CNC Cutting Machine Operating Manual

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2. Installation

2.1 Introductions

In order to moving machine successfully and operating normally, the installation site of the cutting machine should be chosen in the no vibration place. There is no forging hammer, large press machine and other vibration equipment near it. It should be avoid putting the machine at the open-air place. According to the foundation drawing, user should prepare the necessity foundation and working environments. If there is big vibration source, please setting the vibration-proof ditch around the machine to keeping the cutting quality and working performance.
The longitudinal guide rail is the major parts of CNC cutting machine. The guide rail installation directly affects the cutting precision and working performance. Therefore user must follow the technical requirements of guide rail foundation drawing and related technology standards to keep the guide rail precision, when prepare the guide rail foundation.

2.2 Machine installation

The main end frame of eccentric adjusted to maximum position, turn a driving longitudinally box and fixed it, in case the wheel and guide side collision, and then hang the machine placidly through the guide rail which has precision adjustment, and clamping Lord end the shelves of eccentric wheel. In leading rail ends appropriate position adjust longitudinal spacing collision block. Chart 2

2.3 Gas supply

Gas supply connection interface is made by the user, interface dimensions and the export pressure shall do according to our company's request creation, if the user use pipes air, should place plus 200 mesh around gas filter, to ensure air cleaner, and also in case the pipeline of impurity in causing pressure reducing valve, solenoid valve damage and cut tube obstruction.
3. Mechanical parts introductions

3.1 Cable and gas hose

Gas supply could be fuel gas, oxygen, compressed air and etc. There are four type of the cables: power cable, signal cable, plasma cable and earth conductor cable. The cable and gas hose are hanging or hiding in the chain device on the machine. User should connect 3KW Voltage Stabilizer to keep the voltage stable.

3.2 Shift mechanical structure

The components of the shift mechanical structure are as follows.

3.2.1 Longitudinal portal frame

Longitudinal portal frame is the basic part of the longitudinal shift mechanical structure, including two end brackets and the beam supported by end brackets.

- The end brackets are on the sides of the cutting table, which are guided by the ball linear guide rail.
- The beam is welded and boxed frame, which is an inalienable part of the portal frame. There are transverse drive device and transverse ball linear guide rail for the torch on the beam.

3.2.2 Longitudinal driving device

The machine has one of the same longitudinal device drivers, two separate drive unit located in the frame of the sunken place rocker. When do maintenance just loosen negative eccentric can easily turn piece.

3.2.3 Crosswise actuating device and steel belt device

The lateral movement of main cutting torch is through the crossbar to make linear motion, when other cutting torch doing lateral movement, transverse device drivers drive clips onto the metal cutting torch of mobile devices for syntropy or mirror movement. most family machine is two axial motion, traverse feed is based on the longitudinal feeding superposition , it required cutting geometry is through transverse and longitudinal drive cooperate to obtain.

3.2.3.1 Steel strip device adjustment
The beam is steel strip device, after a period of work, steel strip will stretch longer, it will affect transmission precision of the vice movement, if serious will caused the damage and the steel wheel fracture, so the operator should often check whether the steel belt transmission is loose or not. The method of the examination is open the frame of steel belt cover shell, drive the movement make a round trip, and observe the Lord steel strip is in central or not, if steel wheel with fluctuation channeling dynamic phenomenon, should be adjusted, adjust the method as follows, see (figure 3).

1. loose order
2. screw order
3. bolt, tensioning steel belt (notice:)

![Diagram](image.png)

Steel belt cann’t too strict

3. Top tight and adjustment screw, make fluctuation sequence 2 strip steel wheel on the horizontal vertical state, observe whether there is a steel belt up dynamic phenomenon, until the transregional adjusted to steel belt around mobile process is always in the central wheel. And tight sequence 1 screws.
4. such as the discovery of steel with cracks or edge phenomenon, it should change in time.

3.3 Cutting torch device
3.3.1 Cutting torch device

Torch device has torch lifting device and cutting torch holder.

