Huayuan Welder®
止於至善

Automatic Submerged Arc Welding Machine

Model： MZS-5

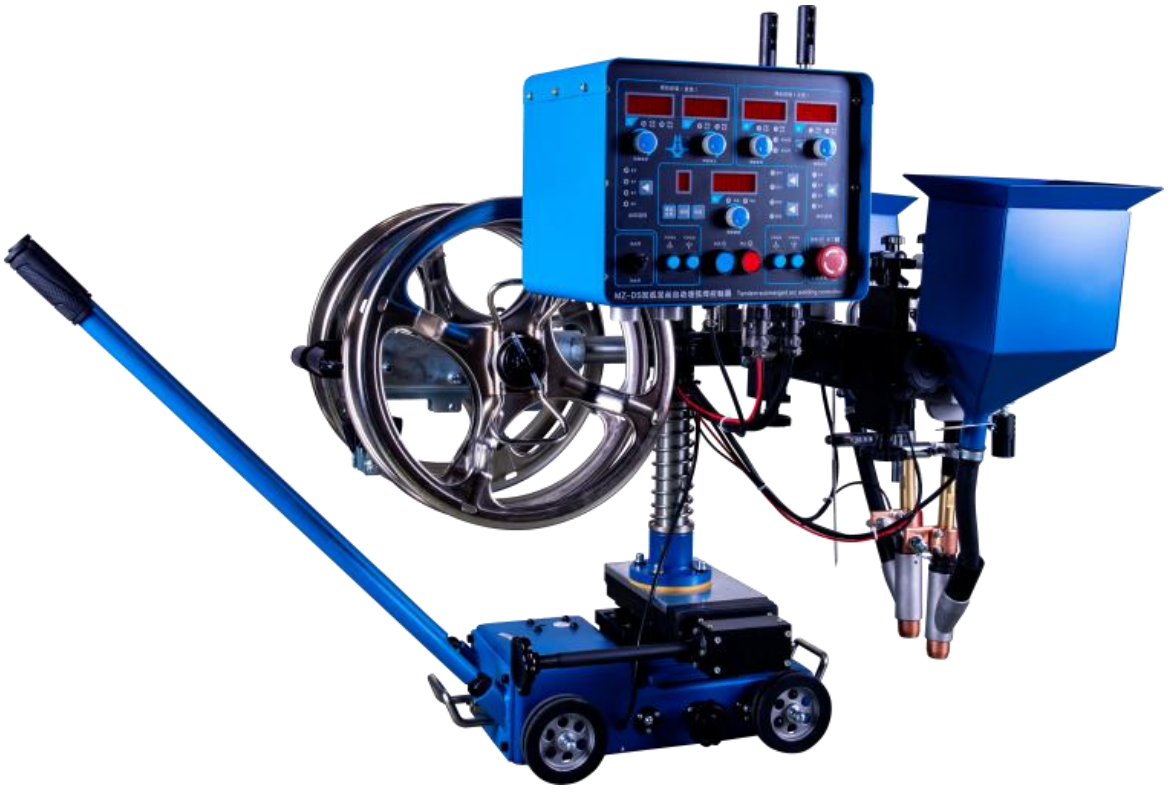
（MZ-DS SAW Controller）

(PLEASE READ IT CAREFULLY BEFORE OPERATION)

Safety Warning

The arc welding and cutting equipment are designed and built with ample safety consideration. However, proper installing and operating the machine can increase your safety.

DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT CASUALLY WITHOUT READING THIS MANUAL THROUGHOUT.



Purchase Date: _____

Serial Number: _____

Machine Model: _____

Purchase Place: _____

Cautions	Arc and arc rays can hurt.

All performing welding workers ought to have health qualification from the authority organization to prevent you and others from arc radiation and burn. It should be prevented for children to enter into dangerous area as well.
Be careful reading the following important items and the welder safety by law from the authority organization. Be sure that qualified professionals perform all installation, maintain and repair procedures.

1 Electric shock: The welding circuits are not insulated when welding. If you touch the two output electrodes of the machine with your bare skin at the same time, it will lead to electric shock, sometimes even fatal dangers. Users need to follow the items below to avoid electric shocks:

- If possible, lay some insulating materials, which are dry and large enough, in your working field. Otherwise, use the automatic or semiautomatic welding machine, DC welding machine as possible as you can.
- Components in the automatic and semiautomatic welding machine such as the welding wire reel, feed wheel, contact tip and welding head are all electric ferrous.
- Always be sure the machine has been connected perfectly to the work piece with the work cables and should be as close as possible to the working area.
- The work piece should be grounded perfectly.
- Make sure that the insulating material of the electrode holder, the grounding clamp, the welding cable and the welding head are not affected by damp, mildewed or spoilt, and be replaced momentarily.
- Never dip the electrode in water for cooling.
- Never touch electriferous parts of two welding machines at the same time, because this voltage is supposed to be two times of welding voltage while the grounding mode is not clear.
- While working high above the ground or other places having the risk of falling, please be sure to wear safety belt to avoid losing balance caused by electric shock.

2 Arc: Use an arc welding mask to protect your eyes and skin from sparks and the rays of the arc, pay special attention to the filter glass, which must be conformable to the national standard.

- Use clothing made from durable flame-resistant material or sailcloth to protect your skin from hurting by the arc rays.
- Remind other nearby personnel before working lest arc rays hurt them by accident.

3 Fumes and Gases: Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. While working in limited room, use enough ventilation and/or exhaust to keep fumes and gases away from the breathing zone, or use the respirator. Do not weld at the same time when using of degrease, cleaning or spraying operations. The heat and rays of the arc can react with these gases to form phosgene, a highly toxic gas,

- Some protective gases used in welding might displace the oxygen in the air, and can lead to hurt or even death.
- Read and understand the manufacturer's instructions for this equipment, and validate the health certification of consumptive materials, make sure they are innocuous.

4 Spatter: Spatter can cause fire or explosion.

- Remove fire hazards from the welding area. Remember that spatter from welding can easily go through small cracks and touch fire hazards. Protect all kinds of lines going though welding area, including hydraulic lines in the wild.
- Where compressed gases are to be used in the field, special precautions should be used to prevent explosion.
- When welding stops, make certain that no live part is touching the work piece or the work stage. Accidental contact can create a fire hazard.
- Do not weld containers or lines, which are not proved to be innocuous.
- It is very dangerous to heat, cut or weld tanks or containers at entry holes. Does not start work until the proper steps have been taken to insure that there is no flammable or toxic gas.
- Spatter might cause burn. Wear leather gloves, heavy shirt, trousers, high shoes and a cap over your hair to prevent from burning by spatter. Wear the ear shield when performing sideways or face up welding. Always wear safety glasses with side shields when being in a welding area.
- The welding cables should be as close to the welding area as possible, and the short, the better. Avoid welding cables going through the building framework, lifting chains, AC or DC cables of other welding machines and appliances. The welding current is strong enough to damage them while having short circuit with them.

5 Cylinder: Damage of it might cause explosion.

- Make sure that the gas in the storage cylinder is qualified for welding, and the decompression flow-meter, the adapter and the pipe are all in good condition.
- Make sure that the installation of cylinder is by the wall and bundled tightly by a chain.
- Be sure to put the cylinder in the working space with no crash or shake, and far from welding area.
- It is forbidden to touch cylinder with the welding clamp or the work cables.
- Avoid facing the cylinder while installing the decompression flow-meter or the gasometer.

- When not working, please tighten the valve.

6 Power: (For electrically powered welding and cutting equipment) Turn off input power before installation, maintenances and repair, so that avoid accident.

- The welding equipment is I class safeguard equipment; please install the equipment in accordance with the manufacturer's recommendations by specific persons.
- Ground the equipment perfectly in accordance with the manufacturer's recommendations.

7 Power:(For engine driven welding and cutting equipment)

- Work in ventilated place or outdoors.

- Do not add fuel near to fire or during engine starting or welding. When not working, add fuel after engine is cooling down; otherwise, the evaporation of hot fuel would result in dangers. Do not splash fuel out of the fuel tank, and do not start the engine until complete evaporation of the outside fuel.

- Make sure that all the safeguard equipment, machine cover and devices are all in a good condition. Be sure that arms, clothes and all the tools do not touch all the moving and rotating components including V belt, gear and fan etc.
- Sometimes having to dismantle some parts of the device during maintenance, but must keep safety awareness strongly every time.
- Do not put your hand close to fans and do not move the brake handle while operating.
- Please remove the connection between the engine and the welding equipment to avoid sudden starting during maintenance.

- When engine is hot, it is forbidden to open the airtight cover of the radiator water tank to avoid hurt by the hot vapor.

8 Electromagnetic: Welding current going though any area can generate electromagnetic, as well as the welding equipment itself.

- Electromagnetic would affect cardiac pacemaker, the cardiac pacemaker users should consult one's doctor first.
- The effect of electromagnetic to one's health is not confirmed, so it might have some negative effect to one's health.
- Welders may use following method to reduce the hazardous of electromagnetic:

a. Bundle the cable connected to the work piece and the welding cable together.

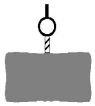
b. Do not in wind partially or entirely your body with the cable.

c. Do not place yourself between the welding cable and the ground (work piece) cable, if the welding cable is by your left side, then the ground cable should be by your left side too.

d. The Welding cable and the ground cable are as short as possible.

e. Do not work near to the welding power source.

9 Lift Equipment: carton or wooden boxes package the welding machines supplied by our company. There is no lifting equipment in its wrapper. Users can move it to the prospective area by a fork-lift truck, and then open the box.



- If having rings, the machine can be transited using rings. While the Welding Machine Manufacture reminds users, there is possible risk to damage the welding machine. It is better to push the welding machine moving in use of its rollers unless special situations.
- Be sure that the appurtenances are all removed off when lifting.

- When lifting, make sure that there is no person below the welding machine, and remind people passing by at any moment.
- Do not move the hoist too fast.

10 Noise: The Welding Machine Manufacture reminds users: Noise beyond the limit (over 80 db) can cause injury to vision, heart and audition depending on oneself. Please consult local medical institution. Use the equipment with doctor's permission would help to keeping healthy.

CATALOGUE

1. Machine Introduction

1.1 Model

MZS-5 tractor can work with 630.100.1250.1600A power source

1.2 Main usage

The welding machine is with a DC submerged arc welding power source and a AC arc welding power source or two AC arc welding power source; it can also separately weld with a DC or AC power source. It is mainly used for filling and resurfacing welding of different work pieces. It can be also used for welding various groove types weld in steel plate structure such as butt weld, fillet weld and lap weld etc, and the weld can be at horizontal level or the angle of weld slope less than 10°with horizontal level. This machine can weld the steel material include the trolley steel, low alloy steel, stainless steel, heat- proof steel and compound steel etc.

1.3 Characteristic

The trolley walking is stable, wide welding range.

Using cross slide for vertical and horizontal movement, with multi-angle displacement of the wire transmission head, convenient and flexible adjustment, suitable for multi-position welding.

