# CNC872 Series CNC System Application for Cutting Machines

## A List of Basic System Features

#### Hardware

Motherboard with a multi-core processor. Control panel with buttons and LCD touch screen. MCAN unit for two CAN-BUSes connecting drives and peripherals supporting the CanOpen standard. Ethernet, USB, COM, and other connections. Optional SU05 unit controlling analogue and/or pulse drives and reading incremental sensors.

#### **Parabolic Velocity Curve**

Velocity follows a parabolic curve, therefore acceleration does not change in leaps. That limits reaction forces and the resulting vibrations of the machine.

When cutting with a water beam, the parabolic velocity curve also serves to "straighten" the water beam.



#### **Dynamic Velocity Control with Upcoming Block Analysis**

The system transfers smoothly between adjacent blocks without changing speed and anticipates upcoming operation speeds according to given criteria, such as accuracy, overload, and centrifugal acceleration. The system can process up to 500 blocks in advance. The system processes the sequence of blocks continuously while attempting to maintain the programme velocity over several blocks. This comes very handy when a programme comprises large numbers of small blocks.



#### **Coordinate Transformation**

The system is capable of several coordinate system transformations: programme transformation, intermediate product transformation, length corrections, two types of shifts, five-axis transformation, and machine transformation. The five-axis transformation refers to tilting of the machine plus tipping along two other rotary coordinates.



An example of intermediate product transformation

#### Programming

Programming can be done in ISO or ESI, with the option of using sub-programmes, macro-cycles, fixed cycle and default shapes. Programming can utilise programme transformation to mirror a shape, shit, turn or scale it up or down. Shapes can also be replicated.



#### **Default Shapes**

The system contains a set of default shapes. When using any of them, mirroring, shifts, turning or scaling can be requested directly. Default shapes can also be replicated. The operator can set the beginning point of a default shape. Entry and exit parameters are taken from a cutting table for the given material. Shape parameters can be stored as pre-sets. Default shapes selection is open and can be expanded by user-defined shapes or modified default shapes. Creation of shapes utilises the HTML code similar to development of web pages.



## PLC Specifications for Cutting Machines

#### **Machine Supports**

The controlled machine may contain up to eight supports. Supports can be combined, with plasma cutter, plasma marker, oxy-acetylene welder, drill or puncher (only one drill and one puncher can be controlled). The particular technology is selected via a dialogue window:



#### **Cutting Parameters Database**

Cutting parameters are stored in a PLC table. The table contains all necessary parameters, such as the type of material, cutting speed, arc voltage, current, thickness, etc. The operator selects the required row in the table, can edit the parameters and store it as a new row. When a row is selected, the CNC system uploads the relevant values (velocity, gap width, etc.). Selected parameters are forwarded to the plasma source (current, pressure values and gas flow rates, gas mixing ratios, etc.); others are forwarded to the plasma support (arc voltage, working height, duration of burning, etc.). If the plasma source and/or plasma support lack a communication link to the system, the necessary parameters must be entered manually.

Rychlost:	6000.0	mm/min	Prodleva regulace výšky:	0.2	S
Šířka řezné spáry:	1.7	mm	Doba "rohu":	0.2	s
Napětí na oblouku: 🕚	119.0	V	Předstih vypnutí plazmy:	0.1	s
Pracovní výška: 🛛 💿	2.0	mm	Proud:	120.0	Α
Zapalovací výška:	5.0	mm	Prahové napětí:	10.0	%
Výjezd při propalu:	0.0	mm	Výška přejezdu:	40.0	mm
Doba propalu:	0.1	S	Velikost nájezdu:	8.0	mm
Rychlost při propalu:	0.0	%	Velikost výjezdu:	4.0	mm

