

# IEC series CNC Router

## Operation menu

### Contents

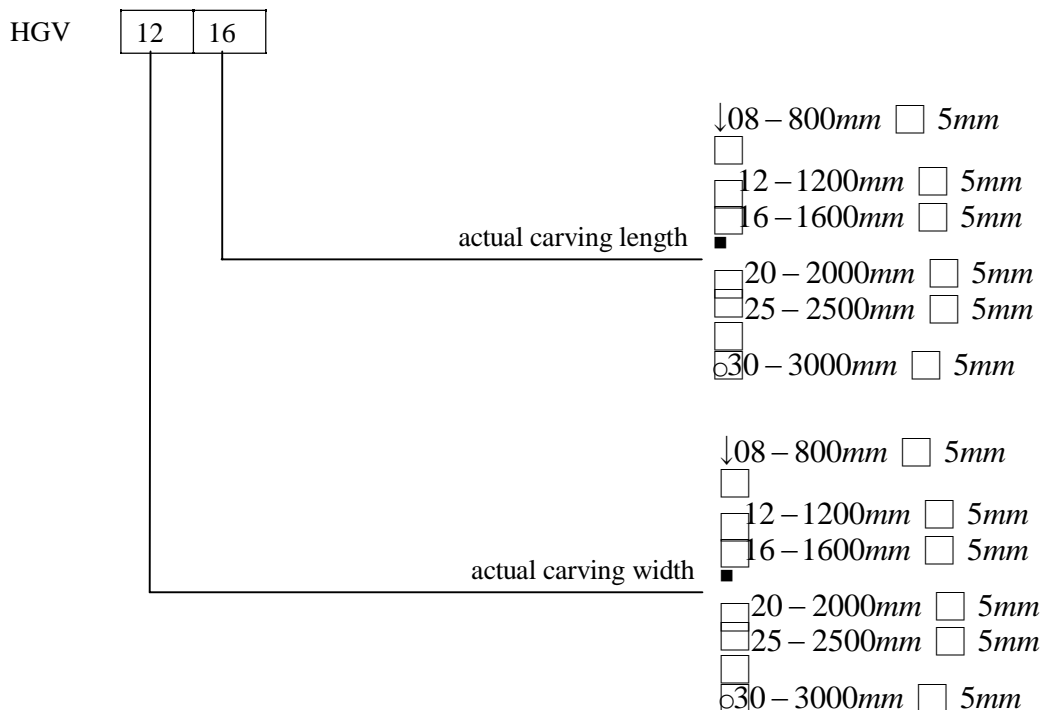
1 Operation Instruction.....	1
2 Packing Box and Accessory.....	2
3 Components.....	4
4 Operating Manual for Function and Keyboard.....	7
5 Control, Operation and Maintenance for Main Shaft Motor.....	12
6 Language Format of NC and Connection Method.....	12
7 Serial interface RS232.....	13
8 Qualification.....	14
9 Operation Table.....	15
10 Maintenance.....	17
11 Using Skill.....	19

# 1 Operation Instruction

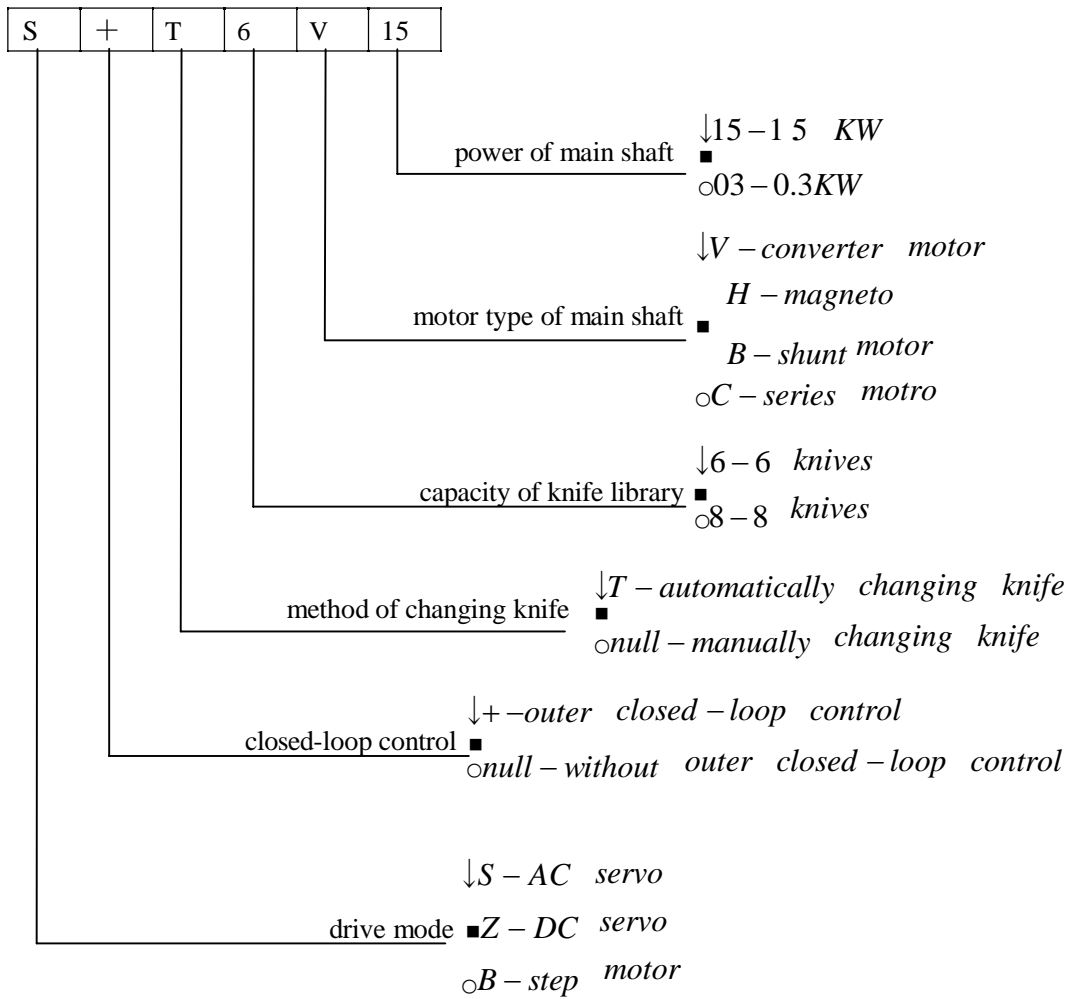
- The carving machine is very sharp. In order to avoid the injury, do not touch the carving machine with hands while operating. Also in order to avoid involving which will injure or damage the equipment, do not touch the carving machine with handkerchief or silk scarf.
- Do not insert and pull out the serial cable linked with the computer with electricity.
- Do not insert and pull out the serial cable of the control box with electricity.
- In order to ensure safety and prevent interfering, the shell of the computer and the carving machine should be connected to the earth wire.
- Please turn off the power in time when the machine does not work..
- Please pull out the plug if the machine does not work for a long time.
- The life-span of main shaft motor bearings is inversely proportional to its rotational speed.