The double drive wire feeding device with calibration mechanism is adopted, with small mechanical loss, strong wire feeding force and good welding stability

2 Technical parameter

Item	Parameter
Walking system rated input voltage	Servo motor DC110V
Feeding system rated input voltage	Servo motor DC110V
Welding speed range	0.0～1.4m/min
Wire feed speed range	0.3～3.0m/min
Suited welding current	1250A
Suited wire dia.	Φ2.0～Φ6.0mm
Cross beam lifting height	100mm
Welding head horizontal adjust distance	200mm
Crossbeam rotate angle	±90°
Welding head rotate angle	±45°

Torch tilting angle	±45°
Flux capacity	6L×2
Wire reel capacity	25kg×2
Dimension（L×W×H）	1100×850×940mm
Weight	71kg

3.Safety

For you and others safety, please read the below items carefully!

The welding machine must be grounded well

In case of any electric shock accidents, please do connect the green/yellow input cable to ground very well!

The safety protective equipment must be wear

In case of ultraviolet ray, hard light hurt and harmful gas, please do wear the protective equipment, make sure the ventilation device is working well;

The gas cylinder must be fixed well, in case of crashing;

The machine and working area should keep away from those flammable things.

Prevent sundries from getting into the machine and sharp thing from cutting cables.

Prevent the machine from damage by falling or hitting. Once it falls or be hit, the machine cannot be used again without professional checking.

4 Connection for power source and trolley

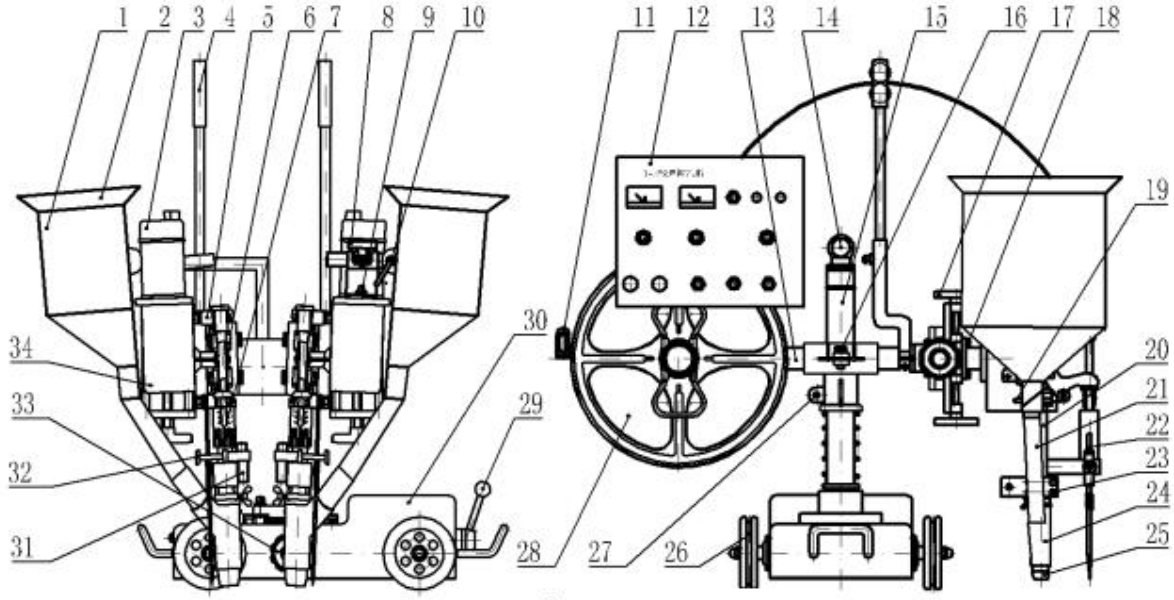
The welding power supply output positive cable is connected to the Figure II conductive plate (23) through the shunt, and the negative cable is connected to the workpiece; it can also be back-connected according to the needs of the welding power supply.

Connect the welding power supply control cable to the input terminal of the trolley control box.

5 Trolley construction and main parts function

5.1 Construction:

Main parts of the trolley(drawing 2)：



Drawing 2

1, flux holder 2, flux filter 3, wire feed motor 4, wire guide frame 5, welding head assembly 6, straight wheel 7, pressure regulating handle 8, M8 hand wheel 9, M8 hexagon nut 10, M8x25 adjustable handle 11, Wire frame 12, control box 13, beam 14, M16 ring screw ,15, column 16, M10x30 external hexagonal bolt 17, cross slide 18, slide connection assembly 19, flux switch 20, torch rod 21, discharge pipe 22, indicator 23, conductive plate 24, feeding cylinder 25, discharge sleeve 26, walking wheel 27, M10x30 external hexagonal bolt 28, wire reel 29, clutch handle 30,basement 31, laser lamp 32, indicator lock screw 33, basement slide adjust handle 34, reducer

5.2 Main parts function

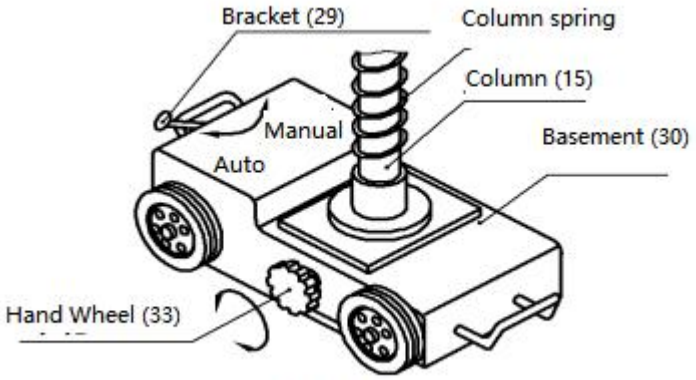
5.2.1 Basement（drawing 3）

The basement (30) is equipped with walking motor reducer and transmission clutch, set the clutch handle (29) to "automatic" is close the clutch, and the delivery trolley can automatically walk; set the clutch handle (29) to "manual" to remove the clutch, the delivery trolley can stop and move by hand. The basement (30) is equipped with slide, rotating the hand wheel (33), column (15) movable, the distance is: 70mm.

5.2.2 Column

Release the M10x30 external hexagonal bolt 2 (27), and the column(13) can rely on the elasticity of the column spring (shown in Figure 2) up or down, the lifting distance is: 70mm.

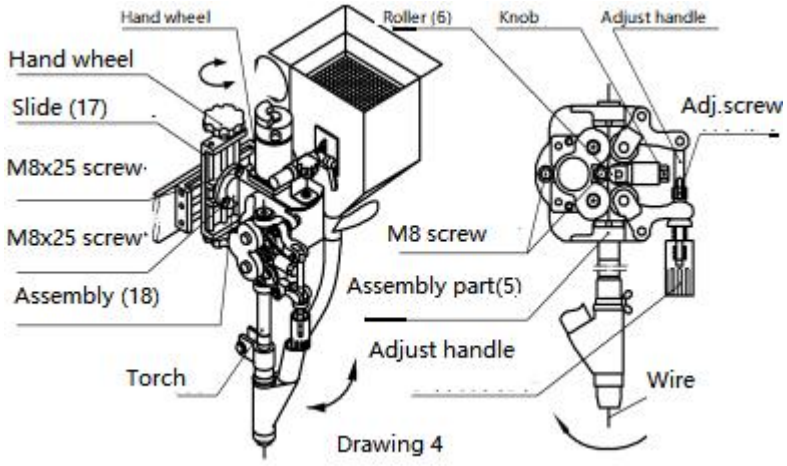
Release M10x 30screw (16), the column (13) can move left and right, and the moving distance is 50mm.



Drawing 3

5.2.3 Welding head（drawing 4）:

This trolley is equipped with two sets of heads, which is composed of wire motor (3), reducer (34), welding head assembly (5), welding torch rod (20) and other components. Its function is to pull the welding wire from the wire reel (28), through the wire guide frame (4) to welding head assembly (5), be straightened, and put input the welding torch rod (20) to the welding area for welding.

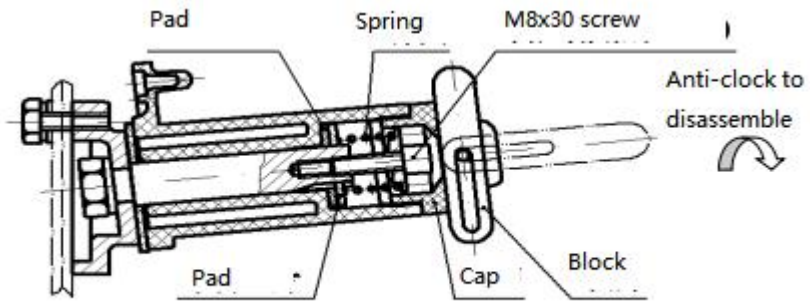


Drawing 4

The welding head is provided with the cross slide (17) and the connecting body assembly (18). Rotate the handle to adjust slide, the vertical adjust distance is 100mm, and the horizontal adjust distance is 200mm; loosen the M8x25 hexagon bolts 1 and 2,the welding head can rotate ± 45°; loosen the 2-M8 hexagon nut to make the welding torch deflection ± 45°.

5.2.4 Wire reel:

The wire reel (28) is equipped with the damping shaft (Figure 5), and the damping force can be adjusted. When the adjustment,pull out the shaft block, remove the cap,tighten the M8x30 hexagon screw to increase the damping,vise versa, then install the shaft block and reset cap.



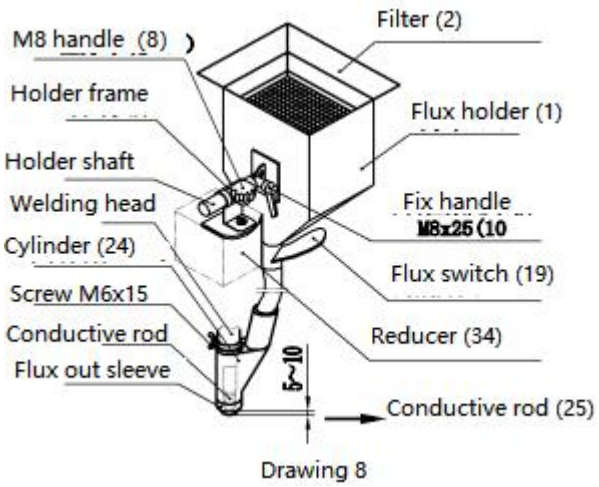
Drawing 5

5.2.5 Controller（Drawing 7）

The control box (12) is equipped with wire feed speed transmission and automatic walking control functions, and there is indication on the panel, as shown in Figure 6: The control box (12) is equipped with a rotary device, loosen the star handle in Fig. 7, the control box (12) can rotate 90°horizontally.

5.2.6 Flux holder（Drawing 8）

The flux holder (1) is fixed on the transmission box (34) through the hopper bracket and the flat shaft, which is fixed by the M8 star handle (8) and can be moved. The M8x25 can fix the handle (10) to adjust the swing angle of the flux holder (1). The added flux is filtered through the filter (2) and smoothly enters the feeding cylinder (24) to the welding area. Loose the screw M6x15,the feeding cylinder (24) can rotate around the welding head to the discharge pipe (21).



