Thank you very much for your choose the Dongda TS series of engraving machines. TS series of engraving machines which high quality and multi-function are producted by Dongda electric. It’s widely used in artware, embossment, badge, medal, mold, PCB drilling engraving, biological experment and so on.

The machine is made in high-grade aluminum, applied import precision roller screw to ensure processing precision. The instruction book is the manual of TS series of mini-engraving machines. The manual provide related note to consumer, above installation, set operation parameters, abnormal diagnosis, daily maintenance and security use. To insure normal installation and handle the series of engraving machines, before you use the machines, you have to read the manual carefully. The manual is enclosed in product, after you read it, please keeping properly in case you use it in the future.

If you have unsolved problems in the process of use, you can touch the operators all places or directly contact our company’s customer service center.

If there’s a change in the manual, it can’t be prior noticed.
Chapter 1: The user guidelines

Packing list

Chapter 2: process and coordinate system

Chapter 3: software introduction and installation

Commonly used software introduction
Software installation
Controller software installation
Knife road soft installation

Chapter 4: The control software interface description

Chapter 5: freshman learning method

Chapter 6: the control software’s matters need attention

Chapter 7: shortcuts list

Chapter 8: common fault and ruled out

explaining in detail of computer can’t resolve problems

Chapter 9: maintenance

Chapter 10: all models of motor parameters

Chapter 11: ARTCAM introduction and commonly used carving parameters

Parameters of engraving machines process craft

Chapter 12: cutters choice

Chapter 13: Wentai engraving system application
Chapter 1 The user guidelines

In order to insure your operatesecurity, please obey the following rules and requirements in the use process.

1. The machine should placed on smooth soild deck plate.
2. Engraving machine or power interface center grounding terminal, please according to national electrical safety regulations and others revelant standradsto execution, reliable grounding.
3. Don’t pull engraving machine’s cable with electric plug.
4. Don’t put screw gasket or conductive body into controller inside, otherwise there’s a fire risk and damage of controller.
5. The high-speed electrical equipment of engraving machine, spindle speed is very high, so the operators should do some protective measures, it is strictly prohibited wear yarn gloves to avoid dangerous
6. Children operate or touch machine can’t be allowed.
7. Please don’t make controller place where may rainor sunshinepoint-blank place, there’s risk of damage the controller.
8. Please don’t contact internal circute board and components under energize, or you will get an electric shock.
9. The machine can’t be setted in the situation of contain explosive gas, otherwise will cause to explosion.
10. When the engraving machine is working, personnele and machine should be keeping a distance, it’s strictly prohibited to touch cutter and
other high-speed rotating parts.

11. It have’t electromagnetic interference source surrounding.

packing list

After open the packaging, please check related accessories are complete.

<table>
<thead>
<tr>
<th>Serial number</th>
<th>accessory</th>
<th>quantity</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Engraving machine</td>
<td>1</td>
<td>set</td>
</tr>
<tr>
<td></td>
<td>main parts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Electric cabinet</td>
<td>1</td>
<td>set</td>
</tr>
<tr>
<td>03</td>
<td>Power line</td>
<td>1</td>
<td>root</td>
</tr>
<tr>
<td>04</td>
<td>Data line</td>
<td>1</td>
<td>root</td>
</tr>
<tr>
<td>05</td>
<td>Key /wrench</td>
<td>1</td>
<td>handle</td>
</tr>
<tr>
<td>06</td>
<td>Instruction book</td>
<td>1</td>
<td>origin</td>
</tr>
<tr>
<td>07</td>
<td>Program CD</td>
<td>1</td>
<td>stretch</td>
</tr>
<tr>
<td>08</td>
<td>fixture</td>
<td>2</td>
<td>pay</td>
</tr>
<tr>
<td>09</td>
<td>graver</td>
<td>2</td>
<td>handle</td>
</tr>
</tbody>
</table>

● If you discover any omission, please contact the Dongda electric equipment factory or dealers.
Chapter 3: software introduction and installation

3.1 Commonly used software introduction

Notice: In addition to ARTCAM installation process choose the language, others all use the default installation in the process of software installation! After fix it, you must restart your computer.
After the installation is complete will generate a few icon on the desktop, you can only keep the following several icons.