Torch lifting device runs on the transverse linear guide rail. The torch lifting device is installed in the dustproof metal box. The lifting slides are driven by motor to shift on the linear bearing. So the torch can shift (the lifting distance is 150 mm). In the cutting process, the torch lifting distance is controlled by the flame torch capacitor sensor or the voltage sensor to automatic adjustment.
with steel strip clamping device. Through the steel tape connect the cutting torch lifting devices and main driving devices, thereby dragging the cutting torch lifting devices move.

3.3.2 Single cutting torch holder device

Single cutting torch holder device can be adjusted in the lengthwise direction (adjusting range 50mm) when start cutting, cutting torch should adjust to front of plate edge, and using the handwheel through rack-and-pinion adjust cutting torch. In the vertical plane of horizontal direction can be rotated to 45 degrees. As sometimes need open edge groove, it can do inclined cutting in longitudinal direction, while cutting torch lifting direction also can rotate, which can prevent damage in cutting process of collision.

3.3.3 straight line single cutting torch holder device
Linear single cutting torch holders can't be adjusted in longitudinal, to cut through the handwheel torch fluctuation adjusted (adjust range 200mm). But in the beginning edge of cutting required the front of plate is accurate calibration (e.g. in cutting platforms need use the positioning block block).

### 3.3.4 three cutting torch swivel head (select use)

Using together with multi-purpose cutting torch fixture device, rotating head use in welding grooves cutting.

#### 3.3.4.1 Manual operation of three cutting torch swivel head

Manual torch rotating head only cut for linear cutting torch. It must use manual to change direction when needs change groove cutting direction. It is merely coordinate direction of the straight-line cutting, linear groove cut or deburring when the welding edge groove.

#### 3.3.4.2 autorotation three-cutting torch

This torch head can cut stepless speed automatically rotating, using for linear and the geometry of the welding grooves cutting, according to the different shape, three cutting torch holder device can automatically rotating, controlled by control system, and cutting torch location plane is adjusted ceaselessly to cut on the cutting point profiles and made the line is in rotation.

### 3.3.5 automatic rotation groove device (select use)

Through cnc control system, this device can be automatically achieve geometry shape which ≤ 45 degrees of groove, such as changing groove, linear vertical cutting. Before open groove device should clean the cutting plate timely, in case the carvers collision automatically change groove device. When the manual adjustment rotation angle ≤ 360 degrees and need positive and negative spin each time lest cable entanglement.

### 3.4 lineation device (select use)

Lineation device function is chalk line. For example: drilling lineation, welding wire, bending line or in cutting process test the thermal deformation of test scribing, in general it's before cutting lineation. Because after cutting, due to thermal deformation, welding position has changed, it will hinder lineation accuracy. Accurate lineation tools has pneumatic blunt dozen lineration tools and powder spraying lineration tools currently. It can make out clear line with high-speed and after
working procedure, positioning or processing line etc.

3.5 fluid system

Each cutting machine all has their own independent fluid distribution system, mainly consist by reduced pressure system, perforated device (option)) and fluid distribution pipe etc.

3.5.1 Pressure-relief system mainly consists of oxygen, gas special throttle valve and the pressure gauge , according to the different cutting process demand, in pneumatic operation panel , it can be easily to adjust system pressure. In each group pressure reducing valve inlet are equipped with gas filter. After work a series, such as if gas flow rate is insufficient, should apart gas filter using compressed air blowing off impurities and dirt which which on the filtering screen .

3.5.2 Fluid distribution pipe, main control to torch and to cut and other auxiliary functions of fluid ,
on the control panel can operate, the method refer to (system operation manual).

Each group are equipped with oxygen cutting torch, fuel gas flashback arrestor, so that can prevent the damage or other casualty accidents casued by temper effectively. So please check the tempering preventive device regularly, if flashback arrestor is damaged, please promptly contact us or replace with new flashback arrestor.

4. Maintenance

4.1. Clearing
The working environment of cutting machine is considerable poor, so regular clearing and maintenance should be carried out for the CNC cutting machine. In order to operating normally and obtaining legible cutting surface, all the guide rails should be cleared with cleaning cloth, then oiling. In addition, clear all the guide pulleys and roller bearings regularly. If the parts are not clear, the rust and dust from the cutting process will adhere to the surface. It will cause those parts attrition, machine working unmorally and unsatisfied cutting surface.