## Type and Code Instruction of IEC Carving Machine

Type Instruction



Code Instruction



## 2 Packing Box and Accessory

### 2.1 Opening the box

The packing box comprises bottom, left / right frame and five wood boards (front, back, left, right and top). First open the five wood boards, lift the bottom slightly. Then unlock the bottom bolt (at four corners) from the lower part. The main engine is fixed on front / back flitch with three bolts. The head of the former two bolts is fixed by steel pin, and the latter is fixed by steel nut along with nut to prevent loosening while transporting. Pull out the pins; unload the bolts, then the machine can be lifted.

Screw the four adjustable rubber undercarriages (in the accessory case) into bottom hole of the main frame. Measure the four sides (front, back, left and right) of the operating platform by level instrument. Adjust height of the undercarriages till the left side and the right side of the operating platform are on a horizontal plane, the back is 5-10mm lower than the front to make for easier refluxing.

Accessory along with the machine

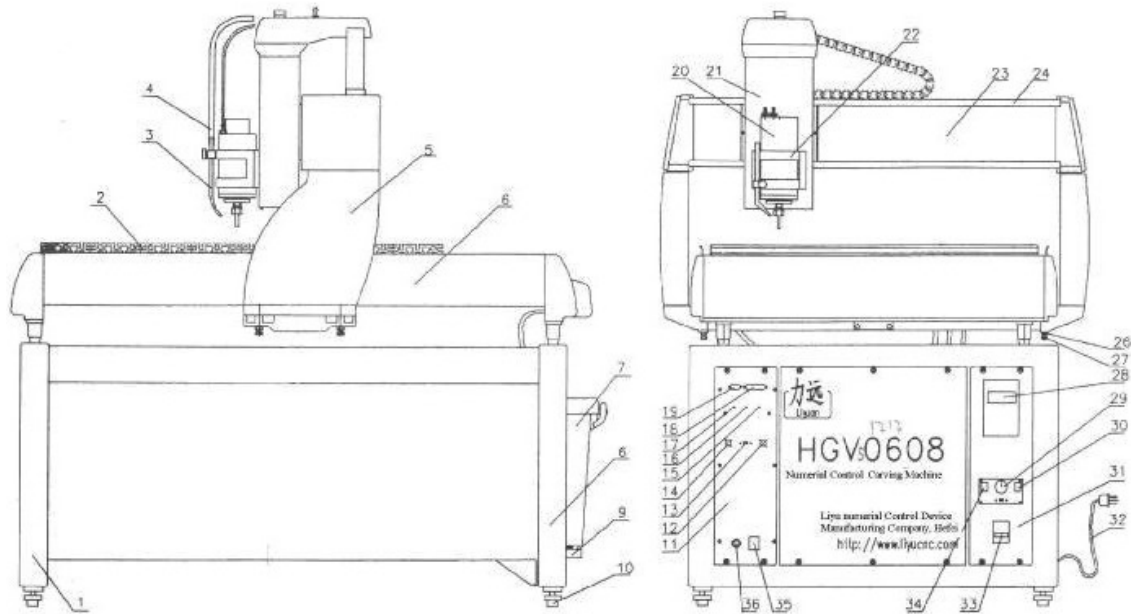
No.	Name	Remark	Number	No.	Name	Remark	Number
1	Operating box		1	10	Inner hexagon spanner	M5 extension	1
2	Operating box cable		1	11	Inner hexagon spanner	M6	1
3	Operating box cable	Reserva tion	1	12	Workpiece presser		10
4	Serial communication cable		1	13	T bolt and nut		10
5	Wrench for loading tool	13mm	1	14	Chipping tool		1
6	Wrench for loading tool	17mm	1	15	Adjustable rubber undercarriages		4
7	Taper sleeve of main shaft	6mm	1	16	Operation manual		1
8	Transition knife sleeve	3.175m m	1	17	Guarantee card		1
9	Carving knife	Each type	12				

Optional fitting part

1.  $\Phi$  100 scroll chuck
2. Universal NC dividing head and tailstock
3. 4mm、 5mm Transition knife sleeve
4. Carving knives
5. Vac-sorb plate (including vacuum pump)
6. Knife grinding machine
7. Cleaner
8. Suction bump
9. Software

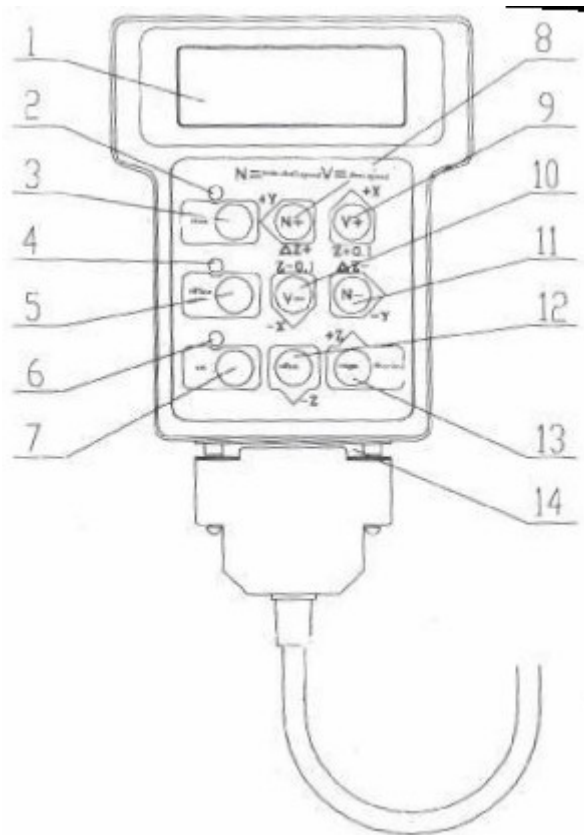
## 3 Components

### 3.1 the front and side view of main engine



- 1.frame    2.operating platform    3.chip nozzle    4.outflow tube    5.rigt gantry    6.body  
 7.pump station    8.back frame    9.pallet of water tank    10.adjustable undercarriage  
 11.panel of triaxial controller    12.index head socket    13.X-axis--option switch of index head  
 14.sensor socket    15. Z-axis lamp    16.Y-axis lamp    17.X-axis lamp  
 18.operation box cable socket    19.serial cable socket    20.main shaft motor    21.Z-direction guide  
 22.folder of main shaft motor    23.Y-direction rolling screen    24.Y-direction guide  
 26.combine nut    27.adjusting screw for X-guide  
 28.indicator of converter  
 29.regulating knob for rotational speed    30.main shaft switch    31.panel for main shaft controller  
 32.general supply cord    33.general supply switch    34.switch for cutting fluid bump  
 35.supply switch for triaxial controller    36.fuse for triaxial controller

