

## Horizontal welding quality control of the CO<sub>2</sub> gas shielded welding

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**Abstract:** In the process of horizontal butt welding of CO<sub>2</sub> gas shielded welding, the molten metal will squat under the effect of its own weight. Therefore, the upper part of the weld seam is very easy to produce undercuts, and the lower part is prone to defects such as welding and unwelding. If the problem is serious, it will cause welding. Seam cannot pass the weld quality test. This article is based on the welding skill training topic "CO<sub>2</sub> gas shielded welding transverse welding". Through trial and error of preparations before welding, selection of welding process parameters, and welding operation process, Weld seam quality is well controlled, weld seams are beautifully formed, and relevant experience is promoted in practical training.

### INTRODUCTION

Transverse welding means that the weld angle is 0 to 180 degrees, and the weld angle is 0 to 180 degrees. In this paper, the teaching links of CO<sub>2</sub> gas shielded welding transverse welding, such as pre welding preparation, selection of welding parameters and welding operation process, are carried out repeatedly, and the weld quality is well controlled by the practice process[1].

### 1 PRE WELDING PREPARATION

#### 1.1 Welding parts.

The weldment we chose is Q235 low carbon steel plate, with a thickness of 12mm, a length of 300mm and a width of 150mm. We use the cutting machine to cut down the material and use the planer to form the V type 60 degree slope. The root clearance is  $b=2.0$  to  $3$ , and the blunt side is  $P=0.5$  to  $1$ . The technical drawings of the welding parts are shown in Figure 1.

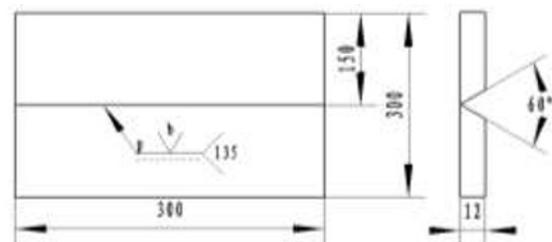


Figure 1 Technical drawings for welding parts

#### 1.2 welding wire.

Welding wire specifications: H08Mn2Si, diameter 1.2.

#### 1.3 Cleaning of welding parts.

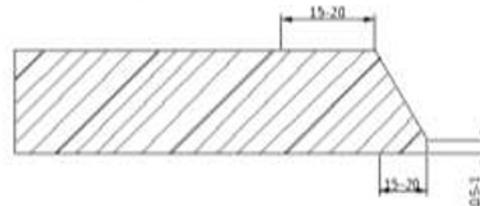


Figure 2. cleaning range on welding parts

We use sand turbine to clean the oil, rust and dirt in the range of 15 ~ 20mm on both sides of the test plate and the edge of the slope, to prevent and reduce the production of non fusion. The cleanup scope is shown in Figure 2. Then, we use the fitter twice to repair the blunt edge of the groove on the weld, and we guarantee that the blunt side

size is 0.5 to 1mm, the blunt side of the straightness is in line with the standard.

### 1.4 Our welding machine.

We choose the NBC - 350 type CO<sub>2</sub> gas shielded welding machine, using argon rich mixed gas, CO<sub>2</sub> gas content 14%, Ar gas content 86%. Before welding, we check the power supply, wire feeding mechanism, welding gun, gas cylinder and pressure reducing flow regulator respectively, and adjust the flowmeter to the required flow, and then carry out the test welding to do the whole inspection of the welding parts[2]. Before welding, we must check and clean the spout on the nozzle, and spray the nozzle with silicone oil.

### 1.5 Assembly positioning before welding.

The assembly gap of the welded test plate should not be too large or too small. If the gap is too large, the back weld will be too high and drop down. If the clearance is too small, the welding will not be able to penetrate. Theoretically, we choose the assembly gap of the initial welding end to be about 3.0mm, and the final welding end assembly gap is about 4mm. But in actual operation, we usually set the gap smaller, the welding end 2.5mm, the final welding end 3.0mm[3]. The weld pool is easier to control and the back weld is beautiful.

The length of positioning welding is 10 ~ 15mm. As shown in Figure 3, the welding quality requirement of the positioning weld is the same as that of the formal weld.

