



4KW Laser Tube Cutting in Metal Fabrication—TP7535M Fiber Laser Tube Cutting System

Shang Hu

Wuhan Optics Valley Vocational College, Wuhan, Hubei, China.

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***Corresponding author:** Shang Hu, Wuhan Optics Valley Vocational College, Wuhan, Hubei, China.

Abstract

Laser cutting is a popular processing method for metal cutting, especially in the field of pipe cutting. The main applied powers include 4KW and 6KW, and the laser used is mainly a continuous laser of optical fibers. We will analyze the structure and cutting principle based on this, and simulate the optimal path cutting of FSCUT. The system mainly uses FSCUT TUBES T software. In the processing process, the relevant cutting power and corresponding air pressure are first adjusted, and the cutting pattern is edited on the software. Then, in the actual production line, the material is added by bundling and loading, and the smooth cutting is completed. The cut workpiece is smooth, flat, and highly efficient, making it very suitable for metal processing operations in sheet metal and related industries. This equipment application is very suitable for most processing and small and medium-sized enterprises. We have obtained this report based on processing and enterprise research.

Keywords

Tube cutting, Laser cutting, Metal Fabrication

1. Laser Tube Cutting Machine Introduction

TP7535M laser tube cutting machine is manufactured by HG Farley Laserlab according to international export standards. This series of equipment is the preferred model for the metal tube processing industry. It has strong cutting capacity, "flying" cutting speed, ultra-high stability, high-quality processing, automatic loading and unloading systems, extremely low operating costs, and super-high adaptability.

The TP7535 laser tube cutting machine can perform high-speed, high-quality laser cutting on round tubes, square tubes, rectangular tubes, and oval tubes. The cutting section has no burrs or slag. The cutting shape can be diversified for any shape requirement.

TP7535M laser tube cutting machine adopts a gantry structure, motor gear rack drive, and transmission components such as gearbox, guide rails, and rack and pinion, which are all well-known foreign brands. It features by stable structure, good rigidity, light weight, and high dynamic response. It is a high-performance laser tube-cutting machine.

2. Technical Specification Parameter

This paper, mainly focuses on the structure of the laser tube cutting, the cutting tube process, the protection guide, etc. We list many pictures to show this. The Equipment model is TP7535, it has a 7.5-meter loading design and a 3.5-meter unloading design.

The loading part could load the tube with a max length of 7500mm, there are square tubes, round tubes, and rectangular tubes as well. For the weight of the tube, they range from 110kg to 250kg.at max, in the market, this range is enough.

Let us talk about the thickness of CS-Carbon Steel, and SS-Stainless Steel. These two sheets of steel are most welcome in the fabrication process, especially for tube cutting, bending, etc. For the CS, during the cutting its thickness should be within 1 to 16mm, and for the SS, 1 to 8mm, Since the power of the laser is only 4KW, the thicknesses of steel need to be compatible with the power of the laser. So, we chose a thickness within the range that could be beneficial for the long-term operation of the machine.

For the feeding method it adopts automatic bundled loading, it could send the Tube automatically by the electric cylinders. The tube is doing the horizontal moving, and while one tube reaches the working station, another tube is waiting in the loading rack, once the first tube is finished, the second comes in and is fabricated.



Figure 1. We add a protective cover in the unloading parts to make sure safety in operation.



Figure 2. Autoloading bundled system—TP7535M [1].

Such operation could decrease the Labor to much extent especially when there is intense work for processing. Automatically loading could work continue for more than 16Hours every day, most clients adopt this way to deal with heavy tubes,

In terms of the three chucks, it is trendy that three chucks are much more popular than two chucks, even three chucks are more complex and much higher in price than the two chucks. For most of the factory, Maximizing the utilization of huge tons of steel, and decreasing the cost of tailings is their necessary aim for the business.

3. Software Generated Processing Code

For the system of operation, CYP CUT5000 is its system, the operation system is WIN10 and CAD/CAM- software is the Tubes T 3D nesting. CAD/CAM software can read 3D graphics that are transformed from SolidWorks drawings, and can also draw standard tube cutting graphics in CAD/CAM software, Once the part is imported or drawn, the CAD/CAM software will automatically generate the laser cutting path and the optimal cutting parameters, and automatically set the cutting best solution [2].

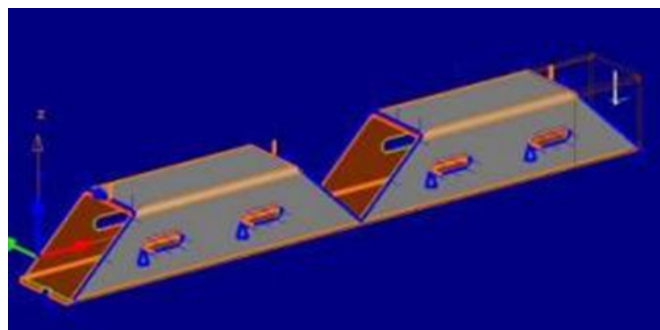


Figure 3. CAD-CAM of Tube cutting.