Drawing 8

6 Operation

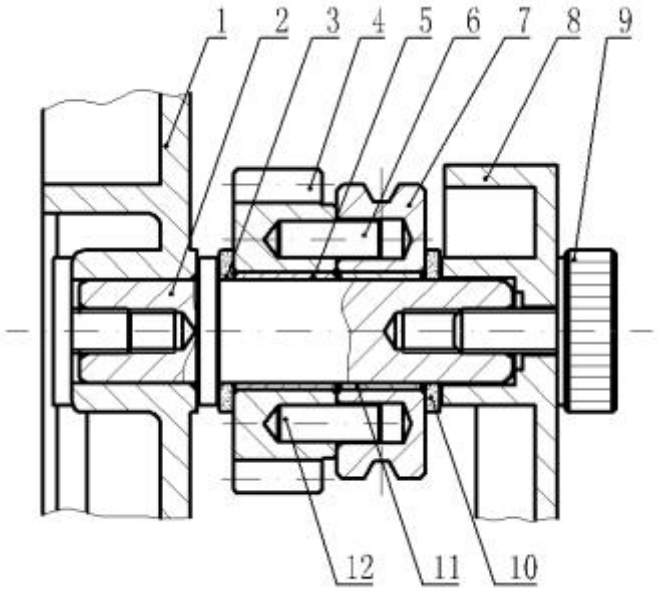
6.1 Welding preparation:

6.1.1 After the trolley is connected with the welding power supply, confirm that each part is connected correctly and reliably.

6.1.2 Make sure that the specifications of the wire feed roller and conductive nozzle match with the selected welding wire.

Wire feed roller installation（Drawing 9）：

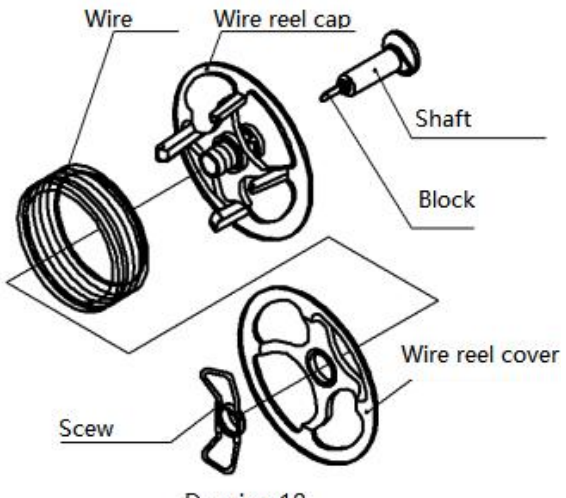
Unlock the M6 screw (9) ⟶ wire shaft support (8) out automatically ⟶ remove the wire feed roller (7) and the oil bearing washer (10) ⟶ install the 4pc same specifications wire feed roller (7) ⟶ install the wire feed roller oil bearing washer (10) ⟶ cover the wire shaft support (8) ⟶ tighten the M6 screw (9).



Drawing 9

1, double drive bracket 2, wire feed roller shaft 3, gear with oil-bearing gasket 4, wire feed roller drive gear 5, gear with high wearing resistance oily bearing 6, cylindrical pin Φ 5x14 (1) 7, wire feed roller 8, wire feed roller shaft support 9, M6 roller screw 10, wire feed roller with oil gasket 11, wire feed roller high wearing resistance oil bearing 12, cylindrical pin Φ 5x14 (2)

6.1.3 Welding wire installation(Figure 10)



Drawing 10

Pull out the damper shaft of the wire reel and ⟶ remove the wire reel (28) ⟶ spin out the wire reel nut ⟶ pull down the wire reel cover ⟶ install wire into the wire reel cover ⟶ press the wire reel cover ⟶ screw into the wire reel nut ⟶ Install the wire reel (28) ⟶ recovery to the original position.

6.1.4 Welding head position adjust

Rotate basement slide hand wheel (33), cross slide (17) hand wheel one and two (shown in Figure 4), move the two welding head to the weld seam, when the welding head need to rotate or the welding torch needs to deflect.

Note: when the welding head need to rotate, loosen the M8x25 hexagon head bolt (Figure 3), please support the welding head to prevent the welding head titing because the release of the locking force.

When the welding torch needs to deflect, need to remove the debris of the bracket and the reducer surface to prevent the debris come into the wire reducer box (34) when the 2-M8 hexagon nut release, or it may cause damage to the internal gear and other parts.

6.1.5 Adjust the position of the guide wire frame: draw out the welding wire head from the two welding wire reel (28),pass through the lead wire holder (11) and (4) the lead wire rack (4), pass into the nozzle and wire feed roller, adjust the guide wire frame and fix.

6.1.6Wire press

The pressure regulating handle (shown in Figure 4) is marked with 3,4 and 5, corresponding to Φ 3, Φ 4 and Φ 5 welding wire. According to the actual wire specifications, adjust the handle nut to the related printing mark, so that the pressure regulating handle can be pushed in smoothly.

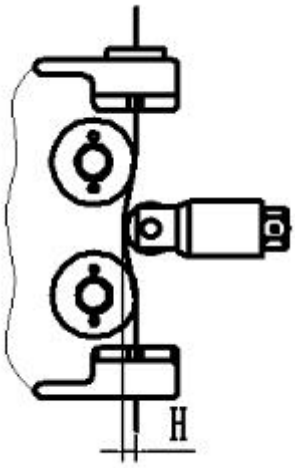
The pressure adjustment handle is rotated clockwise to increase the compression force of the welding wire, counterclockwise to reduce the compression force, the ideal compression force is the welding wire smoothly feed without slip from the wire feed roller.

6.1.7 Wire straightening

Pull the pressure regulating handle (shown in Figure 4), rotate the hexagonal knob, push the straightening roller (6), dial the "power" switch to "on" position, turn on the trolley, press the button "start" of the control box (Figure 5), the wire start to feed, make the straightening roller press the welding wire, close the pressure regulating handle, continue to rotate the hexagon knob, until the visual wire straightness meets the requirements, that is, send the welding wire within 100mm, straightness is not more than 2.5mm, press the "stop" button after adjustment finish to wait for welding.

Attached straightness degree parameter table for reference:：

Straightness data	
Size	**Date H（drawing 11）**
Φ6	**1.3**
Φ5	**1.0**
Φ4	**0.6**
Φ3	**0.4**



Drawing 11

6.1.8 Flux holder position and angle adjust:

Adjust the position and Angle of the flux holder (1) and the cylinder (24) (see P7) to make the flux feed smoothly; adjust the flux flow switch (19) to cover the torch Nozzle and weld seam, adjust the flux flow according to the process requirements and the welding speed.

Note: the flux filter (2) is to filter the iron block, welding slag and other sundries to ensure the smooth feeding, so it should not be abandoned.

6.1.9 Welding parameter set:

According to the thickness of welding material, welding requirements or welding process, the parameter need to preset.

6.1.10 Welding head position adjust:

Inspect the centralize condition of the two welding wire . If there is any deviation, rotate the movable handle (33) and the slide handle (17) until the centralization is well measured.

Release the lock screw (32), adjust the indicator (22) on the torch rod (20) to fix with the welding seam, distance about 10~15mm away from the workpiece, and tighten lock screw (32) after finish.

6.2 Start welding:

Press the "Start" button (Figure 6) till the arc strike finish, then press the corresponding button according to the process needs.

Note: During welding, observe the indicator and welding seam position , and adjust the slide handle (33) if need to keep the welding wire in line.

6.3 Stop:

When welding to the seam end , press the "stop button" (Figure 6), stop the welding, close the flux switch (19), turn off the "power ", push the clutch handle (29) to manual (Figure 3), and pull the trolley out of the welding area.

7 Maintenance

7.1.Protect the cable, avoid distortion, prevent insulation damage, if damaged please replace in time.

7.2.Prevent the control box from being damp, the cable connection and plug shall not be loose.

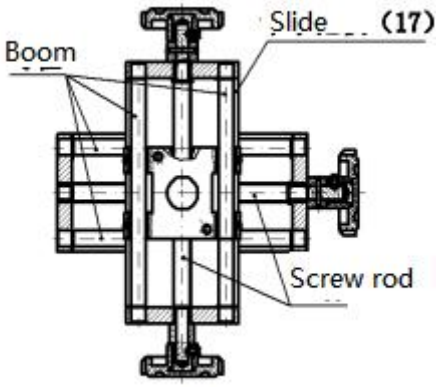
7.3.When using the trolley, keep the welding wire channel clean without oil and debris, and prevent brought into wire feed roller and nozzle.

7.4.The guide wire nozzle (Figure 136), wire feed roller (Figure 27 of 13), exit guide wire nozzle (Figure 1334) and nozzle (Figure 1339) shall be cleaned regularly to remove dirt, otherwise it is easy to cause wire instability. When wear is serious, it shall be replaced in time,pay attention to the wire diameter and install correctly.

🔔 Note: if the wire feed roller groove is seriously worn, please replace the two piece at the same time.

7.5.Nozzle (Figure 1339) and the welding head (Figure 1337) should be tightened, loose will cause abnormal heating at the connection, thread deformation, then cause nozzle replacement difficult, or head burned out.

7.6.The cross slide screw (17) and guide columns (Figure 12) should be kept clean and properly lubricating



Drawing 12

7.7.Although the outer edge design of the walking wheel (26) is resistant to oil , acid and alkali rubber, it is still required that direct contact with oil, sharp objects and acid and alkali media should be avoided, so as to prolong the service life of the walking wheel.

8 Trouble shooting

In case the welding parameter is normal , no wire delivery or unstable wire delivery, please check as below:

8.1Whether the connection plug is loose；

8.2Whether the wire feed motor (3) is damaged;

Note: The wire feed motor (3) and its reducer (34) include the walking motor assembly. Usually do not need to open for maintenance. In case of fault, do not open it without authorization, you can contact the sales department or our company to obtain professional services.

8.3Weather the wire feed roller is worn out；

8.4Whether the welding wire is pressed, whether there is no skid phenomenon;

8.5Whether the nozzle hole aperture has been brushed and worn

After confirming the cause of the fault, replace the parts or adjust according to the specification until the wire is stable and normal.

9 Warning

9.1 The trolley is equipped with lifting device-M16 ring screw (14) , should pay attention to the balance of gravity when lifting.

9.2 The trolley should be placed in the place to avoid direct sunlight, shelter, as low humidity as possible , less dust, flat ground, around The temperature is-10~40 C, and the protection grade of the trolley is IP2X.

9.3 When welding in windy places, attention should be paid to wind shelter. When using fans in summer, do not blow the wind directly in the arc part to avoid the generation of air holes.

9.4 When the trolley is working on the inclined place, attention should be paid to the adjustment of the balance of the center of gravity of the trolley. The maximum inclination shall be no more than 10 degree, and the anti-rollover measures should be greater than 10 degree.

9.5 When the trolley works on the workbench, attention should be paid to the stability of the platform to prevent the trolley from slipping.

9.6 Check the cable insulation condition frequently, if there is any damage, it must stop using.

9.7 The control cable joint should not be loose, to avoid bad contact, affect the welding action, and pay attention not to distort, to avoid damage to the internal wire.