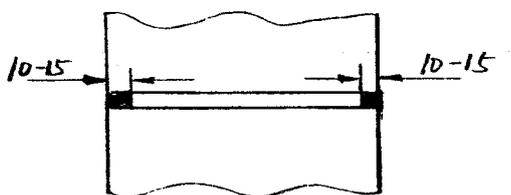


Figure 3. positioning weld

At the same time, the angle of the reverse deformation is about 3 degrees. We usually draw materials from under two boards with an electrode of 3.2. The assembly is accurate and convenient. The specific assembly method is shown in Figure 4.

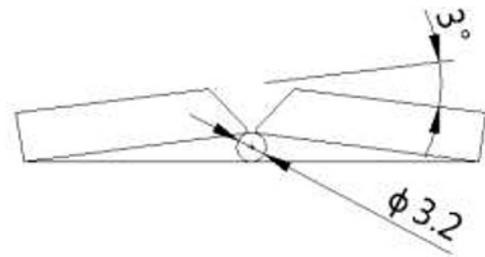


Figure 4. Reverse deformation of a workpiece

### 1.6 Auxiliary tools and measuring tools.

We used CO<sub>2</sub> gas flowmeter, CO<sub>2</sub> gas cylinder, grinding wheel grinding machine, slag hammer, weld universal gauge and so on.

## 2 Welding parameters

Which the selection of welding parameters is correct or not affects the shape, size, welding quality and the productivity of the weld directly. Therefore, the selection of appropriate welding parameters is a very important problem in the welding production. The welding process parameters of CO<sub>2</sub> gas shielded welding mainly affect welding quality, such as welding current, arc voltage, welding speed, length and diameter of welding wire, gas flow and so on. The selection of the recommended parameters in this topic is shown in Table 1.

Table 1 Welding process parameters

Number of welds	wire diameter (mm)	welding current (A)	welding voltage (V)	welding speed (m/h)	Gas flow (L/min)
Bottom seam weld	1.2	100 ~ 110	20 ~ 22	20 ~ 22	15 ~ 20
Filling layer		130 ~ 150	20 ~ 22		
Cover layer		130 ~ 150	20 ~ 24		

## 3 Welding operation process

The plate thickness of the test plate is 12mm, which is usually welded 3 layers and 6 channels, the first layer is the bottom layer, the second layer is filling layer (two weld), and the third layer is welded with 3 welds of the cover layer. The weld height will not be too high, and the

deformation will be reduced and the angular deformation can be reduced.

### 3.1 bottom welding

The test piece is assembled on the welding workstation frame, and the left side welding is adopted, and the one with the smaller gap is placed at the initial welding end of the right side. The reference welding parameters of backing welding are 100 to 110A, and the voltage is 20 to 22V. The angle between the welding torch and the weld is from 85 to 90 degrees, and the angle between the welding torch and the surface of the specimen is 75 to 85 degrees.

In the welding, due to the small gap, we should try to adjust the current and voltage to a large point, current 115A, voltage 20V, so as to ensure the penetration and prevent the production of unfusion. The arc movement is a small skew saw tooth, so that the welding is narrow and fast, and the two sides are very beautiful. The oblique circle can also be used. In the welding process, we should carefully observe the shape of the weld pool and the weld hole, keep the size of the weld pool moderate and uniform, and the welding speed should be uniform. When the welding torch nozzle swings in the groove gap, the residence time at the blunt edge of the upper slope should be slightly longer than that at the edge of the lower groove, so as to prevent the falling of the molten metal.

Welding should be done at once to reduce the joint not to break the test plate welding. It should be welded at same time to reduce the joint, thereby reducing the defect. If the arc is broken during the welding process, the arc should be re drawn from 15mm after the arc breaking, and the welding gun is swinging with a small amplitude, and when welding to the edge boundary of the weld hole, the welding gun should press forward, make a pause, and then resume the oblique sawtooth swing forward to weld, complete the welding of the bottom layer, weld the specimen arc, extinguish arc and welding. The gun can not be removed immediately until the weld pool is solidified before the welding torch can be removed to prevent the blowhole in the arc protection area.