## 3.2 the panel of the operation box



- 1.LCD
- 2.power indicator
- 3.reset key
- 4.offline indicator
- 5.offline key
- 6.set indicator
- 7.set key
- 8.left shift / stroke key
- 9.forward / reduce key
- 10.back / deepen key
- 11.right / increase key
- 12.offset / falling key
- 13.origin / rising key
- 14.cable socket

## 3.3 Connection and Installation

### 3.3.1 choosing the location

The system is a computer control system, has certain demands for the environment of the electric network. There should not exist welder, lathe frequently start, electric tool and radio station on the electric network. The strong interferes from the electric network will cause abnormal working of the system. The space around the machine should be reserved enough for operating and cleaning the cutting. Adjust four adjustable undercarriages till the machine is stable. The front of the operating platform should be higher than the back, and the right is level with the left. The Computer links the carving machine with the serial cable. The serial cable is unsuitable to extend and so as to ensure the dependability of the communication data. The computer can be placed on optional position where the length of the serial cable allows. Placing on the left of the carving machine is preferred.

## 4. Operating Manual for Function and Keyboard

### 4.1 'operating' state

IEC carving machine has six operating states: reset, on-line, offline, set, offline + set, continuous burn-in.

#### 4.1.1 cold reset

The machine is normally started, or press 'offline + set' means cold reset. The main shaft will rise to the peak automatically and move to the mechanical origin precisely, then stop. The LCD displays 'IEC Numerical Control Manufacture'. Under this state, the internal memory of the carving machine is cleared, waits for receiving and executing the data from computer. Only the power indicator (red) is on, the offline indicator and set indicator are off.

As soon as resetting, the following parameters will be set automatically:

- a. Feed speed = 16mm/s
- b. Rotation speed of the main shaft = 14000rpm
- c. Stroke = 3mm
- d. Rising / falling increment 0.08mm
- e. Set origin = mechanical origin = 0,0

Operating can change the setting above.

#### 4.1.2 warm reset

The machine is not shut down; press 'reset' means warm reset. The internal memory is cleared, waits for receiving and executing the data from computer. The origin position, rotation speed, feed speed, stroke and rising / falling increment which set previously will not change.

#### 4.1.3 acceleration / deceleration of carving speed

Under on-line state, press 'V+' or 'V-' key, the feed speed will be changed. The speed increases one class for pressing 'V+' key each time. The carving speed value (display on the LCD) increases 2mm/s. If the highest class is reached, there is no response for pressing 'V+' key any longer. The speed decreases one class for pressing 'V-' key each time. The carving speed value (display on the LCD) decreases 2mm/s. If the lowest class is reached, there is no response for pressing 'V-' key any longer.

For step motor, the feed speed has 15 classes: V1-V15, 2mm/s-30mm/s

For servomotor, the feed speed has 32 classes: V1-V32, 2mm/s-150mm/s

#### 4.1.4 acceleration / deceleration of main shaft speed

Similarly to 4.1.3, under on-line state, press 'N+' or 'N-' key, the main shaft speed will be changed. The speed increases one class for pressing 'N+' key each time. The rotation speed value (display on the LCD) increases 2000rpm. If the highest class is reached, there is no response for pressing 'N+' key any longer. The speed decreases one class for pressing 'N-' key each time. The rotation speed value (display on the LCD) decreases 2000rpm. If the lowest class is reached, there is no response for pressing 'N-' key any longer.

The main shaft speed has 16 classes: N1-N16. For converter motor, the speed is 12000rpm-42000rpm. For shunt motor, the speed is 2000rpm-22000rpm. For other motors, the speed is determined by motor.

There is an option switch on the control panel of converter motor. Switch to right, the speed is controlled by manual knob. If the rotation of the motor do not need, shut down the motor switch of the main shaft.

#### 4.1.5 emergency stop

During automatic carving, press 'offset' key means emergency stop. The yellow indicator flashes continuously until press 'offset' key again. The carving machine will be enabled.

## 4.2 'offline' state

Under on-line state, press 'offline' key to enter offline state. The offline indicator (yellow) is on. 'Move' and 'X=nnnn, Y=mmmm' display on the LCD. This indicates the coordinate position of the carving knife (unit: 0.0125mm). The carving action is stopped and the main shaft motor is lifted. Now the data from computer cannot be received. The following operation is permitted:

4.2.1 Press '↑' or '↓', the operating platform moves forward of backward. If the limit position is reached, there is no response for pressing any longer.

4.2.2 Press '←' or '→', the operating platform moves left of right. If the limit position is reached, there is no response for pressing any longer.

Crawl moving means moving step by step with low speed, which is for pinpoint. Continuous pressing means moving with high speed.

4.2.3 Press 'origin' key means the carving machine takes the present position as origin and the main shaft motor falls to original height.

4.2.4 Press '←' and '→' at the same time to enable self-check (carving test). When the self-check is finished, online is recovered.

4.2.5 After moving, press 'offline' key again, the offline indicator will be off. The main shaft motor and operating platform move back to original position. Online is recovered. If carving is proceeding before offline, the main shaft motor and operating platform will move back to position before stop, the former carving will be resumed.

4.2.6 If press 'offset' key after moving, the offline indicator be off. The figure being carved will move from stop position to present position to resume carving and the online will be recovered.

4.2.7 Return from offline state to on-line state Under offline state, press 'offline' key again, the offline indicator (yellow) will be off. The machine returns to on-line state. 'feed speed=ppp mm/s' and 'main shaft speed=nnnnn rpm' will display on LCD again.

### **4.3 'set' state**

Under online state, press 'set' key one time means entering set state. The set indicator (green) will be on; 'stroke=300, increment=08' and 'knife height=5000' will display on LCD. Stroke means the lifting and dropping distance of knife which controlled by program. 'Stroke=300' means 3.75mm. Increment means rising and falling height of the main shaft for each pressing. '08' means 0.1mm. 'Knife height=5000' means 62.5mm.