9.8 Properly keep the welding wire and flux, do not make them rust, stick dirt and damp.

9.9 The trolley is equipped with laser lamp (31), rated voltage DC3V, the user can wiring as needed.

9.10 The rated load duty cycle of the trolley is 100%.

9.11 The trolley warranty period within one year to implement three guarantees.

9.12 If there is no special description behind the parts in the instruction manual, they all correspond to Figure 2.

10 Trolley Packing List

No.	Item	Model	Size	Qty	Note
1	Trolley	MZS-5		1	
2	Rail			1	
3	Wire feed roller	630A	Φ1.6 Φ2/Φ2.8	2	Install on machine
		1000A	Φ3/Φ4 Φ4.2/Φ5		
		1250A	Φ4.2/Φ5 Φ6		
4	Nozzle	630A	Φ1.6 Φ2 Φ2.4	2	
		1000A	Φ3.2 Φ4 Φ5		
		1250A	Φ5	4	2pc installed on machine
			Φ6	2	
5	Spanner			1	Slide use
6	Spanner		14×17	1	Welding head use
7	Qualified card			1	
8	Instruction manual			1	

11 Wearing part/welding head parts list

1.Wearing parts list

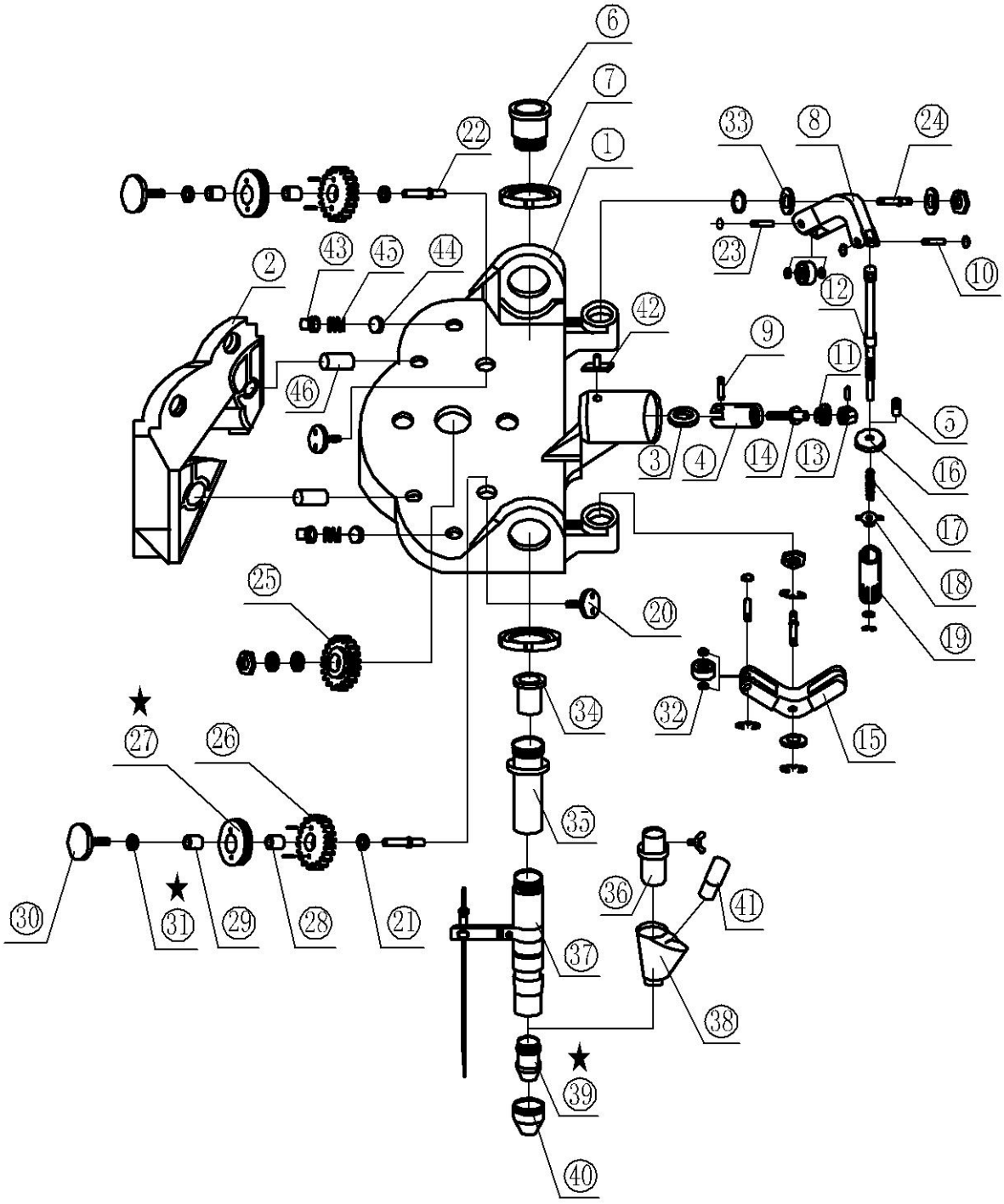
2.Wire feed roller

3.Nozzle

4.Welding head parts list

When users need to purchase wearing parts or other spare parts, please refer to Figure 13 according to the number of Welding Head Parts 1 and Welding Head Parts 2, and indicate the part number, drawing number, name and quantity, so that the company can meet user requirements correctly and timely.

Welding head spare parts list
（Parts code 12-03）



图十三

Note：“★”are wearing parts

Welding head spare parts list 1

Part No.	Item	Qty	Wearing parts	Note
1	Double drive bracket	2		
2	Wire feed roller axis	2		
3	Straightening roller	2		
4	Straightening roller shaft	2		
5	Handle shaft adjusting nut	2		
6	Wire feed nozzle	2		
7	Nut M20×1.5	4		
8	Roller press frame Ⅰ	2		
9	Straightening roller axle pin	2		
10	Roller press axle pin	2		
11	Supporting sleeve	2		
12	Handle shaft	2		
13	Hexagon adjustment knob	2		
14	Lead screw	2		
15	Roller press frame Ⅱ	2		
16	Steel bowl	2		
17	Handle spring	2		
18	Heterotype hexagon nut	2		
19	Adjust handle	2		
20	Tighten screw	4		
21	Drive gear	4		
22	Wire feed roller shaft	4		
23	Pressure axle pin	4		
24	Pressure rod positioning pin	4		
25	Drive gear assembly	2		
26	Wire feed roller transmit gear	4		
27	Wire feed rollerΦ1.6	2	★	Φ1.6 wire
	Wire feed rollerΦ2～Φ2.8	2	★	Φ2～Φ2.8 wire
	Wire feed rollerΦ3～Φ4	2	★	Φ3～Φ4 wire
	Wire feed rollerΦ4.2～Φ5	2	★	Φ4.2～Φ5 wire
	Wire feed rollerΦ6	2	★	Φ6 wire
28	gear wear-resist bearing	4		
29	Wire feed roller wearing-resist bearing	4		
30	Screw	4		

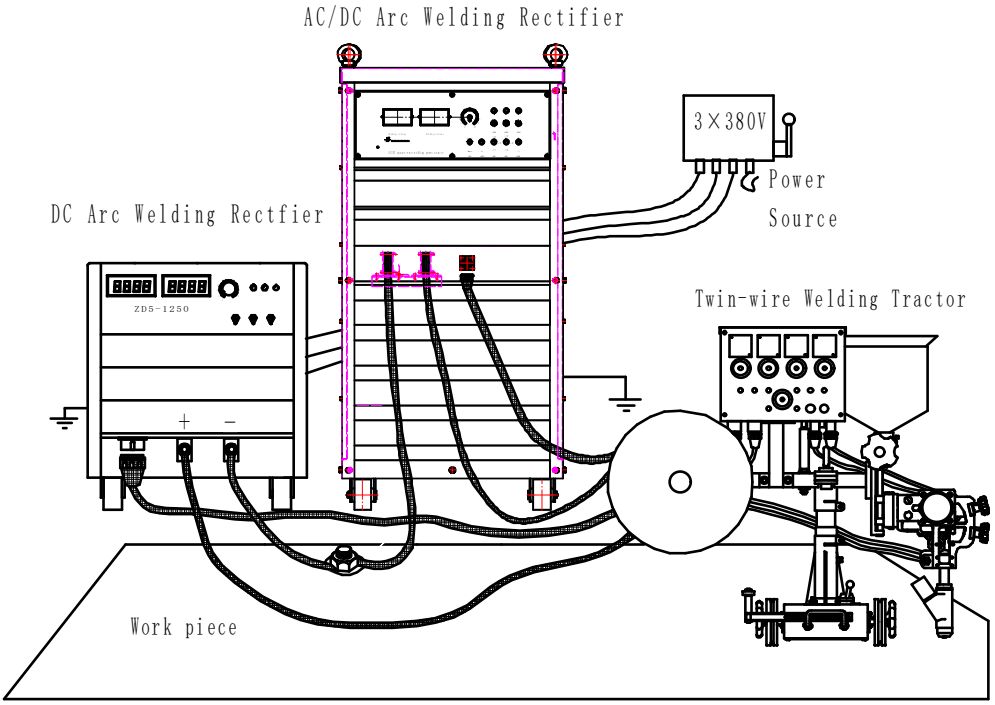
Welding head spare parts list 2

Part No.	Item	Qty	Wearing parts	Note
31	Oil-containing gasket	4		
32	Copper pad	8		
33	Pressure lever pin gasket	4		
34	Wire guide nozzle	2		
35	Conductive rod	2		
36	Insulated roller sleeve assembly	2		
37	Torch head	2		
38	Flux holder	2		
39	Nozzle Φ1.6	2	★	
	Nozzle Φ2.0	2	★	
	Nozzle Φ2.4	2	★	
	Nozzle Φ3.2	2	★	
	Nozzle Φ4.0	2	★	
	Nozzle Φ5.0	2	★	
	Nozzle Φ6.0	2	★	
40	Discharge hose	2		
41	Insulation cap	2		
42	Straightening roller shaft	2		
43	Wire feed roller top pin	4		
44	Spring holder	4		
45	Spring holder	4		
46	Positioning pin	4		

12 Machine Installation (as the figures show below)

Warning

The control box has electrical lines and joints beyond the safety voltage requirements of GB3805-93, and only trained professionals can open the cover and repair under the power condition.



Regarding ZD5(7)-1000/ 1250/1600/2000power source, the power input cable cannot be smaller than 35 mm^2/35 mm^2/50mm^2. And for ZDE(7)power source, the power input cable cannot be smaller than 50 mm^2

12.1Input cables of ZD5(7)-1000/ 1250/1600/2000 power source are connected to output terminals of breaker (200A/200A/250A). The fuse capacity should be not less than 200A/200A/250A. Input cables of ZDE(7) power source are connected to output terminals of breaker (200A). The fuse capacity should be not less than 200A.

12.2The screws at grounding sign on the back of ZD5(7) and ZDE(7) arc power sources should ground reliably. And the connection section area should be not less than 16 mm^2/16 mm^2/25 mm^2.

12.3Connection method of ZD5(7) power source: To make two welding cables (15m) in parallel, one is connected to positive pole of power source outlet and the other is connected to DC conductive plate on the tractor. To make two welding cables (5m) in parallel, one is connected to negative pole of power source outlet and the other is connected to work piece. The four welding cables are equipped with the machine. Note: the left output of ZD5(7) power source is positive and the right one is negative. With wrong connection of the positive and negative poles, it cannot feed wire manually and weld normally.

Connection method of ZDE(7) power source: To make two welding cables (15m) in parallel, one is connected to “Electrode” on ZDE(7) power source and the other is connected to AC conductive plate on the tractor. To make two welding cables (5m) in parallel, one is connected to “Work piece” on ZDE(7) power source and the other is connected to work piece. The four welding cables are equipped with the machine. Note: ZDE(7) power source should be connected as above. Otherwise, it cannot feed wire manually and weld normally.