3.2 software introduction

Professional computer-assisted mapping software

Knife road software (graphics, words, embossment, editing cutter path)

Note: cutter path keep the format selection G-Code (mm) (*.tap)

Engraving software (engraving machine control software)

3.3 Controller software installation

1. Putting the CD into CD-drive, CD will automatically run and pop directory menu, if don’t pop menu, please into CD menu and double-click the icon. Directory menu as below
Clicking software installation into it’s menu

Clicking on the menu first step will appear as follows figure window.
End User License Agreement

Please read the following license agreement. Press the PAGE DOWN key to see the rest of the agreement.

READ CAREFULLY!

This Mach3 CNC for Windows End User License Agreement ("Agreement") is a legal agreement between you (hereinafter referred to as "Customer") and AntiSoft Software Corporation. By installing, copying, or otherwise using the Software or any Software Updates, Customer agrees to be bound by the terms of this Agreement. If Customer does not agree to the terms of this Agreement, do not install, copy, or use the Software, including any Software Updates that Customer received as part of the Software (each, an "Update"). By installing, copying, or otherwise using an Update,

Do you accept all of the terms of the preceding License Agreement? If you choose No, Setup will close. To install Mach3, you must accept this agreement.

[Button: Yes] [Button: No]

Readme Information

Mach3 is now in full release.

It's development continues, and new releases will appear periodically. Please report bugs found within.

Thanks,

Joe

[Button: Back] [Button: Next] [Button: Cancel]

Select Destination Directory

Select the folder where you would like Mach3 to be installed, then click Next.

[Folder Path: C:\Mach3]

[Button: Back] [Button: Next] [Button: Cancel]
After click determine, complete installation and return to the directory menu, click on the second step, choose corresponding model machine.
Click on the installation back to directory menu, click on the third step installation Chinese component default path C:\MACH3, directly fix it.
Click receive—installation

Knife road software installation

Clicking knife road editing software installation, you will see the following interface.
Installing ArtCAM Pro 7.000

Welcome

Welcome to the ArtCAM Pro Setup program. This program will install ArtCAM Pro on your computer.

It is strongly recommended that you exit all Windows programs before running this Setup program.

Click Cancel to quit Setup and then close any programs you have running. Click Next to continue with the Setup process.

WARNING: This program is protected by copyright law and international treaties. Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.

Click NEXT

Installing ArtCAM Pro 7.000

SOFTWARE LICENCE AGREEMENT

Please read the following licence agreement. Use the scroll bar to view the rest of the agreement.

DELCAM PC
SOFTWARE LICENCE AND TERMS OF SUPPLY

These Terms contain provisions placing obligations on the Licensee and excluding and limiting Delcam’s liability. The Licensee’s attention is drawn to particular but not exclusive to clause 4 (Right to Clone). All Licenses are granted subject to such terms and conditions and this Agreement shall incorporate and be read as a whole and not by reference to any separate documents.

Do you accept all the terms of the accompanying Agreement? If so, click Yes and go to the next screen. If you select No, Setup will cease.

Click YES

Installing ArtCAM Pro 7.000

Choose Destination Location

Setup will install ArtCAM Pro in the following directory:

To install to this directory, click Next.

To install to a different directory, click Browse and select another directory.

You can choose not to install ArtCAM Pro by clicking Cancel and stopping Setup.