The gears and racks are in mesh, which is vital issue for the machine operating. So keep the longitudinal/transverse gears and racks clear. The best method is lubricating on the gears and racks regularly. Clearing the transverse rack surfaces with compressed air is strongly recommended per week. The longitudinal guide rail and roller bearings should be cleared after work, then oil the gears to prevent dust.

4.2. Lubricating
4.2.1. All the bearing wheels and guide pulleys have the sealing rolling bearing with permanent grease. As mentioned before, lubricating on guide rails and roller bearings per day. The easy way is clearing and oiling the guide rail per week.
4.2.2. There is permanent lubricant in the longitudinal/transverse gear boxes. In general, it does not
need to alter.

4.2.3. Every month, open the metal box of the torch lifting device to force the lubricant into the oil cup. The lubricating on the linear bearing is with molybdenum disulfide lubricant

4.3. Machine adjustment

4.3.1 It’s easy to adjustment as there are eccentric device on the longitudinal roller bearings and transverse torch posts. After long time working, the abrasion of guide rail is happened. Adjust the eccentric device to keep the machine operating steadily.

Both sides of the main end bracket have the guide pulleys. The function of the guide pulleys on the outside is not for eccentric, but for getting a directional fix on the longitudinal guide tail. The guide pulleys on the inside are the eccentric wheels. Therefore, please use the eccentric wheels on the inside.

After installation, there is the deviation of guide rail precision existing from the result of foundation settlement and vibration. Half year later, the guide rail should be checked and adjusted.

4.3.2 After long time working, the abrasion of longitudinal/transverse gears and racks are happened. Adjust the eccentric wheels on the longitudinal gear boxes to keep the gears and racks are in mesh. For the transverse, loosen bolts on the gear boxes to adjust (Figure 6).

Figure 6
4.4 cutting torch cleaning

Whenever cleaning, should closed preheating oxygen and cutting oxygen, for safety reasons also should remove the ignition cable and close irrelevant cut torch movement and press the button "open", closed cutting oxygen cutting torch on cutting hand valve, can make the cut through needle insert, for blew the dust off, passes through the needle on fast oxygen hole wipe move, and open cutting oxygen hand valve of cutting torch slowly.

5. Oxygen-gas cutting

5.1 Introduction to oxygen-gas cutting

A jet of pure oxygen (at least 99.5%) is used to ignite on the cut surface. A jet of pure oxygen is then directed into the preheated area instigating a vigorous exothermic chemical reaction between the oxygen and the metal to form iron oxide or slag. The oxygen jet blows away the slag enabling the jet to pierce through the material and continue to cut through the material. The cutting process should follow the following conditions.

(1) The ignition temperature must below the melting point of the material.

(2) The melting temperature of oxide must below the melting point of the material in order to remove the oxide.

(3) The ignition temperature should be keeping continuously on the cutting point. The losing heat energy is compensated by heating flame. The non-alloy steel (with carbon content below 0.3 per cent) and low alloy steel (with carbon equivalent above 0.4 per cent) can be cut after preheating. With the increase in the proportion of metal elements, the cutting process is more difficult. Therefore, the nickel-chrome steel, silicon metal and etc. should not be cut by the oxygen-gas cutting without protective measure, which should use thermal cutting to deal it.

\[ \text{Carbon Equivalent} = C + \frac{Mn}{6} + \frac{Ni}{15} + \frac{Cr}{5} + \frac{Mo}{4} + \frac{V}{5} \]

5.2 Working Pressure

The working pressure of the cutting machine could be adjusted. There are three pressure-regulating valves with cutting oxygen, preheat oxygen and gas. The valve can control the working pressure of the oxygen and gas. The data can be checked from cutting list. The manual valve on the cutting
torch should be opened to adjust the pressure of pressure-regulating valves. The cutting efficiency will be lower with unreasonable pressure. It also has harmful influence on the cutting surface.