12.4Connect the power source and the control box of tractor with the multi-pin control cable.

13 Panel function

13.1.Power on/off：

Power switch：
1. Press to power off
2. Clockwise rotate to turn on

The power switch simultaneously turns on the DC and AC power, and turns off the DC and AC power.

13.2.Welding control：

Welding control：
Press toggle and the left indicator shows the current status

When double wire is welded, switch to "Double wire welding", the indicator is on; when DC single wire is welded, switch to "Single wire welding", the indicator is on.
The ZD 5 (7) power supply and the ZD E(7) power supply must be turned on for either single wire welding or double wire welding.

13.3.The ammeter display and the welding current adjustment：

- When the channel is pressed, display the current setting value stored in the channel, no matter the welding is in progress, no matter the encoder is adjusting (now the welding current coding value is invalid); the pre-display indicator light is on;
- When the channel is not pressed, the welding current encoder is adjusting, the welding current setting value is displayed, and the pre-display indicator light is on; no matter it is ongoing welding; if the welding current encoder is adjusted during the welding, it will changed to display the welding current after 1 second; if the controller is locked, the adjustment encoder is invalid.

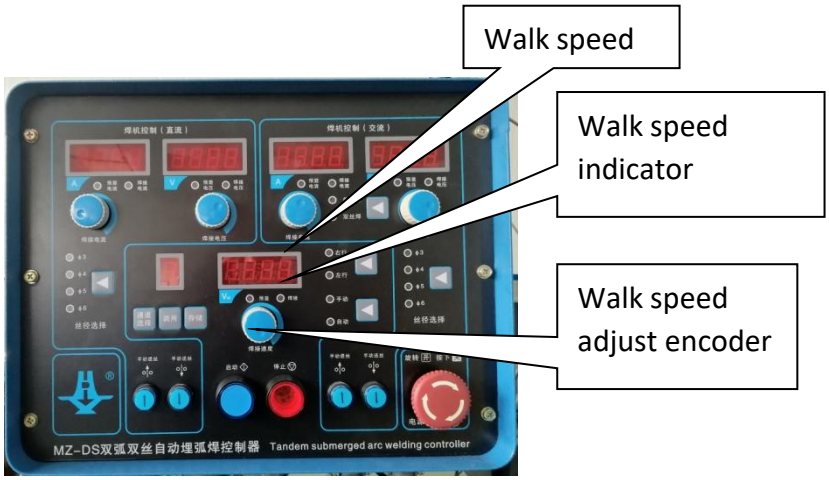
- When the channel is not pressed; and the welding current encoder is not adjusted; and the welding current is shown when the start button is pressed; the welding indicator light is on;
- In other cases, the display show welding current pre-set value; the pre-display indicator light is on;

13.4.Voltmeter display and voltage adjust：

- When the channel is pressed, display the voltage setting value stored in the channel, whether the welding is under way, whether the encoder is adjusting (when the welding voltage coding value is invalid); the pre-display indicator light is on;
- When the channel is not pressed, the welding voltage encoder is adjusting, the welding voltage setting value is displayed, and the pre-display indicator light is on, no matter it is in welding or not; if the welding voltage encoder is adjusted during the welding process, it display the welding voltage if without adjusting for 1s; if the controller is locked, the adjusting encoder is invalid.
- When the channel is not pressed; the welding voltage encoder is not adjusted; and when the start button is pressed, the welding voltage is shown; the welding indicator light is on;
- In other cases, it display the pre-set welding voltage set value; the pre-display indicator light is on;

13.5 Walking speed display and walking speed adjust：

- When the channel is pressed, display the walking speed set in the channel, no matter welding or not, or the encoder is adjusting or not(the walking speed coding value is invalid); the pre-display indicator light is on;
- When the channel is not pressed, the walking speed encoder is adjusting, it display the walking speed setting value, the indicator light is on, no matter welding or not; if the walking speed encoder is adjusted during the welding, it change to walking speed without adjusting after 1s; if the controller is locked, the regulating encoder is invalid.
- When the channel is not pressed; and the walking speed encoder is not adjusted; it display the walking speed when the start button is pressed; the welding indicator light is on;
- In other cased, it display the preset walking speed, the preset indicator on；

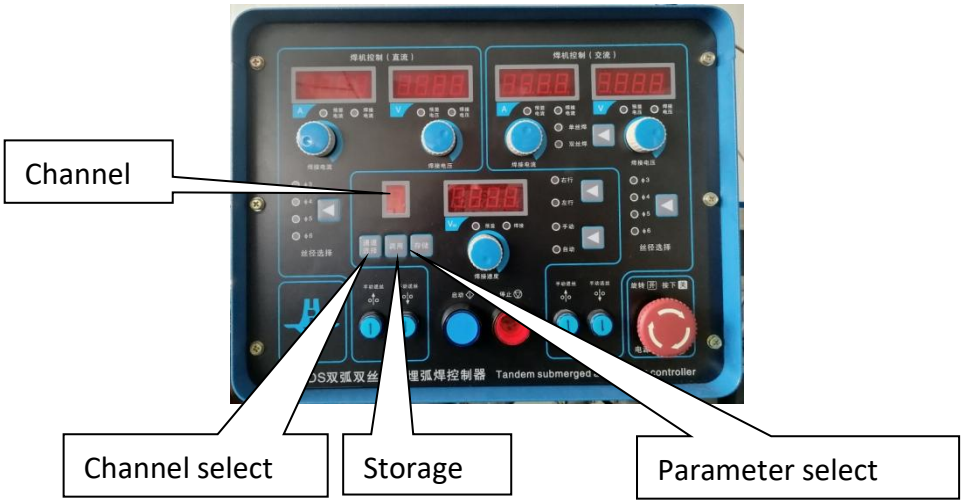


13.6 Function selection：

- Walking direction selection: press the walking direction, when the front welding direction changes from left to right or from right to left. It will not record the present welding direction when the power off and restart; the walking direction cannot be locked;
- Walking mode selection: press the walking mode, when the front walking mode changes from automatic to manual or from manual to automatic. It will not record the present welding mode when the power off and restart; the walking mode cannot be locked;
- Wire diameter selection: press the wire diameter selection to change the present used wire conversion sequence 3mm—4mm—5mm—6mm—3mm

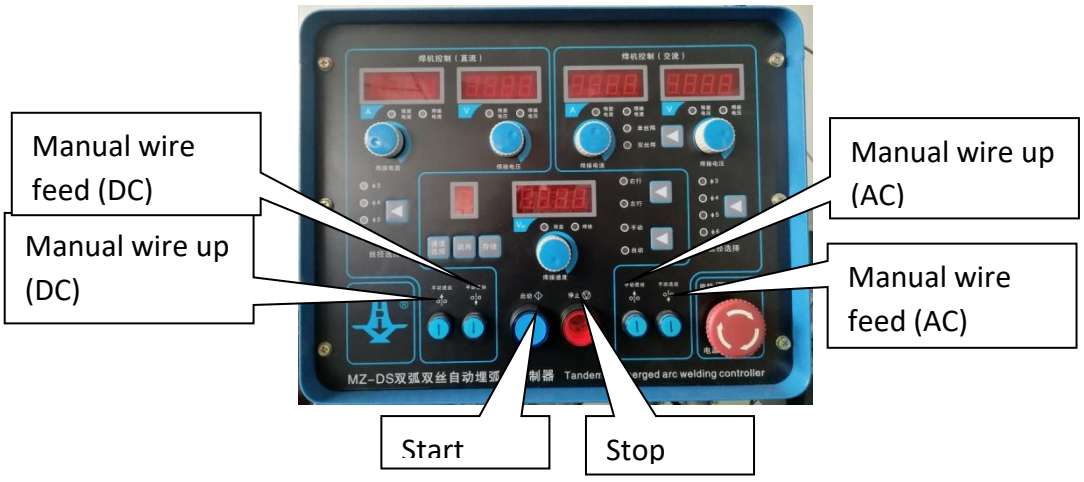
13.7.Storage and parameter selection：

- Channel display: When the present channel number is displayed when the channel code is pressed;
- Channel selection / channel storage / parameter selection: press on channel selection, Channel display the present channel number, no matter welding or not, The indicator light shows the preset, Preset current stored in the ammeter display channel, Preset voltage stored in the voltmeter display channel, Walking speed preset stored in walking speed channel, Adjustment encoder is invalid; If the channel is not selected or stored in the 5S, the channel display will be off, The above table is normally displayed; If channel selection, the present channel code number adds 1, it displays the parameters stored in the next channel; If you press the parameter selection, The parameters in the channel are taken out as present welding parameters; If you press for storage, then stores the preset welding parameters into the present channel, then return.
- The channel storage and parameter selection operation of the channel will operate both the DC and AC welding specifications, regardless of the status of the welder control
-



13.8 Operation：

- Start button: press to start welding;
- Stop button: press to stop welding;
- Manual wire withdrawal knob: press the manual wire withdraw, change to fast wire withdraw after 5S
- Manual wire feed knob: press the manual wire feed, change to fast wire feed after 5S, and automatically stop after the wire reaches the workpiece



14 Electric Board setting

14.1 Welded power supply and wire feed motor selection：

Please read the instructions carefully before the following operation, incorrect setting may appear abnormal welding and other phenomena!

14.1.1 The welding parameters have been set, which can work directly without the following setting.

14.1.2 If the circuit board is replaced or the welding power supply is replaced, the welding may be abnormal due to unreasonable parameters, which can be reset as follows; DC control and AC control shall be set separately;

14.1.3. Press the "manual wire feed" and "manual wire" keys at the same time, after 10 seconds, except the ammeter display, the rest of the digital tube and indicator light are off, and the control box enters the setting mode;

14.1.4.The ammeter display "2" indicate that the power supply of the control box is ZDE AC/DC square arc welding rectifier (ZDE7 series AC / DC square arc welding rectifier selects "7"); "5" means that the control box is ZD5 series DC arc welding rectifier; "7" means that the power supply is ZD7 series DC arc welding rectifier; select by rotating welding current encoder, press the "Storage" key after completion;

14.1.5.The ammeter shows "630" indicates that the power supply of the control box is 630A; "1000" means that the power supply of the control box is 1000 A; "1250" means that the power supply of the control box is 1250A; "1600" indicates 1600A; "2000" indicates 2000 A; select by rotating the welding current encoder, press the "Storage" key after completion;

14.1.6.The ammeter shows "14" indicates that the wire feed motor of the control box is 14 r/min; "21" indicates that the wire feed motor of the control box is 21 r/min; "47" indicates that the wire feed motor of the control box is 47 r/min; select by the rotating the welding current encoder, press the "Storage" key after completion;

14.1.7.All digital tubes and indicator lights flick,turn off the machine;

14.1.8.Turn on the power supply, press "characteristic selection", if it is adjustable,then the setting is successful, select the appropriate wire diameter and characteristics, adjust the welding power supply welding voltage and welding speed to match.

14.2 PCB setting：

14.2.1.Set the main board to the double wire welding state, the set wire characteristic is CV mode, and the rear wire function is effectively.