olba parametrů pro řezání plazmou Materiá Tloušťka Current Komentái 1.0037 St3 25.000 280.000 HiFocus F HiFocus F HiFocus F 1.0037 St37 30,000 280.000 v 1.0037 St37 1.0037 St37 1.0037 St37 280.000 35 36 37 40.000 280.000 HiFocus F+ 1.0037 St37 1.0037 St37 280.000 50.000 HiFocus F+ HiFocus F 60.000 Hypertherm Kjellberg Obecné Rychlost: Šířka řezné spáry: Napětí na oblouku: 1000.0 mm/min 4.9 mm 144.0 V 4.5 mm/mir 01 00 Pracovní výška T2125 T012 T101 Zapalovací výška 8.0 mm Zapalováci vyska: Výjezd při propalu: Doba propalu: Rychlost při propalu: Prodleva regulace výšky 17.0 mm 1.5 s 0 0 0.0 % 0.2 s 0.2 s T3030 V4345 T502 Předstih vypnutí plazmy Zvolit Storno

Existing cutting parameters modification



Modification of cutting parameters in the database

Selection of plasma cutting parameters from the database

Materiál: 1.0037 St37		Tloušťka:	3.000	
Poznámka: HiFocus F+		Záznam:	1 Znače	ní: 441
Rychlost	6000.0 mm/min			
Šířka řezné spáry	1.7 mm	an	00	(Co
Napětí na oblouku	119.0 V	all of	00	a ca
Pracovní výška	2.0 mm	T012	T104	T2115
Zapalovací výška	5.0 mm	1012	1104	12115
Výjezd při propalu	0.0 mm			
Doba propalu	0.1 s			
Rychlost při propalu	0.0 %	( ) ( )	0	
Prodleva regulace výšky	0.2 s		U	
Doba "rohu"	0.2 s			
Předstih vypnutí plazmy	0.1 s	T3030	V4335	T502
Proud	120.0 A			
Upravit Z datal	báze Upravi	t databázi		

Current cutting parameters setting

#### IHT 3000 Support

A machine can be fitted with up to four IHT supports. Communication with IHT supports takes place over galvanised serial link RS485. IHT supports therefore do not contain dedicated terminals (IHT 7260). Some support signals are communicated over inputs and outputs (Corner, Up, Down, HeightControl, etc.), while others are forwarded via a serial port (TorchHeight, PierceDelay, PierceHeight, ElevationHeight, etc.). IHT support parameters are acquired from the cutting parameters database. The operator can modify any of the parameters as required.

Materiál: 1.0037 St37		
Poznámka: HiFocus F+		
Rychlost	6000.0	mm/min
Šířka řezné spáry	1.7	mm
Napětí na oblouku	119.0	V
Pracovní výška	2.0	mm
Zapalovací výška	5.0	mm
Výjezd při propalu	0.0	mm
Doba propalu	0.1	s
Rychlost při propalu	0.0	%
Prodleva regulace výšky	0.2	s
Doba "rohu"	0.2	s
Předstih vypnutí plazmy	0.1	s
Proud	120.0	A

#### **MPS Support**

The MPS stands for a support based on measured drive, controlled by a PLC software module. The system can accommodate four MPS supports. The PLC controls the drives of the support motion, measures the plasma voltage and regulates the cutting height. The PLC also controls the whole plasma ignition technology, including the height sensor and all types of burning. The height regulation is based on analysis of all relevant dependencies (e.g. Corner, Threshold Voltage, etc.). The height regulation is activated according to the required cutting height or the required plasma voltage. When regulation is active, the operator can adjust the cutting height in steps of 0.1 mm. Manual motion of the burner relies on parabolic velocity curve. Fine-tuning of the MPS supports utilises a diagnostic screen.

MPS 1 MPS 2		MPS 3 MPS	4		
Active					
Inputs		Suport		Activate	
Limit Up 1		Torch distance valid			
Limit Down	0	Torch distance	192.67mm	height switch	
Collision	0	Feed	0.00 mm/min		
Height switch 0		Height control		Deactivate height switch	
Plasma started 0					
Outputs		Control active Control requested			
Outputs Plasma preflow 0		Enabled by user 1 Not in manual control		Go to	
Plasma prenow 0 Plasma start / ignition 0				height switch	
Piercing	0	Not in corner		neight switch	
Corner	0	limit switch not reached		0.1	
Activate height switch 0		STOP not pressed 0		Go to	
Y		Treshold voltage not exceeded 1		ignition height	
Arc voltages		Plasma started			
Input voltage	0.00 V	Arc voltage high enough			
Arc voltage	0.00 V	The toninge high chough			
Requested arc voltage	0.00 V				

#### Hypertherm Plasma Source

A machine can be fitted with up to four Hypertherm plasma sources. Communication with the plasma sources takes place over galvanised serial link RS422. Selected parameters from the current parameter set are forwarded into the plasma source. A diagnostic screen displays current parameters loaded for the plasma source.