#### 4.3.1 increasing /decreasing carving depth

Under set state, press 'V+' key each time, the main shaft motor will lift one increment and the value of 'Knife height=' will increase one increment also. Press 'V-' key each time, the main shaft motor will drop one increment and the value of 'Knife height=' will decrease one increment also.

#### 4.3.2 increasing /decreasing the increment

Under set state, press 'N-' key each time, the value of increment will increase one time. The change range of the value is from 2 to 64. For example, the increment is 64 and press again, now the increment becomes 2.

#### 4.3.3 increasing /decreasing the stroke

Under set state, press 'N+' key each time, the value of stroke will increase 100 (1mm). The change range of the value is from 100 to 900. For example, the stroke is 900 and press again, now the stroke becomes 100. The value can also be controlled by program instruction.

#### 4.3.4 quickly rising the main shaft

Under set state, press 'origin' key, the main shaft will rise quickly. Dot press 'origin' key, the main shaft will rise one stroke.

#### 4.3.5 dropping the main shaft

Under set state, press 'offset' key, the main shaft will drop continuously. Dot press 'offset' key, the main shaft will drop one stroke. The dropping speed is equal to the feed speed. This function can be used for manual drilling.

#### 4.3.6 Return from set state to on-line state

Under set state, press 'set' key again, the set indicator (green) will be off. The machine returns to on-line state. 'feed speed=ppp mm/s' and 'main shaft speed=nnnnn rpm' will display on LCD again

## 4.4 'offline' + 'set' state

### 4.4.1 redraw function

Under 'offline' state, press 'set' key. The offline indicator and set indicator will be on at the same time. Press 'N-', the machine will redraw the figures input after the last resetting. If the figures exceed the buffer's capacity, redrawing will be refused. The LCD will show 'can not redraw'. The set indicator (green) glitter constantly. Only press 'reset' key to reset again.

### 4.4.2 Return to mechanical origin

Under 'offline' + 'set' state, press 'V+' key, the main shaft will rise to the top and then move in left-back direction to accurate mechanical origin position.

### 4.4.3 Return to setting origin

Under 'offline' + 'set' state, press 'V-' key, the main shaft will rise 12mm and then move in left-back direction to manual setting origin position.

### 4.4.4 continuous burn-in function

Under 'offline' + 'set' state, press 'N+' key, continuous burn-in program will be enabled. After pressing, the machine will execute self-checking again and again until the power is shut down. The functions under 'on-line' and 'offline' state, such as acceleration / deceleration, compression / decompression, manual moving and so on, will be reserved. Just likes the machine is receiving the data from computer and executes carving. This function is usually used for burn-in or quality control taken by manufacturer, or circuit trouble shooting taken by the maintenance department.

# 5 the main shaft motor

## 5.1 converter motor

### 5.1.1 control

The remote control / offline switch shift to offline position: turning on the main shaft switch, the main shaft motor runs promptly. At the same time the cooling pump runs. Adjust the speed-regulating knob manually to change the rotation speed of the main shaft motor.

The remote control / offline switch shift to remote control position: turning on the main shaft switch, the cooling pump runs promptly. If press reset key or N+ / N- key within 10 seconds, or output carving order within 10 seconds, the main shaft motor runs promptly. Press N+ key one time, the rotation speed raises one class. Press N- key one time, the rotation speed reduces one class. If no order output or no keyboard operated for 10 seconds, the main shaft motor will stop automatically.

### 5.1.2 specification for converter display

The converter shows AC supply frequency or revolutions per second of the main shaft motor.

Frequency multiplies 60 is revolutions per minute.

Indication of converter	revolutions of motor
50	3000
100	6000
150	9000
200	12000
300	18000
400	24000
500	30000
600	36000
700	42000

There exists certain error between the revolution displays on the control box and actual revolution. The frequency showed on converter should be subject to.

