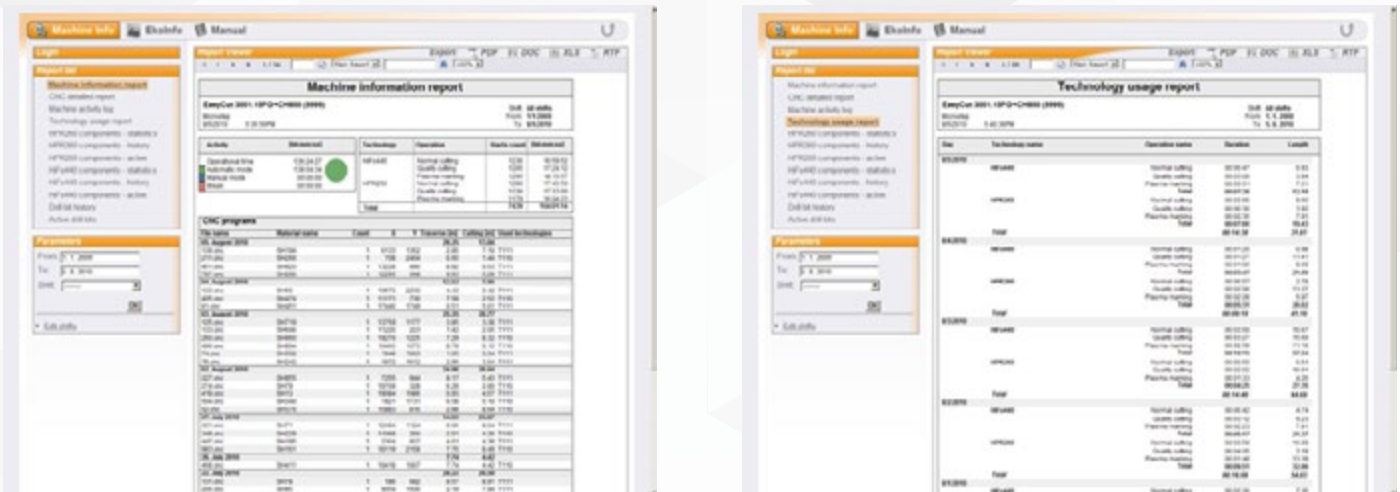
It provides information on:

- Machine and its parameters – operating and cutting costs, machine speeds and technology change times
- Technologies and their parameters – priority (order in a production cycle), times for various actions, cutting costs
- Material parameters and more.



3.4.3 Machine Info

Machine information report is a part of the intranet application that provides detailed information about machine operation.



The report comprises summarised information about machine operation for given time period comprises time information (for example automatic and manual mode, etc.), technologies used and processed CNC programs. Via interactive switching it is possible to find filtered (more specific) information:

- **CNC detailed report.** According to CNC program name list, the report contains selected event (e.g. rapid traverse movements, cutting, interruptions, error messages, etc.), that were active during processing specific program.
- **Machine activity log.** Activity log contains a summary of information about the machine operation condition, error messages, etc. The information can be evaluated also by personalising (in the case of personnel logging in with their names).
- **Technology usage report.** An overview of used technological operations with details of individual parameter groups that were used by the machine in a certain time period (e.g. parameter groups valid for Plasma HPR260 are straight and bevel cutting, marking and punching).
- **Plasma torch components – statistics.** Complete time summary of consumable material usage for particular plasma source (actual operation life-time) with description of applied technological operations (groups of cutting parameters) and their actual time duration.
- **Plasma torch components – active.** List of components for particular plasma source that are at present used on an active cutting head (torch).
- **Plasma torch components – history.** Overview of time of discard of consumable material \ (nozzle, electrode, cap,...) for particular plasma source and a summary of consumable materials usage with total number of starts, cutting duration and reached total percentage expression of operation wear (operation life-time) related to theoretical life-time.

All reports can be printed or exported into PDF, DOC, XLS, RTF file formats to enable their further processing and other usage like for example costs calculation of the company, control, and planning of production and purchase of consumable material.