Destination Directory

C:\Program Files\ArtCAMPro 7000

Click NEXT
Click NEXT

Choose English and click NEXT

Click NEXT and begin installation

After the installation is complete, clicking the software lock and installation. All installation completed, you must restart computer.
Chapter 4: The control software interface description

1. Complete software interface

The screen of the software mainly shows seven interface.
* a. code display area
* b. specific axial shows
* c. knife road track shows (can use mouse do accordingly operate)
* d. Code execution control button
* e. emergency stop button—after open software must click it (green not flashing state)
  only software can use (shortcut “~key”)
* g. spindle manual control (open/close) shortcut F5; can speed by add or reduce, incremental place click on 1000, can plus and minus by 1000
* h. feed rate adjustment (shortcut F10 F11)
2. Manual control shortcut (direction key, page up, page down key)

   Manual speed shortcut: slowdown "{" accelerate "}"

3. Program manual function interface

   When the program is in idle state, please press the keyboard Tab key.

   You can open manual function interface as follows.
1. Study Method

When you operate the machine in the first, please first know software and relevant operation method of the machine, then run it, don’t blindly run it.!

Learning to operate the machine can not put tools and draw (word) method: Will a nib with elastic ball pen fixed in the Z axis (or in spindle) then running, it can ensure safety and can learn the basic operation of the machine. Please pull the spindle motor plug in the process in order to guarantee your safety.

You can set cutters after master generally, try to use soft material as far as possible when carved in case improper operation. Tool is very sharp, please be sure your safety when dis assemble it.

2. Basic Sports Check

Opening control software, then open controller power. Closed emergency stop (evergreen state), If the red green interval is flashing, suddenly stop has launched, any functions can be used at the moment. Use manual control (direction key, up, down key) Check the axis movement direction.

The direction key should fit tool movement direction, Up key upward movement, Down key downward motion.

Note: For not correct axis direction changing by the following way can change direction.
Graphic shows: set DIR series of hook or fork.

Engine configuration—March3 controller menu-config-Ports&Pins

3. basic use procedure

Editing original document pattern: CAD document (format: DXF) / PCB document/pictures BMP… words or graphics, it can directly use Artcam’s words and graphics tools to editing.

Formation processing code

Set and calculate the documents of tools path generation TAP/NC….

Revelent software introduction: Artcam, Wentai carved TAPE.

Clamping work-piece

(For machined parts that high requirment flatness, for example PCB, it must use benchmark pad and double-sided gum to fixes it.

Note: benchmark can use PVC, Acrylic materials, using double sided gum stick it on the work platform, size is on the basis of needs, using
milling cutters about 3mm remove it.

Origin and tool setting

Moving cutters to workpiece origin, click set to origin

(manual speed adjust shortcut “【” decrease “】” increase)

For instance: Xy workpiece origin is in the bottom left corner, click software’ set to origin, then tool setting (Set tool Z height ), cutters move to the surface. Now click Z reset . If need to adjust the position or level, it can be compensate by modify directly.

Specific way: left keyboard click coordinate that need to change and input coordinate value. Then press enter confirm it, input method in English state is effective.

Begin carved

Loading G code

Choose need to process document
For Wentai or some other software make up processing documents when open it, it need to change file types in here (All files or corresponding suffix name).

Tool setting interface as follows shows:

Reduce feed rate to 50% (shortcut F10) add feed rate (shortcut F11) click “begin run” (shortcut Alt+R).
Adjusting feed rate in the process after running. According to actual processing document and processing materials adjust feed rate to 0%-100% appropriately. You can click "stop running" in the process. (shortcut Alt+S) is stop running. If need continue process after stop, note first open spindle.

Suspended use, suspend processing at any time in the machining process, clicking begin running can continue after suspend.

- Brushless Type Setting As Follows:
  - Choose apply after every option setting
  - Setting: Menu-Config-Ports&Pins-Motor Outputs

![Direction Setting, set here when direction is opposite.]

![Low Level Effective.]

![Apply.]

![Engine Configuration... Ports & Pins]
Output Signals Setting

Spindle Setup

Remove this hook

Apply
Chapter 6 control software’s matters need to attention

1. After process finished, it will stop automatically, spindle also close. But at the moment, device driver motor is still in a state of power, so if you don’t work for a long time, please close controller power or click emergency stop.