The software has automatic optimization statistics. The software can automatically arrange the work-pieces under each raw material according to the length of the work-piece and the cut angle combined with the length of the raw materials to minimize the remnant material. The processing code can be imported into the device by USB at one time, and can also be sent directly from the computer to the device by network and a computer.

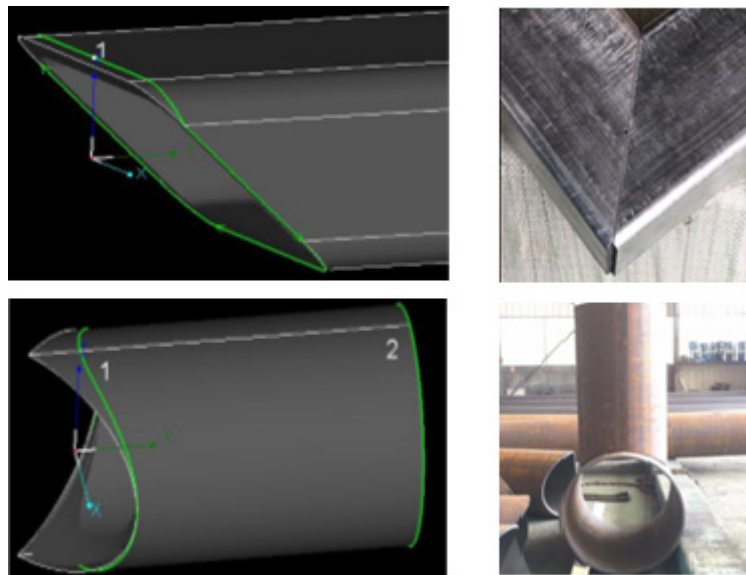


Figure 4. Round tube cutting.

In most cases kerf is necessary. The cut-off section of the tubular part is always vertical to the XOY plane of machine axes because the tube is heading along the Y direction and the laser beam is heading towards the Z axis. The common laser machine is not able to cut the bevel face of the part in the below design, thus the parts are not able to join together in the laser welding process. This software could deal. Many operators choose this Kerf to deal with complex tubes [3].

4. Feeding System

The system can automatically hold and guide the single tube by the main chuck. During the cutting process, the support frame can lift the tube. Chucks are suitable for different tube clamping, the tube end does not need to be polished, tube end with burrs is automatically cut after feeding.

The sensor on the bed automatically senses the tube and executes the mounting program, the clamped tube will be transported to the standby position, waiting for cutting.



Figure 5. Size would be different due to loading pipe requirements from different customer demands.

Feeding and Guiding Function, there is the reference, the system can automatically hold and guide the single tube by the main chuck. During the cutting process, the support frame can lift the tube, then Chucks are suitable for different tube clamping. The chuck can self-center. The tube end does not need to be polished, tube end with burrs is automatically cut after feeding [4].

5. Automatic Cutting Function

The feeding system automatically delivers the tube to be cut to the bed chuck. The machine tool automatically completes the clamping of the tube and clamps the tube into the machining state with the chuck. According to the user's pre-set processing procedures and parameters for automatic cutting.

During the cutting process, the X, Y, Z, and A axes work together to complete the part cutting during the output of the laser beam. The machine tool has a professional tube-cutting database and can be modified and saved at any time during

the cutting process. The finished workpiece falls onto the stocker, and tailings and cutting waste fall into the waste bin. After cutting machine is transferred to the next feeding state.

6. Security Protection Function

Digital interlocks and safety devices are installed in the laser to ensure that the laser is not turned on for safe operation and maintenance, the perimeter of the cutting area is protected to protect the operator from motion system and laser reflections, Laser cutting machine interlock protection, when the cutting head reaches the stroke dead point or when the collision occurs, the laser is turned off. Protective device, in line with the general technical conditions of GB15760-1995 machine tool safety protection [5].