14.2.2.Press the "parameter select" key for 5 seconds without loose, release when the DC current meter and AC current meter show 0;

14.2.3.Set DC ammeter encoder to get 18 for the DC current, set AC ammeter to 18 for the AC current, press the "Storage" key after adjusting;

14.2.4.Use the DC current meter encoder to 1 (1 represents the double wire welding function on, 0 means closed), use the AC "welding current" encoder to 1 (1 represents the double wire welding function on, 0 means closed), and press the "Storage" key;

14.2.5.Automatic restart, and the setting is complete;

14.3.Set rear wire to delay start time:

14.3.1.Press "parameter selection" key for 5 seconds without loose, release when the DC current meter and AC current meter show 0 ;

14.3.2.Set DC current meter to 19 by adjust DC "welding current" encoder, set AC ammeter to 19 by adjust AC"welding current" encoder, press the "Storage" key after adjusting;

14.3.3.The data displayed by the AC ammeter is the rear wire delay start time, measured in seconds. Use the AC "welding current" encoder to adjust the rear wire delay start time, press the "Storage" key;

14.3.4.Automatic restart, and the setting is complete;

14.4.Set rear wire to delay off time：

14.4.1.Press the "parameter selection" key for 5 seconds without loose, release when the DC current meter and AC current meter show 0 ;

14.4.2.Adjust the DC ammeter to 20 by the DC "Welding current" encoder, adjust the AC ammeter to 20 by the AC "welding current" encoder, and press the "Storage" key after all adjustment;

14.4.3.The data displayed by the AC ammeter is the rear wire delay off time, measured in seconds. Use the AC "welding current" encoder to adjust, then press the "Storage" key;

14.4.4.Automatic restart, and the setting is complete;

15 SAW welding material and procedure

15.1 Welding flux

The function of welding flux is to ensure a good welding seam shape, besides its molten slag covering the molten pool can prevent oxygen, nitrogen in air from entering molten pool. The welding flux has a metallurgical reaction with liquid metal, which can remove the impurities in metal like oxygen, hydrogen, sulfur, phosphorus, and add to the required alloy, then a welding seam metal with good mechanical property or special property can be obtained.

According to the alkaline level, welding flux can be divided into alkaline flux, acid flux and neutral flux. According to the chemical property, it can be divided into oxidizing flux (inclusive of SiO2,MnO or Feo largely), weak oxidizing flux and inert flux (inclusive of Al2O3, CaO, MgO, CaF2, but almost no SiO2,MnO or Feo).

Table 4 Common welding flux usage and matched wire

Welding flux type	Usage	Welding flux granularity(MM)	Matched wire	Suitable current type
HJ130	Low carbon steel, common low alloy steel	0.45～2.5	H10Mn2	AC/DC current
HJ131	Ni alloy	0.3～2	Ni wire	AC/DC current
HJ150	Roller surfacing	0.45～2.5	2Cr13、3 Cr2W8	DC

				current
HJ172	High Cr iron steel	0.3～2	Steel wire	DC current
HJ173	Mn-A1 high alloy steel	0.25～2.5	Steel wire	DC current
HJ230	Low carbon steel, common low alloy steel	0.45～2.5	H08MnA、H10Mn2	AC/DC current
HJ250	Low alloy high tensile steel	0.3～2	Steel wire	DC current
HJ251	Heat resistant steel	0.3～2	Cr-Mo steel wire	DC current
HJ260	Stainless steel, roller surfacing	0.3～2	Stainless wire	DC current
HJ330	Low carbon steel and common low alloy steel	0.45～2.5	H08MnA、H10Mn2	AC/DC current
HJ350	Low alloy and high tensile steel	0.2～1.4	Mn-Mo、Mn-Si and Ni high tensile steel wire	AC/DC current
HJ430	Low carbon steel and common low alloy steel	0.45～2.5	H08A、H10MnA	AC/DC current
HJ431	Low carbon steel and common low alloy steel	0.45～2.5	H08A、H10MnA	AC/DC current
HJ432	Low carbon steel and common low alloy steel(thin plate)	0.2～1.4	H08A	AC/DC current
HJ433	Low carbon steel	0.45～2.5	H08A	AC/DC current
SJ101	Low alloy structural steel	0.3～2	H08MnAH10MnMoA H08Mn2MoA、H10Mn2	AC/DC current
SJ301	Common structural steel	0.3～2	H08MnA、H10Mn2、H08MnMoA	AC/DC current

15.2 Welding wire

The applied welding wire in submerged arc welding is different for different types of welding metals. Usually, there are carbon structural steel, alloy structural steel, high alloy steel, various nonferrous metal welding wires and special alloy wires used for surfacing. The allied welding wire surface should be smooth enough, so that it can be feed smoothly. It is better to choose the wire coated with copper, which can not only prevent rust, but also improve the contact status between wire and conductive tip. If there is oil stain and rust on wire, it must be cleaned, or they will be brought into welding seam and cause blow holes, and affect mechanical property of welding seam.

Table 5 steel wire diameter and allowed deviation（mm）：

Wire diameter（mm）	2.0 2.5 3.0	3.2 4.0 5.0 6.0	6.5 7.0 8.0 9.0
Allowed deviation general precision	-0.12	-0.16	-0.20
Allowed deviation	-0.06	-0.08	-0.10

high precision					

Table 6 current range for various diameter wires

Wire diameter（mm）	2.0	2.5	3.0	4.0	5.0	6.0
Current range(A)	200～400	250～450	350～600	500～800	700～1000	800～1200

15.3 Parameters of affecting welding seam shape size

A. Welding technology parameters

1)Welding current

Welding current I increases, productivity improves, and deposition R, molten depth H enlarges. If I is too large, it will cause burning through and overlarge heat-affecting zone. If I is too small, it will cause insufficient molten depth and deformed welding seam. Under normal welding conditions and no change made to other conditions, welding seam molten depth H is almost direct ration to welding current I. H=Km X I

Km is proportion coefficient, it changes with the change of current type, polarity, wire diameter and welding flux chemical composition.

For thick wire submerged arc welding, Km≈1mm/100A. For thin wire submerged arc welding, Km≈1.3mm/100A.

2)arc voltage

Arc voltage is direct ration to arc length. If no change made to other conditions, with the increase of arc voltage welding seam molten width increases apparently, but molten depth and excess weld metal decreases a little.

3)welding speed

Welding speed has a great effect on molten depth and width. When the welding speed is low(eg. Single wire submerged arc welding speed is less than 670mm/min), with the increase of welding speed, arc column inclines, and this is beneficial for backward flowing of molten metal, molten depth increase a little, but usually the increase of welding speed can reduce molten depth, width and excess weld metal. When welding speed increases to a certain level, molten depth and width will reduce greatly due to the decrease of energy input.

B. Welding technology

Both the inclined angle of welding wire and workpiece angle have a great effect on welding seam shape.

The inclination direction of wire includes forward and backward inclination. If the inclination direction and angle is different, the force and heat function of arc to molten pool is different, thereby it has a different effect on welding seam shape. When welding wire inclines backward at a certain angle, the arc force to push the metal in molten pool backward is reduced, the metal on the molten pool bottom become thick, so molten depth reduces, but the preheat effect of arc to base metal forward increases, so molten width enlarges.

Inclination welding of workpiece includes up-slope welding and down-slope welding, which have a different effect on welding seam shape. When it is up-slope welding, it is easy to occur overlarge excess weld metal, undercut on both sides, deformed welding seam etc. In practice, up-slope welding should be avoided as much as possible. The effect of down-slope welding is contrary to up-slope welding. When the inclination angle is less than 6°～ 8°, the molten depth and excess weld metal all reduce, molten width increases a little, welding seam shape is improved. But if welding angle is too big, it will cause incomplete fusion, welding bead and other flaws.

C. Structure

1) Groove shape

Under same conditions, if groove width and depth is increased, then molten depth will decrease a little, and excess weld metal, deposition ratio reduces greatly.

2) Welding seam gap

For butt welding, the change of welding seam gap can be used to adjust excess weld metal and fusion ratio. Too large gap will cause flux skips easily.

Table 7 the influence of welding seam gap to butt welding seam size（wire Φ5mm flux HJ330）：

Plate thickness (mm)	parameters			Molten depth（mm）			Molten width（mm）			reinforcement（mm）			Fusion ratio%		
	Welding current（A）	Arc voltage（V）	Welding speed（cm/min）	gap（mm）											
				0	2	4	0	2	4	0	2	4	0	2	4
12	700～750	32～34	50	7.5	8.0	7.5	20	21	20	2.5	2.0		74	64	57
			134	5.6	6.0	5.5	10	11	10	1.0			71	61	46
										2.0	-	-			
20	700～750	36～38	20	10	9.5	10	27	27	27	3.0	2.0		60	57	52
			33.4	11	11.5	11	23	22	22	2.5			63	58	49
			134	6.5	7.0	7.0	11	11	10	3.5	2.5		72	61	45
										1.5					
										2.5	-	-			
30	700～750	40～42	20	10.5	11	10.5	34	33	35	3.5	3.0		61	59	55
			33.4	12	12	11	30	29	30	2.5			67	63	69
			134	7.5	7.5	7.5	12	12	12	3.0	2.0		77	72	60
										1.5					
										1.5	-	-			

16 SAW welding craft and condition

16.1 Butt joint single side welding

For automatic submerged arc welding, a groove can be made or not on workpiece. A

groove does not only ensure molten depth, sometimes also meet other technology purposes. Butt joint single welding can take following methods: weld on welding flux backing plate, weld on permanent backing plate or locking bottom, weld on temporary backing plate and impending welding etc.

1) weld on welding flux copper backing plate. It takes copper backing plate with groove, to which welding flux is filled. During welding the welding flux plays the role of backing plate, also protecting copper backing plate, which will be avoided to get direct effect of arc. Groove plays the role of shaping back welding seam.

2) Weld on permanent backing plate or locking bottom plate. When welding workpiece is allowed to keep permanent backing plate, the workpiece under 10mm in thickness can adopt permanent backing plate single welding method. The workpiece above 10mm in thickness can adopt locking bottom welding method.

3) Impending welding. When the workpiece is well assembled and has no gap, it can adopt impending welding without backing plate. When this method is used for single side welding, workpiece can be fused completely. Usually molten depth does not surpass two-thirds of plate thickness, or it is easy to weld through. This method is only suitable for welding the joint which is not required to fuse completely.

4) Weld on welding flux backing. For this welding method, the quality of welding seam shape mainly depends on the backing strength, evenness of welding flux, and the evenness of welding seam assembling.

Table 8 welding conditions of butt joint single welding on welding flux backing：

Plate thickness（mm）	Assembling gap（mm ）	Wire diameter（mm）	Welding current（A）	Arc voltage（V）	Welding speed（cm/min）	Granularity of welding flux backing
2	0～1.0	1.6	120	24～28	73	fine
3	0～1.5	1.6 2.0 3.0	275～300 275～300 400～425	28～30 28～30 25～28	56.7 56.7 117	fine
4	0～1.5	2.0 4.0	375～400 525～550	28～30 28～30	66.7 83.3	fine
5	0～2.5	2.0 4.0	425～500 575～625	32～34 28～30	58.3 67.5	fine
6	0～3.0	2.0 4.0	475 600～650	32～34 28～32	50 67.5	Normal
7	0～3.0	4.0	650～750	30～34	61.7	Normal
8	0～3.5	4.0	725～775	30～36	56.7	Normal

16.2 Butt joint double-side welding

1) Impending welding. No gap or a very little gap less than 1mm is left during assembling workpiece. For the 1st side welding, the molten depth usually should be less than half of workpiece thickness, and the molten depth for opposite side welding is required to reach 60% to 70% of workpiece thickness, so that the

workpiece is molten completely.