2. In an emergency situation, please press emergency stop quickly or shortcut “～”

Note: Once the press the emergency stop will cause origin migration, if continue to manufacture, you need to proofread origin transfer.

Chapter 7: contral software shortcut list

<table>
<thead>
<tr>
<th>function</th>
<th>Default shortcut</th>
</tr>
</thead>
<tbody>
<tr>
<td>X+</td>
<td>Right the direction key</td>
</tr>
<tr>
<td>X−</td>
<td>Left the direction key</td>
</tr>
<tr>
<td>Y+</td>
<td>Up the direction key</td>
</tr>
<tr>
<td>Y−</td>
<td>Under the direction key</td>
</tr>
<tr>
<td>Z+</td>
<td>Page up</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Z-</td>
<td>Page down</td>
</tr>
<tr>
<td>Switch of abrupe stop</td>
<td>Symbol ~ key</td>
</tr>
<tr>
<td>Manual rate increase</td>
<td>symbol ] key</td>
</tr>
<tr>
<td>Manual rate decrease</td>
<td>symbol [ key</td>
</tr>
<tr>
<td>Begin to run</td>
<td>Alt+R</td>
</tr>
<tr>
<td>Stop to run</td>
<td>Alt+S</td>
</tr>
<tr>
<td>Spindle switch</td>
<td>F5</td>
</tr>
<tr>
<td>Feed rate plus</td>
<td>F11</td>
</tr>
<tr>
<td>Feed rate minus</td>
<td>F10</td>
</tr>
<tr>
<td>Set to origin</td>
<td>Home</td>
</tr>
<tr>
<td>Single-step operation</td>
<td>ALT+N</td>
</tr>
<tr>
<td>Manual switch</td>
<td>Ctrl+Alt+J</td>
</tr>
<tr>
<td>stop</td>
<td>SPC</td>
</tr>
<tr>
<td>All clear</td>
<td>Ctrl+O (English)</td>
</tr>
</tbody>
</table>

Chapter 8: common fault and ruled out

<table>
<thead>
<tr>
<th>Common problems</th>
<th>Common reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sculpture size don’t accord</td>
<td>1. Checking the unit set whether MM or not</td>
</tr>
<tr>
<td></td>
<td>2. Motor parameters is not correct, please to correct setting with the last page of document about “motor parameters”</td>
</tr>
<tr>
<td></td>
<td>3. Wrong path is calculated</td>
</tr>
<tr>
<td></td>
<td>4. Error of cutters’ size</td>
</tr>
<tr>
<td>Issue</td>
<td>Cause</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Automaticalrun can engrave, but the key board can’t handle.</td>
<td>1. Checking the switch on the interface of M3ACH3 (see 5.2 interface about manual function)</td>
</tr>
<tr>
<td></td>
<td>2. Whether the manual mode is CONT or not.</td>
</tr>
<tr>
<td>The computer can’t control the machine to carve.</td>
<td>1. Checking stop button of control software</td>
</tr>
<tr>
<td></td>
<td>2. Other likely reasons</td>
</tr>
<tr>
<td></td>
<td>a. Software installation or setting are incorrect, after unloading control software to reinstall (default install)</td>
</tr>
<tr>
<td></td>
<td>b. If operate system have problems, it is suggest that reinstall 2000 or XP system.</td>
</tr>
<tr>
<td></td>
<td>c. Parallel problems (hardware failure or parallel mode) make some computers can’t control machine, you can buy parallel expansion card.</td>
</tr>
<tr>
<td></td>
<td>d. Please contact with suppliers</td>
</tr>
<tr>
<td>Carving misalignment</td>
<td>1. Speed is fast, appropriately cut feed rate</td>
</tr>
<tr>
<td></td>
<td>2. Too much obstruction that remove wire screw and bodies and lubricate.</td>
</tr>
<tr>
<td></td>
<td>3. If coupling is loose, you can luck screw.</td>
</tr>
<tr>
<td></td>
<td>4. Missed grounding.</td>
</tr>
<tr>
<td>If spindle don’t working, other all normal.</td>
<td>1. Parameters setting is incorrect</td>
</tr>
<tr>
<td></td>
<td>2. Carbon brush of spindle motor is bad contact, replacement carbon brush</td>
</tr>
<tr>
<td></td>
<td>3. Please contact with suppliers</td>
</tr>
<tr>
<td>Motor make such noise that vibration is very obvious.</td>
<td>1. speed is too deep, after unload spindle and remove, putchuck and appropriately knock tight.</td>
</tr>
<tr>
<td></td>
<td>2. Motor is in oscillation area, it usually change feed rate or manual rate.</td>
</tr>
<tr>
<td></td>
<td>reasons: Single knife is too deep, after unload spindle and remove, putchuck and appropriately knock tight.</td>
</tr>
<tr>
<td>Sculpture depth not consistent</td>
<td>Table and workpiece uneven, Milling flat plate or replace the workpiece</td>
</tr>
<tr>
<td>Sculpture has burr</td>
<td>1. Different tools heart</td>
</tr>
<tr>
<td></td>
<td>2. Blunt tools</td>
</tr>
<tr>
<td></td>
<td>3. Eccentric chuck</td>
</tr>
</tbody>
</table>
Detailed interpretation about the computer can’t control problems