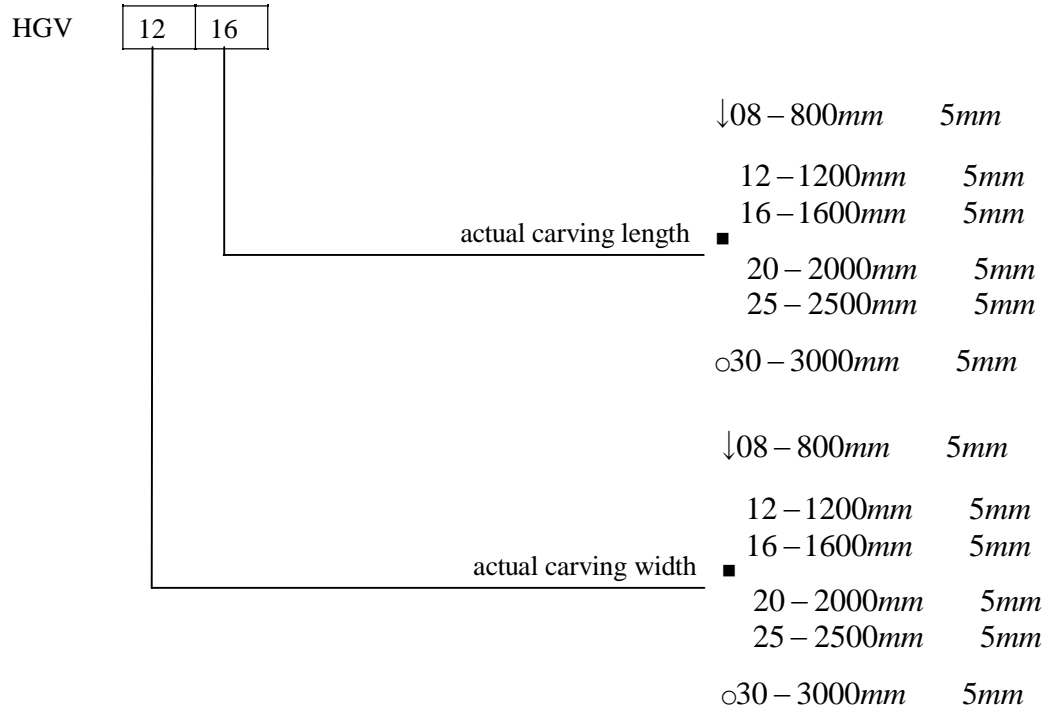
### 5.1.3 application and maintenance

#### 5.1.3.1 application

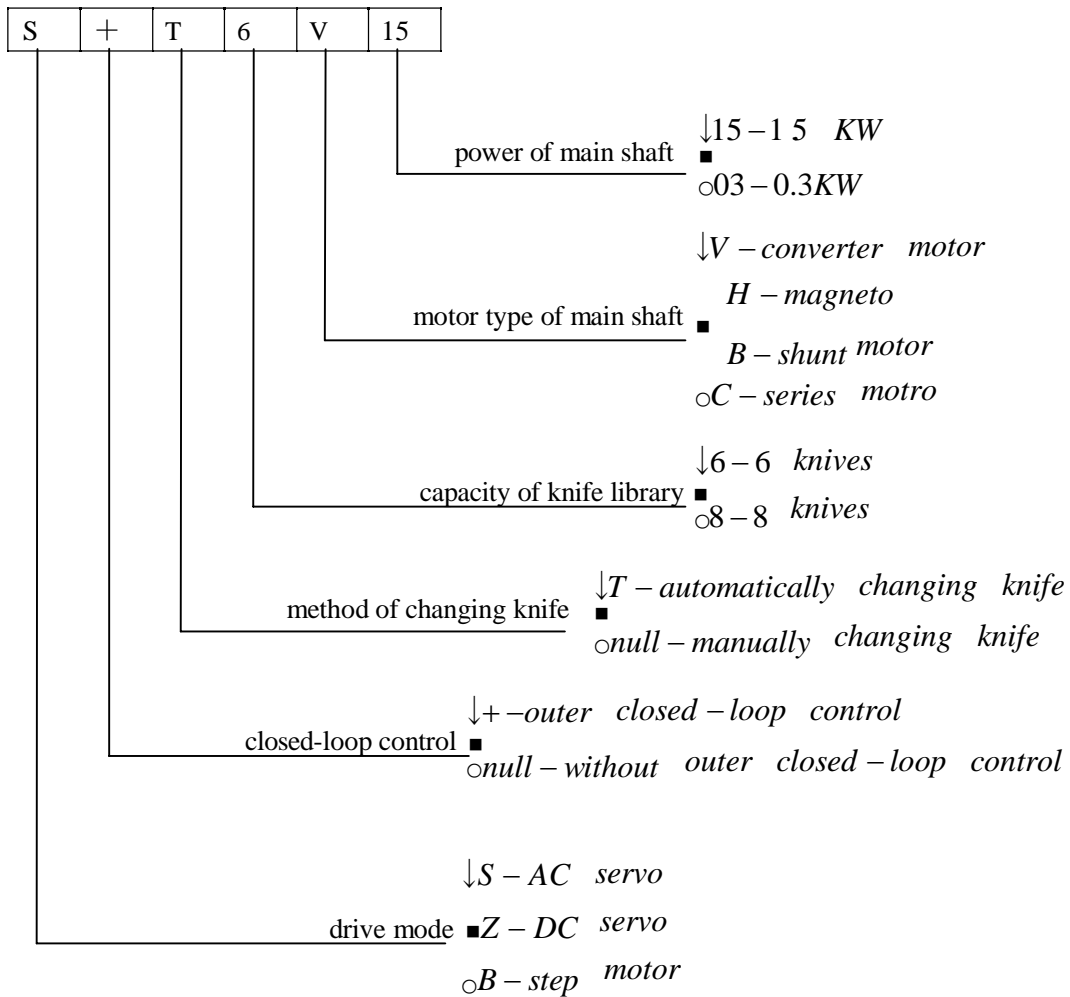
1. The life-span of main shaft motor bearings is inversely proportional to its rotational speed.
2. The main shaft motor deposits or stops using for 3 months, lubricant grease (Sapphire high speed grease, British) must be changed. Rotate the shaft with hands after changing. If the hand feeling is flexible and fluent, the motor can be put into operation.

# Type and Code Instruction of IEC Carving Machine

## Type Instruction



## Code Instruction



3. Firstly switch on the cooling water before operation.

4. In case that the off period is comparably long, blow off the cooling water in the electric spindle with compressed air.

### 5-1-3-2 Maintenance

1. In case that an increase in noise and vibration occurs to the motor, it should be considered as the result of bearing wear, and the machine requires timely replacement.
2. In case that an abrupt stalling occurs, or an unusual odor gives out during operation, immediately cut off the power, and then point a megameter measuring stator to the insulation resistance and measure the symmetry of the three-phase resistance. When the difference between the maximum/minimum values and the average value of the phase resistance exceeds 3%, or the insulation loses out, the stator is determined to be burn out and should be timely repaired.
3. After being placed for many days, the electric spindle should be operated without load for half an hour before starting operation, to enhance the stator's insulation performance.
4. During maintenance, storage and transportation, the dust proof cap should be mounted at the inlet of cooling water, to prevent sewage from entering the water passage.

### 5-1-3-3 Repair

1. It's recommended that the bearings of the electric spindle requiring replacement or other types of repairs should be returned to the manufacturer's plant or submitted to the designated maintenance departments.
2. When self-replacement or disassembling is required, send for a specialized operator, as well as use special disassembling tools. Forceful beating should be strictly prohibited to avoid the damage to parts.
3. During assembling, wash clean each part with highly graded gases to prevent the dirt from entering the shell and impacting the spindle's precision and life, and blown it dry with clean compressed air.
4. Line the bearings in the consistent manner with the original ones, with both interior and exterior shock insulators in running-in. Press the bearing into the shaft and the shell, and the beating is strictly prohibited.
5. After the bearing is well fit, adjust the precision of the spindle radially, on its end face and in its inner hole, and make all its bounces less than 0.004 mm before putting into use.
6. For the partial or fatal damages due to the user's own disassembling operation, the user should assume the costs in replacing or maintaining the part.

(For the demands in bearings, special greases, and so on, please feel free to contact our Company.)

**5-2 Shunt Motor. Please refer to the operation instructions contained in the motor.**

**5-3 Series Motor. Please refer to the operation instructions contained in the motor.**

### **5-4 Operation Instructions for Cooling Water Pump**

The engraving machine can be supplied with one to two water pumps, one for spraying cutting fluid in cooling cutters, and the other for the cooling of the water-cooling spindle motor. The air cooling motor doesn't require cooling the water pump.

When the water pump is used for the first time or after being placed for a period of time, the pipe will be filled with air. So there will be the phenomenon that the cooling water does not cycle or the cutting fluid nozzle does not spray after the water pump is powered on. In case that there is air in the cooling pipe in the spindle motor, pulled off the cooling backwater hose from the 6mm connector on the water pumping station with the spindle switch turned on. Use the aspirator pump or mouth to exhale the air inside it until water comes into the backwater hose and the normal water back flows. Then plug back the connector onto the hose and resume operation.