3.4.4 Manuals

Manuals – quick access to all electronic documentation related to the machine. Manuals and documentations are divided into more specialized parts according to the contents and theme.

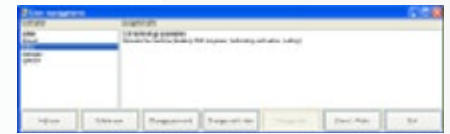
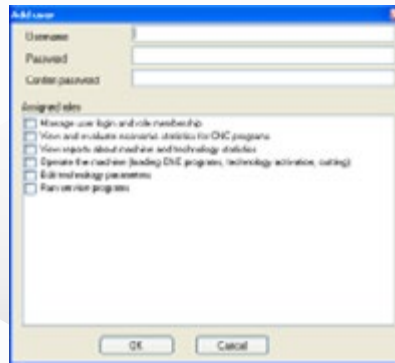


3.5 User management program

The user management software module is used to provide some degree of protection of the iMSNC control system. The password and user access rights management system is intended for allowing or limiting access to selected functions of a machine.

The operating personnel can access only certain functions depending on their qualification. The goal is to prevent a machine operator from performing operations without corresponding training or authorization and thus prevent losses, machine damage and possible risk of injury.

The program User management is accessible from Windows Start menu. User logs into system iMSNC immediately after start up. After logging on, users have certain privileges resulting from roles assigned to them by User management. A machine operator may have roles assigned according to their qualification, skills and abilities required for operation of the machine. The decision to assign roles to operators is made by a supervisor or machine owner.



If no user is logged in (after switching the machine on or after the previous operator logged off), then the user is set to "default". Assignment of roles for the "default" user is made by a supervisor or machine owner.

Depending on assigned roles, iMSNC buttons for certain functions, to which the given user does not have access, are blocked. If all automatic functions of the machine are blocked then the machine can be operated only in the manual mode.

Roles that can be assigned to users (individually or in combination):

- View and evaluate economic statistics for CNC programs
- View reports about machine and technology statistics
- Operate the machine (loading of CNC programs, technology selection, cutting)
- Edit technology parameters
- Run service programs
- Manage user login and role membership

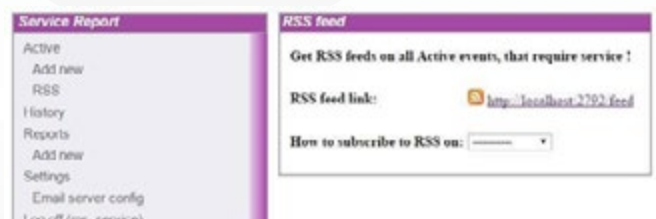
3.6 Monitoring & Service Event Module

The application monitors machine activity and evaluates the need of maintenance or service actions based on defined conditions. The user creates an event with one or more different conditions such as cutting time or number of start-ups and when the conditions are reached, the application sends them a message via e-mail or other means that an action the user has defined in the event must be taken. The user can view, create, copy, edit and delete events and other parameters according to the level of his rights.

A short overview of features

A defined service event can be contingent on:

1. Date – a fixed day
2. Active time – hours of iMSNC running
3. Automated mode – hours of automatic mode running
4. Cutting length – total length of cutting
5. Start count – number of iMSNC's start-ups
6. Technology – Cut time – total time of cutting for one technology
7. Technology – Cut length – total length of cutting for one technology



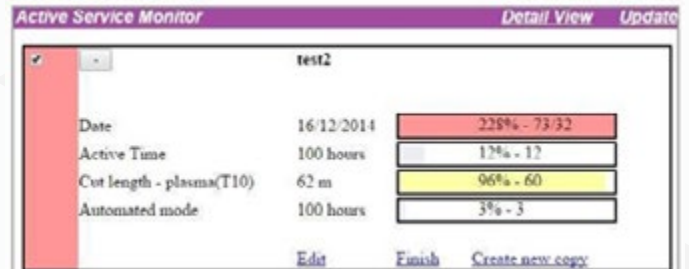
The events can be reported via **iMSNC, intranet (MSMain), email or a RSS feed.**