Method: purchase a piece of PCI expansion and parallel port card to replace original or replace computer.

modify control software installed after add parallel port expansion card.

modify method: right key “my computer” choose “attribute “------hardware------open equipment management------double-click PCI-LPT card, open nature, you will see the same window like following, Remember you red circle of character ,like this is 0378.

Then open the control software, click setting ---Port and pin, you will see something like the following illustration window.
Then character that you just remember will be filled in port address, Click on the application, ascertain!

Chapter 9: maintenance

Engraving machine is precision equipment that controlled by computer. precision mechanical movement mechanisms finish its working motion, In order to ensure the normal use of carving machine, we must usually maintain the engraving machines. Specific requirement as follows

1. Dairy maintenance

Cleaning the work site, Maintain cleanliness of the machine tool, water-collected
spindle must check scream before use it. Must always clean up the spindle chuck. Clear screw guide rail scraps and dirt in time and to screw guide added a grease or lubricating oil.

2. **Regular maintenance (period is three months)**

Unpark the Z axis. Clearing screw guide rail scraps and dirt, then add a grease or lubricating oil to it.

Check the connection situation of connecting cable.

Check belt wear.

---

**Chapter 10: all models of motor parameters**

Check method: MACH 3 mill interface -- setting -- motor parameters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Steps Per</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>320</td>
<td>400</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>320</td>
<td>400</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600</td>
<td>1200</td>
<td>2000</td>
<td>2000</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>Acceleration</td>
<td>300</td>
<td>400</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Y</td>
<td>Steps Per</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>320</td>
<td>400</td>
<td>400</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>320</td>
<td>400</td>
<td>400</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600</td>
<td>1200</td>
<td>2000</td>
<td>2000</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>
speed can be raised by 20%–50% after machine running, but the need to pay attention to clean up screw and guide rail body and add Oil lubrication to ensure the stable sculpture

**Chapter 11 ARTCAM introduction and the commonly used sculpture parameters**

ARTCAM software interface and basic function introduction

(Detailed advanced tutorial see CD tutorial part)

1 interface
Vector editing area

Cutters path parts
Basic setting process parameters (such as depth, tool specification, engraving speed, spindle rotate speed).

Note: parameters have’t specified value, it just need a safe range like speed. The specific process can also appropriately adjustments the processing speed or spindle speed through the control software.

For example, Carved a round hole with a diameter 25 mm deep 2 mm, materials for 2 mm thick PVC board.