5.3 Cutting performance and nozzle parameters (only for GK1, GK3 nozzle, other types can refer the cutting parameters specification)

<table>
<thead>
<tr>
<th>Cutting Nozzle NO.</th>
<th>Cutting Thickness (mm)</th>
<th>Cutting Speed (mm/min)</th>
<th>Gas Pressure (Mpa)</th>
<th>Preheat Oxygen Pressure (Mpa)</th>
<th>Cutting Oxygen Pressure (Mpa)</th>
<th>Cutting Oxygen Consumption (m³/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5~10</td>
<td>700~500</td>
<td>&gt;0.03</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>19~20</td>
<td>600~380</td>
<td>&gt;0.03</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>2.23</td>
</tr>
<tr>
<td>3</td>
<td>20~40</td>
<td>500~350</td>
<td>&gt;0.03</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>3.48</td>
</tr>
<tr>
<td>4</td>
<td>40~60</td>
<td>420~300</td>
<td>&gt;0.03</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>5.44</td>
</tr>
<tr>
<td>5</td>
<td>60~100</td>
<td>320~200</td>
<td>&gt;0.03</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>7.84</td>
</tr>
<tr>
<td>6</td>
<td>100~150</td>
<td>260~140</td>
<td>&gt;0.04</td>
<td>0.3~0.5</td>
<td>0.7~0.8</td>
<td>10.68</td>
</tr>
</tbody>
</table>

The above table lists the cutting parameters of oxygen-acetylene and oxygen-propane fast nozzles. Referring to the table, the operator can choose the specific nozzle (depending on the thickness of the steel plate) and adjust the cutting speed (depending on the preheat flame and cutting oxygen to control the pressure). If use other gas, it should refer to other manufacture’s cutting parameters to adjust.

5.4 Setting the cutting speed and the gas pressure
The cutting speed, gas consumption, the pressure in the cutting list is average value. The value of operating machine could be above or below the average. Thus, the operator should control the cutting speed and pressure parameters correctly according to the characteristics. The cutting oxygen has been weakened by the rust dust and oxide. Similarly, the incorrect regulating of cutting flame has bad effect on the cutting quality and cutting speed.

5.5 Flame adjustment
(1) Preheat flame with excessive gas (2) Neutral preheat flame (3) Cutting flame
Open the oxygen and gas valve, a balanced mix gas is burned, then adjust the flame properly. (See the right picture).

Soft flame should be used to cut the sheet, harsh flame should be used to cut thick plate. If the cutting edge is melting with hanging drop or blowing ball, the power of heating is too strong. Additionally, soft flame may cause the cutting surface damaged or the flame to backfire, which always accompanied by a snapping or popping noise. If the cutting flame is proper, the jet of the cutting oxygen will clean and sharp.

5.6 Cutting oxygen jet adjustment

The quality of cutting oxygen jet plays a vital role in obtaining well cutting surface. If cutting oxygen jet is in the center of the flame and can be easily seen as cone-shaped jet, the cutting jet adjustment is proper. When the cutting jet is out of the nozzle, like broom completely spreading or can not be seen clearly, this is the phenomenon of cutting nozzle jam. Only the recommended nozzle cleaner are used to clean the cutting nozzle. Using inappropriate tools will cause cutting nozzle damaged.
5.7 The distance between cutting nozzle and workpiece

Another important factor to achieve well cutting surface is to set correct space between cutting nozzle and workpiece. When the primary flame (flame core) is about 1mm top of workpiece, it is the ideal cutting space for the nozzle. The space of cutting nozzle depends on the size of cutting nozzle. The distance of cutting nozzle is 3-10mm with acetylene cutting. Besides, the distance of cutting nozzle is 6-12mm with other gas.

The approximation of cutting nozzle distance with acetylene cutting

<table>
<thead>
<tr>
<th>Cutting thickness</th>
<th>Cutting distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10mm</td>
<td>3mm</td>
</tr>
<tr>
<td>10-25mm</td>
<td>5mm</td>
</tr>
<tr>
<td>25-50mm</td>
<td>6mm</td>
</tr>
<tr>
<td>50-100mm</td>
<td>8mm</td>
</tr>
<tr>
<td>&gt;100mm</td>
<td>10mm</td>
</tr>
</tbody>
</table>

The voltage sensor controls the height of cutting nozzle on the cutting process. If there is no automatic height adjustment or the automatic height adjustment is turned off, the correct nozzle space should be paid attention constantly. When using propane or natural gas and the cut thickness is to 50mm, the height of cutting nozzle should be doubled. If it is necessary, adjust it.
5.8 Preheating time

The preheating time of edging cutting or perforation depends on the type of gas, the quality of steel plate and the flame adjustment.