### 3.2 Filled welding After.

Cleaning the spatter of the weld surface, the welding current we choose is 130 to 150A and the voltage is 20 to

22V. During welding, we should maintain the angle between the welding torch and the horizontal plane at 5~10 degrees. When we weld the first weld, the welding gun is 0 to 10degree angle, and the arc is swinging in the horizontal oblique circle with the lower edge of the bottom of the soldering track to ensure the good fusion. The welding path is 1/2 to 2/3 before the welding. When the second road is filled, the welding gun is 0 to 10degree angle. The arc is centered on the upper edge of the bottom welding path, and it swings between the first and the upper slope of the filling layer to ensure good fusion, and the welding path 1/2 to 2/3 before overlap.

In the operation, the oblique circle method is used. In fact, the trajectory of the motion is not necessarily a skew circle, it may be a slanted L, and the height of each weld and the forming of the weld are controlled. And the use of such a gun method can ensure good fusion on both sides of the slope, and avoid the phenomenon of groove between the welds, so as to avoid the production of non fusion, control the height of the weld seam and the forming of the weld. The welding of the filler layer should be staggered. The welding speed is slower, the thickness of the filling layer is less than 1.5 to 2mm, and the edge angle of the edge of the groove can not be melted to help the welding of the surface. Otherwise, it is not only unfavorable to welding, but also directly affects the appearance of the weld. If the pores are filled or the droplets can not be cleaned up, the welding holes and droplets must be thoroughly removed before the welding can be carried out.

### 3. 3Cover welding.

After cleaning the spatter on the weld and the groove, the matching of the welding current and voltage is 130~140 A and the voltage is 20 to 24V. The current and voltage matching between the two front welds is current 135A and voltage 21V. In the last welding line, the current voltage is smaller than that of the filler layer. Usually we tune it to 130A, and the voltage is adjusted to 20V. The angle of the welding gun is about 0~10 degrees. If the last electric current is larger, the weld is very easy to bite. At the same time, the last layer is high and the pool is easy to droop. So try to adjust the current and change the angle of the welding gun to about 15 degrees. The key to the first weld

of the cover surface is not only to weld straight, but also to form a smooth transition of the weld shape. The nozzle of the welding torch is drawn circle or straight line reciprocating strip. The welding speed is slowed down, the residence time at the edge of the pool is increased, and the arc force drives the metal flow upward. During welding, the fusion of both sides of the weld should be ensured, so the weld pool edge is better than the groove edge 1.5 ~ 2mm. The welding layers are lapped to 1/2 to 2/3 to prevent the appearance of overlapping groove on the welding layer, which will affect the appearance of the weld surface.

While the V shaped groove butt welding is easy to operate, the weld surface is easy to operate, but the weld surface is not easy to be symmetrical, so the weld pool should be as small as possible. In addition, multi pass welding method is used to adjust the appearance of the weld. Finally, the symmetry of the weld appearance is obtained. The angle deformation of the specimen in the transverse welding is large. It is related to the welding parameters, the number of welds, the number of welds per layer and the stay time between the welding tracks. The larger the melting pool, the longer the residence time, the high interlayer temperature, the larger angle deformation, and vice versa. Most of the non fusion occurs in the filling layer, which is common outside the fusion line and between the two channels. The main reason is that there are oxide film or rust skin on the surface of the weld area, insufficient heat input, too large weld pool, improper welding technology and unreasonable joint design. ical industry press, May 2018.

Undercut is also common in welding process, especially when welding the last surface of the transverse plate cover. The main reason is that the welding speed is too high, the arc voltage is too high, the current is too large, the residence time is not enough, and the angle of the welding gun is not correct.

Through the above improvements, the angular deformation of the weld is controlled, and the non fusion, undercut and welding seam are reduced, and the weld shape is also beautiful.

## 4 Conclusion

Through the study of the welding process parameters and the operation process of CO<sub>2</sub> gas shielded welding in horizontal welding, we draw the following conclusions: the use of positioning technique before welding (such as using the head of 2.5mm and 3.2mm welding rod at the blunt edge of the mouth of the test plate and fixing two specimens.) The operation techniques of each layer of the weld (using small oblique serrated wire) and the selection of the technology can improve the welding operation level and the fine rate of the welding parts faster and better, and greatly improve the quality of the weld.

## Reference

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- 2 Shen Hui Tang "welding technology and brilliant idea" Machinery Industry Press 2012.
- 3 Fang Hongyuan "welding structure", mechan