2) Weld on welding flux backing. For the 1st side welding, the most economic welding method is reserve a gap but no groove opened, and the selected welding parameters must ensure that the molten depth is more than 60% ~ 70% of workpiece thickness. For the opposite side welding, its welding parameters can be the same as that of the 1st side welding, so that the workpiece can be molten completely.

Table 9 welding conditions of butt joint impending & double-side welding without groove

Plate thickness（mm）	Wire diameter（mm）	Workpiece front-side welding parameters			Workpiece opposite-side welding parameters		
		Welding current（A）	Welding voltage（V）	Welding current（A）	Welding voltage（V）	Welding current（A）	Welding voltage（V）
6	4	380～420	30	58	430～470	30	55
8	4	440～480	30	50	480～530	31	50
10	4	530～570	31	46	590～640	33	46
12	4	620～660	35	42	680～720	35	41
14	4	620～660	37	41	730～770	40	38
15	5	680～720	34～36	63	850～900	36～38	43
17	5	800～850	35～37	60	900～950	37～39	43
18	5	850～900	36～38	60	900～950	38～40	40
20	5	850～900	36～38	42	900～1000	38～40	40
22	5	900～950	37～39	53	1000～1050	38～40	40

16.3 Fillet welding

1) Boat-shape welding

The both sides of workpiece for fillet welding is placed under 45°with vertical line, this is the best condition for welding seam shape. This kind of welding method requires that the assembling gap of joint is no more than 1 ~ 1.5mm, or the measure must be taken to prevent the los s of liquid metal.

2) Horizontal fillet welding

When the boat-shape welding is unsuitable for some workpieces, it can take horizontal

fillet welding. The corresponding position of welding wire and welding seam has a great effect on the quality of horizontal fillet. Usually the inclination angle of welding wire within 20°~ 30°, the actual position of welding wire should be decided as per joint state. The cross section of each single pass horizontal fillet is not more than 40 ~ 50mm², that is, when the welding foot length is more than 8x8mm, it will cause metal spillover and undercut.

17 Tandem welding procedure application

17.1.Tandem welding brief introduction:

- Tandem welding features:

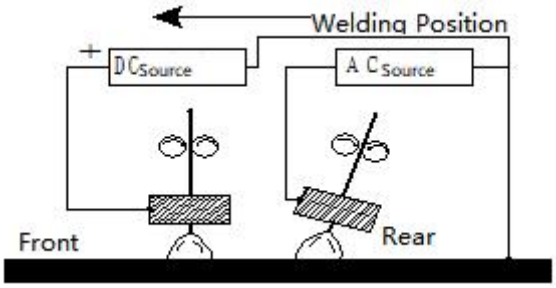
Tandem submerged arc automatic welding is an high efficiency welding method, which can achieve reasonable welding forming and good welding quality with high welding speed, which can effectively reduce welding deformation and improve the pore resistance of weld.

- Tandem welding power supply selection

Based on the requirements, the welding heat input of each welding wire can be adjusted separately. Currently, two independent power sources are used for tandem submerged arc welding. The first is to choose the type of power supply, which can be DC + DC, AC + AC, DC + AC, etc. When selecting DC + DC power supply, the effect of electromagnetic force on the arc and molten pool and the influence of the arc can cause defects such as pores, slag clamp and welding deviation. Although selecting AC + AC power supply can reduce the electromagnetic force, the influence of flux on AC arc stability can avoid the shortage of previous power supply, but the suppression of the pores is not as good as the double DC power supply.

Generally, DC + AC is selected, and the front welding wire is connected to DC power supply, and the rear welding wire is connected to AC power supply, as shown in Figure 8. In some special applications, such as the inner ring joint of the pipe, it must all use the AC arc welding power supply.

Drawing 8



- Welding wire arrangement

There are wire arrangement types of horizontal, vertical and string types. The application is generally vertical type, that is, two welding wires are arranged in order along

the welding direction. Generally, the front conduction arc is DC, choose low voltage and large current, obtain enough melting depth, subsequent arc with AC, using low current and high voltage, adjust the melting width or improve the role of the forming, in order to form a smooth and smooth weld path shape.

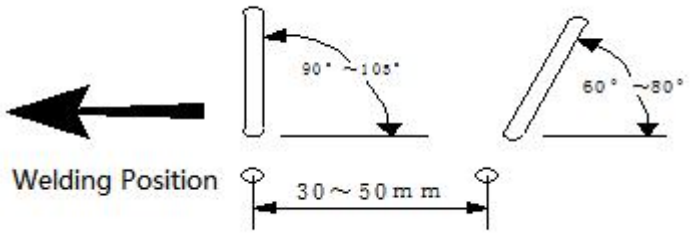
- Distance between the wires

According to the different spacing between the two welding wires, there are two methods: co-melt tank method and separate arc method (no co-melt tank) method, both of which can improve the productivity. Wire spacing and Angle are the main factors affecting the weld depth, pool shape, arc action and weld forming. The spacing and Angle should be determined according to the groove form, weld appearance and welding speed.

During co-melt tandem welding, the double arcs work together in a molten pool, and the enhanced arc mixing effect of the melting pool can effectively eliminate the non-fusion at the edge of the groove. At the same time, the bottom area of the melting pool expands, which is not easy to form a pear-shaped welding path, which can reduce the probability of thermal crack at the root of the weld. In the process of welding gas is inevitable, the key is whether the formation of pores, double filament single melting pool buried arc welding for gas escape created good conditions, the influence of forming pores, mainly double arc on the enhancement of mixing pool, of course pool high temperature stay time growth and more fully metallurgical reaction also has certain effect. In the appearance of the weld forming, it can effectively reduce the bite edge and the weld surface of the fish scales, especially suitable for the occasion of the double wire cover surface. In order to ensure that the spacing of the welding wire in the single melting tank should be controlled at 10~40 mm. For a specific welding joint form, the welding wire spacing of type I joint can be appropriately increased, and the welding wire spacing of V-type joint can be appropriately reduced, generally not more than 25 mm. The front wire is usually perpendicular to the steel surface or slightly towed back for optimal melting depth; the rear wire is generally tilted forward to achieve a smooth surface forming. This way is easy to adjust the weld composition through welding wire matching to achieve the purpose of adjusting the joint organization and performance.

The electric arc separation method can start the front arc preheating, rear arc filling and rear heat action to achieve the purpose of over welding or welding alloy steel crack and improve the joint performance. The advantage of the double melting pool is that it can control the welding heat input in a large range. When adjusting the Angle of the welding wire, the diameter of the pipe and the influence of downhill welding should be fully considered. The main wire should be designed with a certain back Angle, and the auxiliary

wire is a certain forward Angle, or the main wire is vertical and the auxiliary wire is a certain forward Angle. The spacing of the wire and the angle between the wire and the workpiece are shown in Figure 9. At this time, the front end arc has the effect of melting depth and preheating, and the back end arc has the effect of improving productivity, delaying the weld cooling speed and the first layer of the weld after heat treatment. When submerged arc welding in the double melting tank, the spacing of the welding wire should be selected according to the solidification temperature, the solidification time and the conductivity of the slag, and the maximum spacing should be less than the solidification length of the slag.



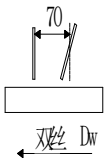
Drawing 9

17.2.Tandem welding application:

- Filled Welding

Table 10 is the welding conditions for single side welding of tandem submerged arc welding.

Table 10

Thickness（mm）	Wire qty	Groove			Welding parameter			
		h1/mm	h2/mm	θ(•)	Wire	Current /A	Voltage /V	Speed cm/min^{-1}
20		8	12	90	Front	1400	32	60
					rear	900	45	
25		10	15	90	Front	1600	32	60
					rear	1000	45	
32		16	16	75	Front	1800	33	50
35		17	18	75	rear	1100	45	43

- Corner Welding

The corner joint can be used for double wire submerged arc welding in the boat shape position or in the transverse welding position, and the size of the welding foot is greater than 8mm on the right. When making up the bottom plate and web of the same thickness in the ship shape position, the Angle of the welding wire and the workpiece can be 45^0, such as the plate thickness is different, the Angle between the welding wire and the workpiece can be less than 45^0, so that the welding wire is close to the side of the thick plate. The assembly clearance between each web of the floor is usually less than 1.5mm. Otherwise, flux pads should be added to the back of the weld to prevent the loss of molten metal from the gap. See Table Table 11 for the parameters.

When welding in the transverse welding position, the weld formation is not easy to control, usually the wire is tilted to the bottom plate, and the Angle between the wire and the bottom plate can be between 30^0 and 40^0.

Table 11 Ship shape corner joint tandem parameter

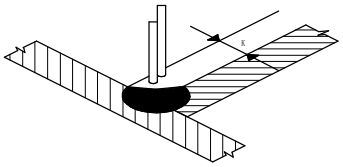
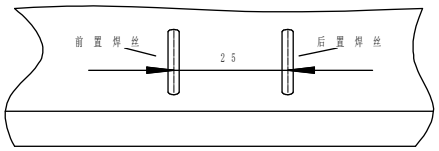
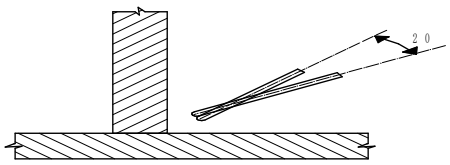
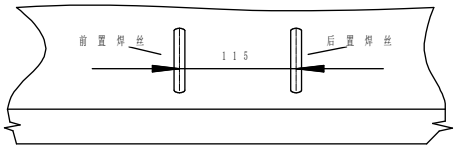
Joint shape and wire position					
					
Welding feet height K/mm	Wire dia. ¤/mm	Current /A	Power supply	Voltage /V	Speed cm/min^{-1}
6.0	Front5.0 Rear4.0	700～730 530～550	DC reverse AC	32～35 32～35	150～153
8.0	Front5.0 Rear5.0	780～820 640～660	DC reverse AC	35～37 35～37	117～120
10.0	Front5.0 Rear5.0	780～820 700～740	DC reverse AC	34～36 38～42	92～95
13	Front5.0 Rear5.0	900～1000 840～860	DC reverse AC	36～40 38～42	67～70
16	Front5.0 Rear5.0	980～1100 880～920	DC reverse AC	36～40 38～42	45～47
19	Front5.0 Rear5.0	980～1100 880～920	DC reverse AC	36～40 38～42	33～35

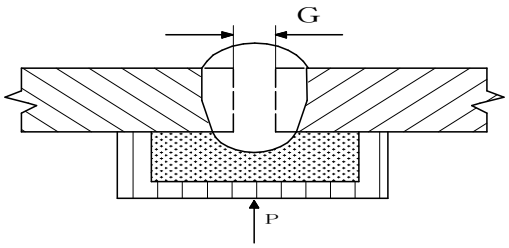
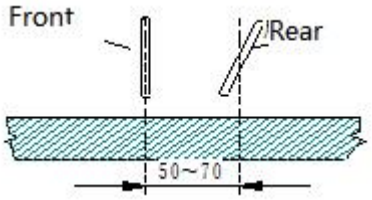
Table 12 Ship shape corner joint tandem parameter

Joint shape and wire position					
					
Welding feet height K/mm	Wire dia. ¤/mm	Current /A	Power supply	Voltage /V	Speed cm/min^{-1}
6.0	Front4.0 Rear3.2	480～520 380～420	DC reverse AC	28～30 32～34	100～102
8.0	Front4.0 Rear3.2	620～660 480～520	DC reverse AC	32～34 32～34	80～83
10.0	Front4.0 Rear3.2	640～660 480～520	DC reverse AC	32～34 32～34	65～67

- Single-side welding double side molding

Tandem welding is an ideal method for single side welding, which requires forced forming. There are often gantry pressure frame-flux copper pad method, water cold slider copper pad method and hot curing flux pad method. The gantry pressure frame-flux copper pad method is to use the gantry across the welding piece with several pressure cylinders, the welding piece on the copper pad for submerged arc welding. Table 13 shows the parameters of submerged arc welding with single-sided welding of gantry pressure holder and flux copper pad.The water-cooled slide copper pad method uses the assembly gap to keep the water-cooled copper slide close to the back of the weld, and clip it on the welding car to follow the arc together to force the weld to form. Table 14 listed the process parameters, and the wire spacing is adjusted within 60 to 150 mm. Hot curing flux is made of strip hot curing flux and asbestos cloth, corrugated paper to prevent the molten pool metal overflow and control the back molding. Table 15 is the typical application parameters of the thermal curing agent pad method.