The reference value of the average preheating time

Average preheating time (second)

<table>
<thead>
<tr>
<th>Cutting thickness</th>
<th>Acetylene</th>
<th>Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>To 20mm</td>
<td>5(30)</td>
<td>8(34)</td>
</tr>
<tr>
<td>To 50mm</td>
<td>8(50)</td>
<td>10(53)</td>
</tr>
<tr>
<td>To 100mm</td>
<td>10(78)</td>
<td>14(80)</td>
</tr>
</tbody>
</table>

The values in brackets refer to the preheating time of perforation. If use high-pressure preheating system, the above value can be reduced about 40%, which can be set in the control system.

5.9 Cutting

The beginning of each cutting process of a complete automatic preheating circulation, selects the multi-purpose cut torch then start to press "heating flame start" button or executive NC cutting begins to command.

Before cutting operators should pre-selected cutting edge start or by board hole method began in control panel.

5.9.1 Piercing reheat circulate

When open the heating flame, heating flame center gas and oxygen flow increases with the pressure should be open, began with cutting torch ignition preheating time. When preheating time finish, cutting torch promote immediately, after piercing, the automatic device closed.

5.9.2 Cutting quality

The high quality oxygen cutting has no defect. The cutting surface is evaluated by the regulation DIN2310.

The easy way to evaluate the cutting quality is compare the cutting surface with the sample. Besides, cutting surface crassitude should be Ra12.5 by eyes.
6. Cutting torch operation

Before operating the machine, the user must confirm no objects are on working area or cutting table to avoid colliding causing the possible damage. Before transport, every torch should undergo flashback safety checking procedures. Operating with filthy or damaged cutting torch would cause safety issues, such as flame reverse back to the cutting torch. In such situation, flame disappears suddenly from the head of cutting torch and give out roaring or sizzling sound. If the above situation occurs, fuel gas valve should be turned off immediately, following by the heating oxygen and cutting oxygen valve. Approach the specialists to check before the ignition. Blow dirt off the pipe and cutting torch before ignition.

7. Turn off the cutting torch

After operating process finishing, the cutting torch should be switched off within the following procedures. Firstly turn off the valve, then cutting oxygen, fuel gas, heating oxygen. Lift up the cutting torch, then start the next cutting process. Always remember to move the beam to the top of the guide rail. Then turn off the gas and power source.

8. Safe operating

During the cutting process, gas leakage or misoperating may cause explosion and fire emergencies. Therefore the operators have to ensure the safety precautions and follow the safety operation standards strictly by the rules.

8.1 The working environment should be equipped with fire fighting equipment, such as fire extinguisher, fire hydrant, sandbox, etc.

8.2 The operators should be trained the third degree of safety education and are trained knowledge of safety operation before working.

8.3 Follow the safety precautions and safety operation standards of pressure reducing regulator, such as acetylene cylinder, oxygen cylinder, etc.

8.4 No flammable material allowed in the working area.

8.5 During the operating process, there are bits of flame, heat, radiation, smoke, noise and lighting,
etc. It is important to install sufficient ventilation device in the working environment, at the same time, sufficient personal protection equipment should be provided for the operators.

8.6 When the serious execution errors happened, the possibility of explosion due to leakage of flammable gases cannot be eliminated. It is hence advisable to install sufficient ventilation system near the gas power.

9. Precautions

The operator must be familiar with the thermal cutting principle and the specifications for safety operation. Before operating the machine, the operator must read the CNC system manual and the operation manual carefully to avoid misoperation causing the machine damaged.

The gas source should be in the safety situation before the operation. During the cutting process, make sure no gas leakage. If abnormal situation happens, such as the operator smell the gas, the operator should close the machine immediately, turn off the gas source and the power source, and call the relevant person to check it. Only after the problem solved could the machine be restarted. Inflammable and explosive materials should be far away from cutting jet area. When using the automatic ignition, the operator should make sure nobody in the flame area, and then start to cut.