As follows, processing mode option 2 d contour processing, Inside processing, 2 mm over depth, safe height Z is 5mm, choose 2mm milling, slice step distance is 0.5mm. The 2 mm depth need to cut into 4 times, feed rate is 15mm/sec or 900mm/min, cut the rate is 6mm/sec or 360mm/min, spindle 15,000. Cutting direction use the default climb milling. Special circumstances can use inverse milling (such as carve...
soft materials, soft wood, improve the finish. Other can use the default Settings. Choose the vector part that need to processing in the right, click on the now will automatically generate knife road, the last save the tool path, save format select G-Code (mm). tap
Parameter of engraving machine crafts (for example; acrylic): other cutters’ material can set or reference following.

<table>
<thead>
<tr>
<th>cutters</th>
<th>Row spacings Path pacing</th>
<th>Slice step distance</th>
<th>Slice speed MM/second</th>
<th>Feed rate MM/second</th>
<th>Spindle speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 Column knife</td>
<td>0.6</td>
<td>0.2-1</td>
<td>2-7</td>
<td>5-15</td>
<td>18000</td>
</tr>
<tr>
<td>2.0 Column knife</td>
<td>0.8</td>
<td>0.5-1</td>
<td>2-7</td>
<td>5-15</td>
<td>18000</td>
</tr>
</tbody>
</table>
Chapter 12 choose cutters

Tools use guide:

1. Acrylic cutting processing, recommend to use single blade spiral milling cutter. Characteristic is processing speed quickly, high efficiency, not glue the crumbs, the special manufacture process ensure processing acrylic not cracking-off, knife is very fine, surface is clean and smooth. If you want the machined surface to achieve grining arenaceous effect, recommend to use double blade or three blade spiral milling cutters.

2. Density board cutting processing, recommend to use double blade and big row crumbs spiral milling cutters. It has two scraps discharge groove of high capacity two-edged design, not only have it good scraps discharge function, but reach good tool balance. When process high density board, don’t black, has’t smoke, Long service life.

3. Precision small type anaglyph processing, recommend to use a bottom graver.

4. Soft wood, density board, original wood, PVC, Acrylic large type.
anaglyph processing, recommend to use single blade spiral ball milling cutter.

5. Without burr cutting, recommend to use single knife, the double blade milling cutters.

6. Metal engraving processing, recommend to use single blade.

7. High densityboard, real wood recommend to use arrises tooth milling cutters

8. Sandwich plate, splint processing, recommend to use two-edged straight slot cutter.

9. the use effect of the slice sword, processing product surface without burr,

Processing will not become warped board

10. Metaldies process milling, recommend to use tungsten steel milling cutters, coating surface with violet black hardened titanium

11. It recommended to use diamond twist when acrylic mirror is sculpture processing

12. Rough machining particieboard, recommend using many stripes milling cutter.

The 13th chapter  the axis of rotation of the tool path editor

For the fourth axis tool path editor, it is a plane processing in actual. We will
First of all, we have a diameter of 30MM, length 50MM of a cylindrical opening. Then we can imagine to open a plane.

The second step: our expansion cylinder for processing cylindrical unfolded, equivalent to become a high 30MM, width 50MM of a rectangular, we in this a rectangle above a height of 3MM, length 40MM of a tool path editor. This is in accordance with the plane tool path editing, then generate a G code.

The third step: we right click to use Notepad to open G code, enter a the following picture,

![G code example](image)

Then left click on the "Edit" menu" replacement" in out like,

![Replacement dialogue](image)

find contents fill in X, replace contents are written as A, and then click and then save point.

At this time, a complete A axis tool path is completed.
Below we talk about how to set A axis motor parameter.

The A axis settings:

one circle of Motor is 1600 pulse

1 motor:1 chuck = 2.25:1,

one circle of chuck = 1600 * 2.25 = 3600 pulses

The A axis of the motor parameters: 1, pulse number 3600/ is carving circumference = motor can count. For example, the US on a diameter of 30MM to calculate the motor parameters: 3600/94.2 = 38.217, this number to fill in the corresponding digital steps per , we according to regulation speed ,

we according to the need, the acceleration is adjusted according to the need, 

Note: with the processing of each of a different diameter of the cylinder, the electrical parameters must be changed.