Table 13 Gantry pressure frame—single side welding double side molding parameter

Joint shape and wire position	
	

Thickness T/mm	Gap G/mm	Wire dia. ¤/mm		Current/A		Voltage/N		Speed cm/min^{-1}
		Front	Rear	Front	Rear	Front	Rear	
6.0	3^{+1}	4.0	3.0	500～550	250～280	30～31	32～33	60～62
8.0	3^{+1}	4.0	3.0	600～620	250～280	31～32	32～33	60～62
10	4^{+1}	4.0	3.0	700～730	250～300	31～32	34～35	53～55
12	4^{+1}	4.0	3.0	800～820	300～320	32～33	34～35	50～52
14	4^{+1}	5.0	3.0	850～880	350～380	33～35	36～37	43～45
16	5^{+1}	5.0	3.0	850～880	350～380	33～35	36～37	40～42
18	5^{+1}	5.0	3.0	900～940	400～430	36～37	39～40	33～35
20	5^{+1}	5.0	3.0	950～980	400～430	36～37	39～40	33～35

Table 14 Water cooling slide copper pad single side welding double side molding tandem parameter

Thickness （mm）	Gap （mm）	Wire dia.		Current		Voltage		Speed cm/min
		Main	Deputy	Main	Deputy	Main	Deputy	
6	3	4	3	500～550	250	30～31	33	62
8	3	4	3	600	250	31～32	33	62
10	4	4	3	700～750	250～300	31～32	35	55
12	4	4	3	800	300～350	32～33	35	52
14	5	5	3	850	350～400	33～35	37	45
16	5	5	3	850～900	350～400	33～35	37	42
18	6	5	3	900～950	400～450	36～37	40	35
20	6	5	3	950～1050	400～450	36～37	40	35

Table 15 Solidified flux pad tandem welding parameter

Thickness T/mm	Gap G/mm	Groove			Wire dia./mm	Wire dis./mm	Current /A	Voltage /V	Speed cm/min
		Shape	Angle (^{0})	Blunt edge/mm					

12	0^{+1}	V	60^{+5}	2^{+1}	Front¤5.0 Rear¤5.0	$90^{\pm5}$	1000～1100 650～670	36～37 40～41	58～60
20	0^{+1}	V	60^{+5}	3^{+1}	Front¤5.0 Rear¤5.0	$90^{\pm5}$	1100～1200 850～880	37～38 42～43	52～54
32	0^{+1}	X	P 50^{+5} N 60^{+5}	2^{+1}	Front¤5.0 Rear¤5.0	$90^{\pm5}$	1100～1150 1050～1100	34～35 48～50	35～37
40	0^{+1}	X	P 50^{+5} N 60^{+5}	2^{+1}	Front¤5.0 Rear¤5.0	$90^{\pm5}$	1350～1400 1300～1350	35～36 51～52	27～29

- Narrow gap SAW welding

If the welding parts with a thickness of more than 50mm and ordinary V-shaped or U-shaped buried arc welding is adopted, the number of welding layers and channels are large, the metal filling amount and the required welding time increase with the thickness, the welding deformation is large and difficult to control, so narrow gap buried arc welding should be used. The bottom groove gap is 12~35mm, and the groove Angle is 1^0~7^0. The process pad is often used for base welding.Because the arc is easy to induce magnetic bias in the narrow slope, AC arc must be adopted. In order to improve the melting and welding speed of the submerged arc welding at the narrow groove, the serial double arc welding with AC-AC combination can be used. In order to deliver the welding wire to the bottom of the narrow breaking plate, a special narrow welding nozzle should be designed, and the extension length of the welding wire should be 50~75mm to obtain a high melting rate. Narrow gap welding should use special flux, its granularity is generally fine, slag removal is particularly good, most of the high alkalinity flux. Automatic tracking control should be adopted to ensure the wire and arc in the deep and narrow groove.

18 The weld defects and prevention

18.1 The main welding defects and reasons

- Blow hole

a) Moisture, filth and oxidizing iron scrap in the flux, etc. all can cause blow holes in welding seam.

b) The insufficient covering of welding flux during welding causes the exposure of arc, which have air involved in and causes the blow hole.

c) The molten slag is too viscous;

d) The arc magnetic blow causes the blow hole, which is usually produced at the end welding area of thick plate.

e) The welding position is polluted by iron rust, oil stain or other filth.

- Crackle

a) Solidification crackle: For welding steel, the impurities such as the sulfur, phosphorus etc in the welding seam causes solidification crackle while the welding seam solidifies.

b) Hydrogen-caused crackle: This kind of crackle is mostly formed in the heat-affect zone of welding the low-alloy steel, middle-alloy steel and high-carbon steel.

- Slag inclusion

Slag inclusion caused in submerged arc welding is related to not only the slag of welding flux, but also the assembling state of workpiece, and welding technology parameters.

18.2 Prevention methods

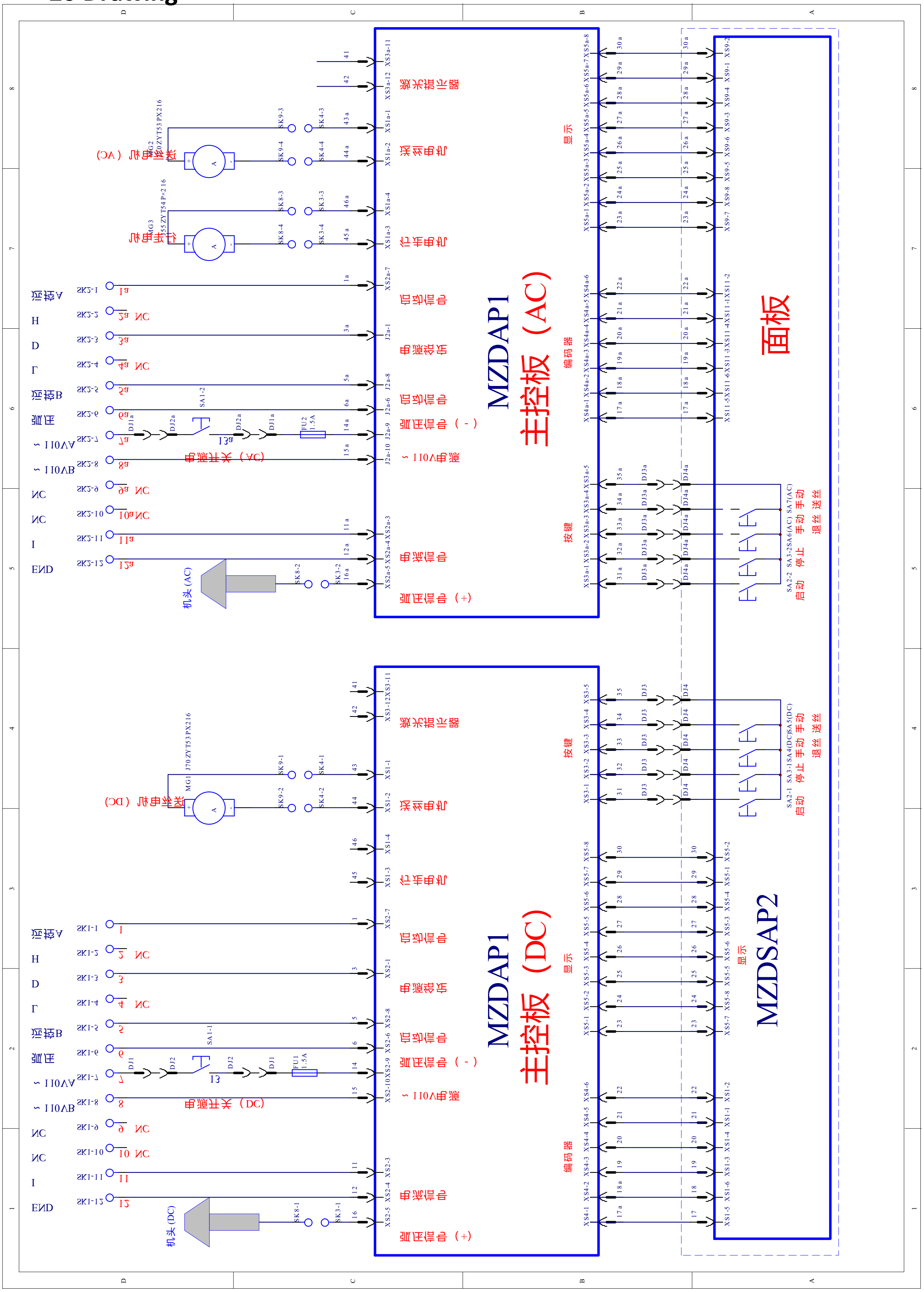
Please take the following methods according to the quality demand of welding.

- Remove and clean oil, rust, moisture and other impurities on the surface of wire and on the both sides of welding seam within the range of 20mm.
- The flux must be dried according to its operation regulation, store them under about 50°C temperature for stand-by.
- The reclaimed flux must be prevented from pollution of the oxide, slag, water dust etc.
- the granular size of the flux must be suitable, the powder and dust should be cleaned up.
- The workpiece assembling gap for impending welding is not more than 0.8 ~ 1.0mm.
- When arc magnetic blows, the welding starts from the earth line side, and earth line must be connected reliably.

19 Packing list

- MZS-5 trolley.....1
- Tools.....2
- Conductive rod.....2
- Wire feed roller.....2
- Rail.....optional
- Fuse 2
- Control cable.....2
- Welding cable.....1
- Ground cable.....1
- DC power source（ZD5-1250、ZD7-1000/1250/1600/2000IGBT）.....1
- AC power source（ZDE-1250、ZDE7-1200HD）..... 1
- Instruction manual.....1
- Qualified card.....1
- Warranty card.....1

20 Drawing



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If there is any changes in the user's manual, forgive not to inform separately!

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