The application recognizes **three types of users:**

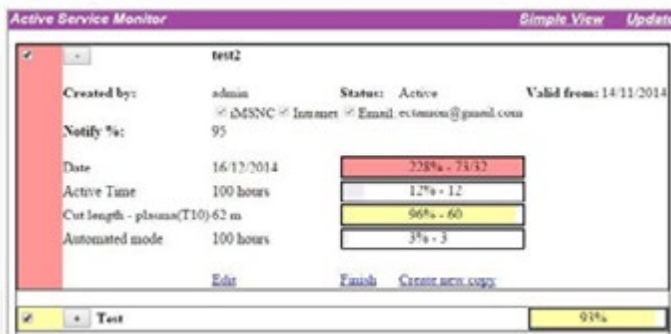
1. Msservice – full control
2. Service_monitor – can access all functions but cannot edit, end or pause events created by a msservice user
3. Others – read-only mode

The overview screen shows **all created reports** with a description and a progress bar:

The “+” button shows more information



“Detail View” of open events:



By clicking “Create new copy” a new copy of the same event can be created. By clicking “Finish” a technician can finish the event and file a report.

The link “Edit” can be used to change the event’s settings.

Reports view shows all reports associated with event or autonomous.

3.7 Remote service software including hardware

Diagnostic software is designed to enable control over all important functions of MicroStep iMSNC control system, installed software applications and parameters as well as over the other important functions of CNC machine itself (servo regulators, servomotors, end switch...). Remote Diagnostics is an essential tool for first- contact diagnostics and troubleshooting which can quickly and effectively fix many issues or provide a convenient issue diagnostics for localisation of the problem cause. The sense of using RD by your service technicians is in the quickest way of investigating the issue and collecting all information for elimination of the issue – so that the machine has least possible idle time.

The connection is made by means of TeamViewer software (www.teamviewer.com) with machine machines which have access via broadband internet connection.

Remote diagnostics on machines with dial-up modems and ISDN connection is possible as well and a modem (DSL, dial-up) or ISDN-card is included (The customer must provide a telephone line for the machine.).

Being run on the request of operator, remote diagnostics is free of charge during the warranty period. Integration of SecuRemote VPN Client in CheckPoint-Software form provides high security. Easy access to the equipment from MicroStep support central unit remarkably reduces service and interference costs as well as unnecessary travel costs, saves time and improves productivity of the CNC machine. In many cases by the Remote diagnostics can be resolved a problem with no need for a subsequent site visit, keeping "downtime" to an absolute minimum.

Team Viewer provides:

1) Remote support

With TeamViewer you can remotely control any PC anywhere on the Internet. No installation is required, just run the application on both sides and connect - even through tight firewalls.

2) Highest security standard

TeamViewer is a very secure solution. All versions feature completely secure data channels with key exchange and AES (256 Bit) session encoding, the same security standard used by https/SSL.

3) File Transfer

TeamViewer comes with integrated file transfer that allows you to copy files and folders to and from a remote partner - which also works behind firewalls

Wide offer of software service tools for commissioning and fast faults diagnostics, most of them accessible via remote diagnostics.

Local backup - stored on machine's HDD preserves the history of changes. It can be used for evaluation of changes between the actual state and a history point or between any history points.

Export backup - particular configuration files, local backup point or the complete iMSNC® installation can be exported to an external medium and used for a later system restore – including all settings and parameter adjustments made by the operator

Snapshot – immediate saving of the actual machine state – all parameters including the executed cutting plan can be stored for a later analysis – without interruption of the machine operation