In case that the cutting fluid nozzle does not spray, pull off the water outflow hose from the nozzle with the water pump switch turned on. Use the aspirator pump or mouth to exhale the air inside in until water flows out. To prevent the air from reentering the cutting fluid pipe after the pump is powered off, turn off the discharge valve over the nozzle before powering off the pump. This way, when the pump is switched on again, the water can flow out after the discharge valve is opened.

## VI. Computer Numerical Control (CNC) Language Format & Connection Method

### 6-1 3D HPGL Computer Numerical Control (CNC) Language

IN	Vector head, program initialization command
SPn	Tool selection command, n as the number of tool
PD	Run a vector at the operating speed Vn
PU	Run to the target point at idle running speed
xxxx, yyyy, zzzz	X Y Z coordinates, xxxx, yyyy as unsigned integers, not larger than 65535 with unit: 0.0125 mm; and zzzz as signed integer, not larger than 32767 with unit: 0.0125 mm
Vn	Speed setup instruction. N=0-15, corresponding to maneuvering box display
Q	Sensor location function
B	Sensor location cancellation function
SPN (Numeric 0)	Program termination instruction
;	Command end mark
,	Data delimiter

Example:

```
IN;ZZI;PA;SP1;V12;PU2642,3226,-200;V5;PD2642,3226,20;
PD2759,1027,23;PD2755,1022,17;PU2705,1011,-200;SP0;
```

### 6-2 Several Modes of Computer Connection with Engraving Machine

6-2-1 The engraving machine can be connected to the computer with the following software:

1. Compile the engraving program with EDIT and output with DNC program.
2. Compile the engraving program with QBASIC and output with serial ports.

6-2-2 The engraving machine can use the software capable of generating three-dimensional HPGL numerical control code, such as Wentai 3D Engraving, CAXA Three-dimensional Engraving and Type 3 Engraving Software, etc. to connect with the computer

## VII. RS232 Serial Port Connection with Computer

This series of engraving machine applies 9-core socket with holes for its RS232 serial port.

There are two types of RS232 serial port socket for PC, 25-core and 9-core, which are

respectively related as in the following table:

Signal Name	TXD	RXD	RTS	CTS	DSR	GND	DCD	DTR	R1
25-core	2	3	4	5	6	7	8	20	22
9-core	3	2	7	8	6	5	1	4	9

The are different requirements for the communications cable wiring methods in operating the software with different serial port setup, as in the following table:

Computer		Engraving Machine		
9-core	25-core	Signal	Signal	9-core
3	2	TD -----	RD	2
2	3	RD -----	TD	3
7	4	RTS -----	CTS	8
8	5	CTS -----	RTS	7
5	7	GND -----	GND	5

## VIII. Technical Indicators

Item	Content
Maximum Engraving Width	600 mm, 800 mm, 1000 mm, 1200 mm
Maximum Engraving Length	800 mm, 1200 mm, 1600 mm, 2000 mm 2500 mm 3000 mm
Gantry Passage Width	800 mm, 1010 mm, 1210 mm, 1410 mm
Maximum Engraving Height	128 mm
Feeding speed	Step motor V1-V15, 2 mm/s - 30 mm/s Servo motor V1-V32, 2 mm/s - 150 mm/s
Spindle rate of rotation/ power 12000	Frequency conversion motor n1 - n16,  rpm - 42000 rpm/1200 W Shunt motor n1 - n16, 1000 rpm - 22000 rpm/1250 W - - 1850 W
Repeatability precision	0.03 mm
Port type	RS-232 Serial Port, BAUD = 9600
Power supply	Built-in switching power supply, AC 220V, 50 Hz - 60 Hz
Working environment temperature	0 to 35 °C
Working environment humidity	5% to 95% (Without coagulated water)

## IX. Concise Table of Operation

Content	Method & Procedures
Cold reset & on-line state	Power on or press “Reset + Off-line” keys, and the spindle returns to the mechanical origin
Hot reset & on-line state	Press “Reset” key, clear the memory, with the setting origin, speed and rotating speed, etc.
Change of feeding speed	unchanged During on-line state: Press “V+” key once, speeding up one level Press “V-” key once, speeding down one level
Change of speed of spindle	During on-line state: Press “n+” key once, speeding up one level Press “n-” key once, speeding down one level
Scram and	During on-line engraving, self-checking or move

	quick return states: Pressing “offset” key, the movement will immediately stop, and the yellow lamp will flash continuously; press “offset” key again to restore
Enter into off-line state	During on-line state: Press “Off-line” key, the yellow lamp will be on
Pause engraving	The same as above
Workbench fore and aft movement	During off-line state: Press “↑” or “↓” keys
Spindle head left and right movement	During off-line state: Press “←” or “→” keys
Self-checking test engraving “↑”	During off-line state: Simultaneously press down and “↓” keys
Return from off-line to on-line	Press “Off-line” key, the green lamp is off and move to return
Pause engraving and move out the workpiece, and resume engraving after observation	The same as above
Set zero point	During off-line state: Press “←” or “→” keys and press origin key
Enter into setup state	During on-line state: Press down “Setup” key, and the green lamp in on

Content	Method & Procedures
Lift spindle head	During “setup” state: Activate “zero point” key, make the spindle head ascend a travel, continuous ascending with continuous pressing Activate “deviation” key, make the spindle head descend a travel, continuous descending with continuous pressing
Lift one increment for the spindle head	During “setup” state: Press “V+” key for once, ascend one increment step Press “V-” key for once, descend one increment step
Change of lift increment	During “setup” state: Each time when “N-” key is pressed, the increment increase twice. But if the increment is 64, the increment changes to 2 when “N-” key is pressed.
Change of travel	During “setup” state: Each time when “N+” key is pressed, the travel increases by 100 steps. But if the travel is 900, the travel changes to 100 when “N+” key is pressed.
Re-draw	“Off-line” Key + “Setup” Key + “N-” Key
Return to mechanical origin	“Off-line” Key + “Setup” Key + “V+” Key
Return to setup origin	“Off-line” Key + “Setup” Key + “V-” Key
Continuous self-checking	“Off-line” Key + “Setup” Key + “N+” Key

## **X. Maintenance of the Engraving Machine**

### **10-1 Routine maintenance**

After the work is completed each day, the mains switch should be powered off and timely measures should be taken to clear the cutting scraps on the workbench and the return water conduit at two sides of the workbench. Particularly when the cutting fluid is applied, the timely measures should be taken to clear the cutting scraps on the copper wire mesh at the back end of the return water conduit of the workbench (There is one hole in the middle of the copper wire mesh, which can be hooked up with iron wire), to avoid clogging.