#### **Kjellberg Plasma Source**

A machine can be fitted with up to four Kjellberg plasma sources. Communication with the plasma sources takes place over galvanised serial link RS485. Selected parameters from the current parameter set are forwarded into the plasma source. A diagnostic screen displays current parameters loaded for the plasma source.

Not used	Power o	ff Not active		Not ready	OK
Power source:		Firmware: 0	)	Ready	Error No:0
Gas control:		Firmware: 0	)	Ready	Error No:0
Actual cutting current Actual cutting voltage Cutting current set	0 A 0 V 0 A	Identification gas Special identification Cutting current set PGC	0 - 0 - 0 A	Power ON	Power OFF
Corner current set Pre gas time set Post gas time set	0 A 0.0 s 0.0 s	Pressure set Flow rate PG1 set Flow rate PG2 set	0.0 bar 0 - 0 -	Gas test START	Gas test STOP
Upslope time set Downslope time set Cutting time	0.00 s 0.00 s 0 s	Flow rate PG3 set Flow rate WG1 set Flow rate WG2 set	0 - 0 - 0 -		
Cutting number Arc interruptions Digital inputs 1 Digital inputs 2	0 - 0 - 0 - 0 - 0 -				

#### **Generic Plasma Source**

A generic plasma source does not contain a serial link to the system (e.g. Cebora). The operator must enter the desired parameters from the table manually.

#### **Oxy-acetylene Welder**

The system can control various oxy-acetylene welder supports. The welder burner can be mounted separately or in combination with a plasma burner. The PLC can control the technological process in combination with automatic or manual gas console. The support height and movement regulation can operate autonomously or be controlled by the PLC module.

#### Cutting on a Tube

The system allows for controlling a machine cutting on a tube. Cutting on a tube utilises machine transformation, without affecting the burning programme. The operator enters the tube diameter in the dialogue window shown on the right.



#### Drill

A machine may contain one drill. The drill is controlled autonomously and the drilling depth is set by stoppers.

The machine support can be combined and contain several devices (oxyacetylene welder, plasma cutter, plasma marker, puncher, drill). In such a scenario, accurate distances between the adjacent technologies on the support must be entered. The processing plan then contains a selection of technologies, but does not contain measurements corresponding to the relevant device shifts.

Posunutí nástrojů a poloha pro řezání na rouře						
	х		Y			
Autogen:	0.00	mm	0.00	mm		
Plazma:	0.00	mm	0.00	mm		
Značkovač:	0.00	mm	0.00	mm		
Vrtačka:	0.00	mm	0.00	mm		
Děrovač:	0.00	mm	0.00	mm		
Ukazovátko:	0.00	mm	0.00	mm		
Poloha roury:			0.00	mm		
	ОК	3	Storno			

### Puncher

A machine can be fitted with a text puncher. Communication with the puncher takes place via a serial link RS232.

The text to be punched is entered directly in the burning programme.

#### **High-pressure Water Beam**

A PLC variant is used to control machines with a high-pressure water beam to:

- control the high-pressure analogue or dual-mode pump;
- control abrasive dosage;
- straighten the beam in corners when cutting thick materials through selection of suitable parabolic ramps parameters;
- automatically set all technological qualities according to the cutting parameters database.

#### **Future Outlook**

Further improvements are under development, such as:

- Cutting of non-round profiles with programming based on unfolding.
- Burner tilting. Determination of the cutting angle at any point.
- Combination of high-pressure water beam with plasma and oxy-acetylene burners.

#### Language Versions

- Czech
- English
- German
- Polish