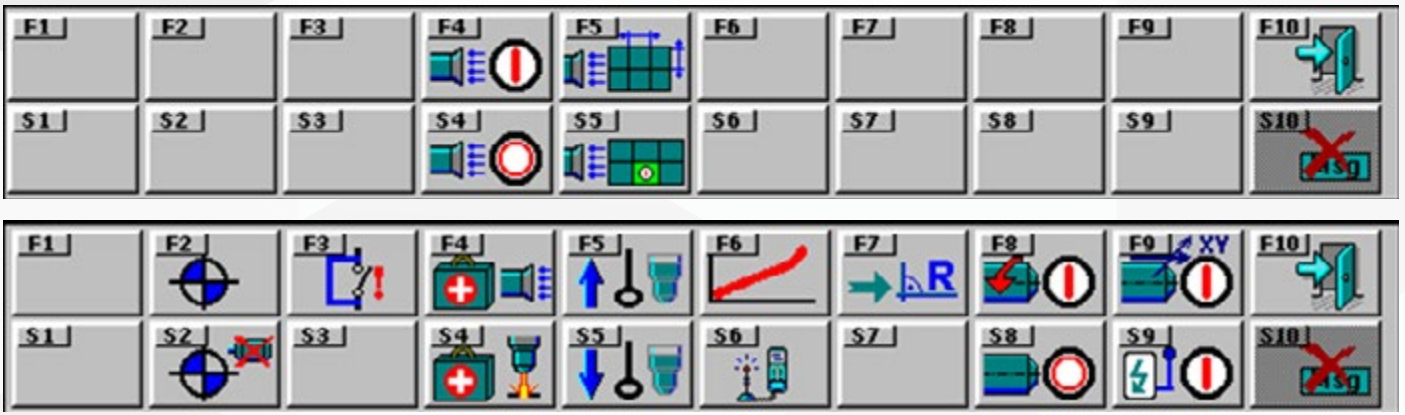
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3.8 Remote control for filtering unit

The filtering device is equipped with its own control unit and remotely controlled by the iMSNC control system. It saves time, energy and provides high safety of the cutting process. Control system switches contactor with its characteristics: max. 110V and max. 2A.

Warning:

In case of not ordering this option, the I/O system for control of the filter is blocked, so it is not possible to automatically switch the filter unit on/off. Furthermore, this item is proposition of supplying of MicroStep control system of filter unit – in case of not ordering, the filter unit will be not equipped with MicroStep control system.



Filter unit has control system from MicroStep and it is possible to have complete control, diagnostics and report of filter unit. Every parameter can be seen and set via Remote diagnostics as well.



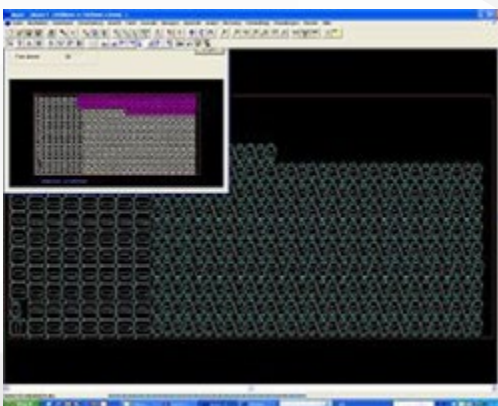
3.9 Power distributor for system control

The power distributor provides connection for the entire equipment (technological table, cooling and filtering units) to electricity. Power distributor includes main switch (emergency switch), circuit breakers for separate units.



4. AsperWin® – MicroStep CAM software

MicroStep CAM software, AsperWin, is the result of 15+ years of intense development and continuous customer driven improvement in the area of software applications for CNC machinery. It unifies the practical programming experience with long-term user know-how and has an intuitive, transparent means of operation.



AsperWin provides tools for easy and fast creation of NC programs for different cutting technologies. The basic pack (dedicated to straight cutting) can be extended by a variety of specialized modules designed for particular cutting applications (e.g. bevel cutting, pipe cutting, and multi-torch cutting) and fitted to special customer requirements. With its transparent menu structure and enhanced functions AsperWin represents a modern and powerful tool for NC programming.

A network version allows the installation of AsperWin on a network drive with enabled access from several workstations. The licence is herewith not limited to just one user or computer while cost is significantly reduced.