### **10-2 Guide rail clearance adjustment**

The clearances between the guide rail sliding block sets will influence the working precision and will easily break the tool nose during the metal working. Therefore, the guide rail clearance should be eliminated. However, the excessive clearance reduction will cause too large frictional forces of the sliding block on the guide rail, as well as lower the precision of the engraving machine (e.g. The tiny circle that it engraves is not round, etc.). At the mean time, it will influence the life of the guide rail set, and may further cause the step motor to lose steps (dislocated).

The principle in adjusting the guide rail clearances is: in the cases that there are no clearances (or comparably narrow clearances), the slighter the guide rail set slides, the better.

Clearance adjustment of X-directional guide rail: there are respectively two clearance adjusting bolts at the left and right bottom of the gantry frame. After being adjusted, they should be tightened respectively with one tightening nut. If it requires adjustment, please at first unscrew the tightening nut, and screw up the clearance adjusting bolts clockwise for one little angle, and tighten the tightening bolt again.

Clearance adjustment of Y-direction guide rail: Four socket hexagon screws at the inward side of the Y-directional sliding block are used to adjust the clearances between Y slide block and Y guide rail. During adjustment, firstly move Y sliding block making its centerline reach the centerlines aligned to the four holes at the left or right end at the back of the beam. Insert the lengthened inner hexagon spanner through four holes in turn until the hexagonal holes of the socket hexagon screws at the sliding block, and rotate them. Rotate clockwise to decrease the clearances and vice versa. The rotation should be proper as soon as the clearances are eliminated without the needs to get too tight.

Clearance adjustment of Z-directional guide rail: Dismount the spindle motor, and open the two dustproof cover plates at the back of its foundation, you can see that there are eight holes on the Z-directional guide rail. The four in the middle are clearance adjusting holes of Z-direction guide rail. Lift the Z-directional guide rail to the four socket hexagon screws of the sliding block, which can be observed from inside the hole, and insert the inner hexagon spanner into the hexagon holes and rotate. Rotate clockwise to decrease the clearances. The rotation should be proper as soon as the clearances are eliminated without the needs to get too tight.

Dismount Z guide rail from Y sliding block: In the above-mentioned eight holes, the four in the outside are used to insert bolts and fix Z sliding block to Y sliding block. Therefore, if it's required to dismount Z guide rail set, you can insert inner hexagon spanner into the four holes and unscrew four inner hexagon bolts.

### **10-3 Lead screw clearance adjustment**

Use a dial indicator to contact the spindle. Use a maneuvering box or compile a short section of program to move the spindle firstly in the direction of one axis forward for 100 steps and write down the reading on the dial indicator. Then move forward 100 more steps and backward 100 steps, and observe the difference between the readings on the dial indicator and the previous one. The difference reflects the sum of clearances existing between the lead screw set and the bearing lead screw. If the clearance is too wide, it should be adjusted and eliminated.

For X and Z axes: The bearings of the bearing lead screw are the two radial thrust bearings inside the motor. There is a screw thread cover on the motor back cover with a tightening bolt at its casing. If the clearance adjustment is required, firstly unscrew the tightening bolt, and rotate counterclockwise the screw thread cover to eliminate the axial clearance. Tighten the tightening screws again to prevent the screw thread cover from self-loosened.

For Y axis, the bearing of the bearing lead screw is at its left end. There is a split nut at the end of the lead screw with two bolts used for tightening on it. Before adjustment, unscrew two bolts and screw the split nut against Y lead screw. Rotate clockwise to decrease the clearances. After adjustment, screw up two bolts to prevent the split nut from self-loosened.

There will be no clearances between the ball screw shaft sets in a short time. After the wear due to long time running, the clearances between double-nut ball screw shaft sets can be eliminated by replacing the shim between two bolts. The clearances between single-nut ball screw shaft sets can be usually eliminated by replacing balls or nuts.

### **10-4 Lubrication**

The following parts in the machine require lubrication: 1. Three-core ball screw shaft. Inject lithium base grease from the charging point of the ball nut. 2. Tri-directional ball guide rail set. Inject lithium base grease from the charging point of the ball sliding block.

### **10-5 Rust Prevention**

If the climatic environments are damp and muggy, or the machine has been placed idle for a period, the following antirust measures should be taken on the machine's metal parts:

1. The surface of steel parts, such as the ball screw shaft, the hardened steel ball track and the steel fastener surfaces, should be painted with cloth or cotton dipped with butter. The other parts should be observed for any faint rusts, which, if any, should be erased and be taken as the key antirust points in the future.
2. The surface of aluminium parts should also be either painted with cloth dipped with butter once per days, or sprayed with a layer of varnish. And they should be frequently observed for any corrosive points.
3. The cooling water tank should be better filled with emulsified oils, which are in favor of rust prevention, rather than water.

## **XI. Operational Tips for the Engraving Machine**

### **11-1 Settings of BeiHang CAXA Engraving Software**

#### **11-1-1 Postposition settings**

Specific operations: application/postposition procession/postposition setting

1. Add machine tools;
  - a. Present machine tool: HPGL;
  - b. Program header:;IN;PU;ZZI;PA;SP1;
  - c. Program end: SP0 (Arabic numeral: 0).

Note: When it's set at "PA0,0,-300;SP0", the engraving tool can be forcibly returned back to the zero point and lifted up 3.75 mm.

2. Postposition procession settings:

- a. The maximum length of the output file = 999999 KB;
- b. Line number setting: no output & no filling up;
- c. Coordinate output format setting: Absolute, integer; machine tool resolution: 80; ✓  
optimized coordinate value.

11-1-2 Pickoff filtration setting

Specific operation: set/pickoff filtration setting:

1. Click on and select all the types;
2. Click on and select all the colors;
3. Click on the confirmation.

### 11-2 On-line Operation

11-2-1 Create a subdirectory COMM on the hard disk

Copy the on-line file on Disk A: into COMM; create a shortcut for the file DNC.BAT in it and place it onto the desktop.

11-2-2 On-line file

Specific operation: Application/ disposition procession/ Generate HPGL/ Input file name \*.PLT, and create the file under COMM directory.

Note: At this time, you should use the mouse to draw a frame around the generated engraving path (two points in diagonal position); press the right side of the mouse or enter.

11-2-3 Access the on-line interface via DNC shortcut

1. Parameter management/ Communication parameters: Baud rate: 9600; Check bit: none; Stop bit: 1; Data bit: 8; Serial port: COM2 (or other); XOFF/XON.