6.1 Graphic Design for the Protect Board

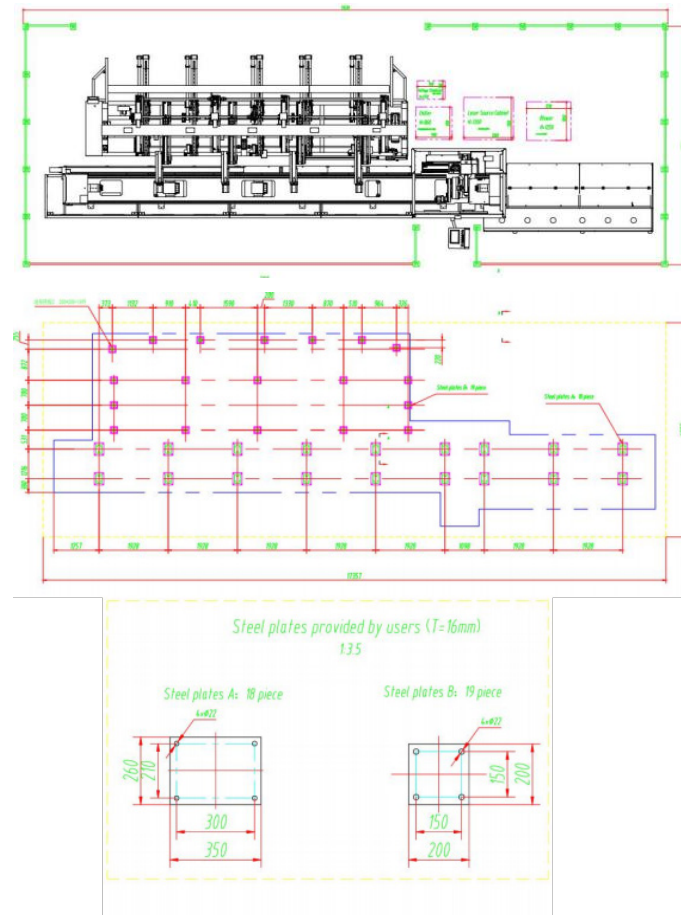


Figure 6. Protective Board and Position.

The picture in the first is for the protective board and light curtain, second is for the ground, which we will use before installation on site, A and B are two different steel plates. Then, for the Security and Protection Function, there is extra more.

This base cement layer thickness requirement is more than 200mm, Level ± 0 with a smooth surface, and the high and low difference is not greater than 5mm. After the installation of the equipment gutter cover plate is made by the user, laser in the glass air conditioning room uses the frame with aluminum alloy or plastic steel made by the user.

Machine tool to the scene by us punch fixed installation personnel responsible for the scene, Shockproof ditch must be settled, if there are vibrations round the machine, the draught pipe can be placed in the ground or according to the actual situation of the site, The ditch position to the scene can be moved by the user depending on the situation of the scene, cable and pipe can be set ted on the ground if the ditch cannot be settled, Ground wire of the body with a copper bar of the diameter bigger than 20mm, the purity is bigger than 99.5%, the depth of copper bar underground bigger than standard and the contact area between the bar and cable bigger than 25% sure millimeter.

The laser processing industry has become a high-tech industry, which requires high-quality operators and maintenance

personnel not only to better operate but also to maintain the machine in good condition. For the long-term stable work of the laser cutting machine for 24 hours, there are the following requirements for water, electricity, gas, working environment, foundation, and processing materials, which need to be careful as well [6].

We could conclude that at least the 110KVA is needed if we want to make sure it covers. Gas is needed during the work, we use the three-phase power.

Table 1. Parameters of power consumption, gas and working conditions—Tube cutting-List

No.	Item	Name	Requirements	Notes
1	Power	Laser/Chiller	8 KVA	The total installed capacity is not less than 70 KVA
		Machine tool	25KVA	
		Other accessories	10KVA	
		Stability of 3-phase power	380V± 5%, 50Hz/60Hz	
		Instability of 3-phase power	<2.5%	
		Grounding	<4Ohm	
2	Water	Water for chiller	Distilled water without minerals	
			N ₂ >99.5%	
3	Gas	Cutting gas	O ₂ >99.5%	The processing parameters will differ with different materials
			AIR pressure should not less than 0.8MPA	
4	Working condition	Temperature requirements	5-40 Degree	2KW laser source need air conditioning room
		Humidity requirements	Less than 70%	

7. Exhibition and Customer for Reference

Sketch of Manufacturing workshop from giant clients, one of the biggest heavy types of machinery manufacturers in China Its income is more than 5 billion USD in 2021 from 1st to 4th season. Adopts HGTECH TP Fiber Laser Cutting Machine with bundle auto feeding to achieve much higher efficiency and profits. Rec tube cutting is in the application. their tube length is 6000mm, in general around 4-5min/ piece [7].

Thus, according to the introduction of TP7535M from manufacturing, we could see its value in dealing with the Rec tube, Round Tube, etc., which could be a reference.

Laser cutting has more advantages compared with physics cutting by tools or plasma cutting, it has a tiny influence on the surface of the tube, also you could design a variety of pictures in the work-piece, then for the cost of the manufacturing, only gas and electricity and two people. That is a safe way for manufacturing business.

Also considering the environment, laser cutting is much better than other ways, it is an environmentally friendly way, also for the worker just to use the anti-radiative protective tools, and they could be safe in their daily work. We will discuss more in the modeling for the tube cutting and optimize the way the cutting works in the future papers.

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