Note: Use “←” & “→” direction keys to select the numerical values above; use “↑” & “↓”

direction keys to select items; Enter after selecting all the options.

2. File transfer/ File Send, Enter, Input file name \*.PLT, and enter to get on-line.

Note:

- a. If it's on-line for the first time after reset, point the cutter to the surface of the workpiece; if it's on-line without reset, it's not required to point the cutter to the surface of the workpiece and it's ok to directly output, or else the cutter will get bound or get too deep with 3 mm.
- b. Before connection, set the feeding speed and the speed of spindle of the engraving machine.

### 11-3 Troubleshooting FAQs

11-3-1 Troubleshooting for not being on-line

1. If the on-line interface doesn't come out, it's due to the loss or damage of files. Recopying files is required.
2. If it says that “The file is being sent, please wait...”, but the engraving machine stays idle, please turn on the off-line lamp and turn off to get on-line.
3. Check whether the communication parameters, especially serial ports, are correct or not, and COM ports can be changed and retested.
4. If it says, “Press any key to return...”, it indicates that no file is found. Check whether it is created under COMM directory or whether the file name is wrong.
5. Check whether the machine tool is HPGL in the disposition setting.
6. Replace on-line cable lines.
7. Switch to DOS environment and execute DNC.BAT to get on-line.

### 11-3-2 Troubleshooting for error engraving

1. The engraved letters and graphs are inconsistent with the typesetting sizes. Solution:  
In the disposition procession settings, set the resolution of the machine tool at: 80
2. Troubleshooting for step losses in any direction at X, Y and Z:
  - a. Check whether the guide rail in the direction is too tight, which causes step losses.
  - b. Check whether the step motor in the direction is fast connected.
  - c. Check whether the special cables in the maneuvering box is properly connected, whether there is a pin retraction or disconnection. Replace it with a backup cable line and test it.
3. Troubleshooting for unsmooth engraved letter or graph contour:
  - a. Unscrew the cutter holder head, and turn around the cutter before reclamping, thus ensuring that the blades participate in the cutting process.
  - b. Replace with new cutters.
  - c. Increase or decrease the speed of spindle to adapt to different materials.
4. Troubleshooting for frequent breaking
  - a. Mount the cutter properly for its wide-range nose swinging movement can easily cause breaking.
  - b. Eliminate the clearances between slipways on X, Y and Z directional coordinates. c. Increase or decrease the speed of spindle to adapt to different materials.
  - d. Decrease the cutting depth of one cut and separate the cutting into twice or several times. e. Select the engraving knife with comparably large cutter angles.
  - f. Select the cutter with high quality.

### 11-3-3. Why will the phenomenon of misplacement (step loss) occur?

1. During graphic typesetting, the maximum size of the output graphs must be smaller than the machine's actual working travel, or else such problems as misplacement or graffiti will occur.
2. During graphic typesetting, be noted that no parts should be placed outside X and Y coordinate axes (shifting to the negative value), or else such problems as misplacement or graffiti will occur.

### 11-3-4. Why will the phenomenon of tool bound occur?

1. For the curved surface with comparably large height difference of engraving, you must firstly try to move the spindle motor up and down. Ensure that there will be still a certain allowance from Z-directional guide rail to the maximum limit location when the tool is at the maximum point of the curved surface, or else, it will probably be withheld for the upward movement of Z-directional guide rail has exceeded the maximum movement range, and after that, all the graphs will be moved down for some distances, causing the tool to be bound.
2. After the workpiece engraving completes, it should automatically execute the end directive for the file output. The tool nose will be raised to 3.75 mm above the surface of the workpiece, when the Z coordinate of the tool nose is at -300. If it directly sends the directive for the next graph, the tool nose will conduct deep cutting according to the correct

depth. If the maneuver control box locate the tool hose at the workpiece' s surface, please be sure to reset once before again outputting graphs, or else the tool hose will firstly lower

3.75 mm for the current location (The software believes that it currently only reaches  $Z = 0$ , i.e. the workpiece surface.) before setting to the defined depth to engrave, thus causing the tool to be bound.

#### 11-3-5 How to troubleshoot the miss or error in the process of engraving?

Fault cause: This is mainly caused by incorrect handshaking of the serial communication. There is data register inside the engraving machine. When its read-in data fills up the memory space, the engraving machine will send out a pause signal to the computer, noticing the host to pause data transmission. When the memory space is larger than 64 K, it again informs the host to resume transmission. If the buffer memory is full and the hose does not receive the pause signal sent by the engraving machine, the later sent data will overwrite the first sent unexecuted data. Looking from the phenomenon, the engraved pattern might miss a part or be a graffito. There are two types of signals that the engraving machine sends to the host: One is software handshaking, which is transmitted through the TXD line at the serial port. TXD connects No. 3 pin at 9-core serial port of the engraving machine to No. 2 pin at 9-core serial port of the host. When it requires the host to pause transmission, it sends out "13", and when it requires the host to resume, it sends out "11"; the other is communication handshaking transmitted through RTS lines in the serial ports. RTS lines connects No. 7 pin at 9-core serial port of the engraving machine to No. 8 pin at 9-core serial port of the host. When it' s at low level, it allows the host to send; and when it' s at high level, it prohibits the host to send.

When the engraving software sets serial ports, it should correctly select handshaking modes from XON/XOFF or RTS/DTS. But some handshaking modes are not well applicable to some kinds of software. E.g. "DNC" communication software earlier supplied by Beihang Hair can only apply XON/XOFF mode, and RTS mode doesn' t work for it. But the communication software contained in the new version of Beihang engraving software (Serial port transmission), RTS can also be used.

To test whether the handshaking is effective or not, the simplest method is to raise the spindle of the engraving machine. The hose will output a file to put the engraving machine in the idle run, and the host screen will display the output directives of continuous upshift. Press down the off-line key, and the output will immediately stop; press the off-line key again, the directive output will resume. This indicates that the communication handshaking is in good condition.

There are several possibilities in making handshaking invalid:

1. Disconnection of the serial port cables (esp. TXD lines or RTS lines in them).
2. Disconnection of the cables inside the maneuvering box.
3. Incorrect setting in the handshaking modes for the software.
4. Trouble at the computer' s serial ports (including incorrect BIOS settings.)
5. Trouble in software (including the software damage caused by viruses).

## **Special Disclaimer**

- 1. The manufacturer reserves the rights of changing product parameters and settings without notice in advance.**
- 2. The manufacturer only bears its obligations for the product itself sold to the user, rather than the other losses that the user incurs after the product has fault**