SPT Plasmateknik AB

STATE OF THE ARC PLASMA CUTTING TECHNOLOGY

MANUAL

SPARCIN 4000

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1. TECHNICAL DATA

	SPARCIN 4000
Mains voltage:	3~50Hz, 400V
Fuse:	80A slow blow
Process power:	20-200A/180V
Duty cycle:	100 %
Maximum power:	40 kVA
Power factor:	0,95
Open circuit voltage:	250V
Dimensions	
Power Source (PA):	740 x 510 x 1210 mm
Gas console (GCU):	450 x 420 x 320 mm
Weight:	150 kg

2. INSTALLATION

Below is a scheme over the principle of the system and its components. These instructions are aimed at system builders with experience in mechanised plasma cutting. If such competence is not available it is advised that SPT be contacted for guidance.
To obtain satisfactory cutting quality and economy it is vital that the CNC-machine be equipped with a suitable height control device for plasma cutting. The plasma technology requires a very well defined process control. The height control must be able to handle different heights for ignition, piercing and cutting. Most robots can easily be programmed to handle the process.
If a suitable height control system is not available one can be delivered by SPT. Contact us for advice.

Electrical supply:

SPARCIN 4000: 3~50 Hz, 400V, 80A slow blow

Note that the SPARCIN 4000 is an inverter power source and it requires a stable power supply. Make sure that the power supply is stable and within 400 V +6/-10 %. A circuit breaker should be present at the wall socket.

Gas supply:

Connect the gases to the rear of the gas console. Use only 2-step pressure regulators of high quality and adjust to 9-10 bar on each bottle. Also the compressed air shall be adjusted to 9-10 bar. The compressed air should be dry, oil free and free from particles.
Bear in mind that pressurized oxygen and oil is an explosive combination that can lead to loss of life as well as destruction of property.

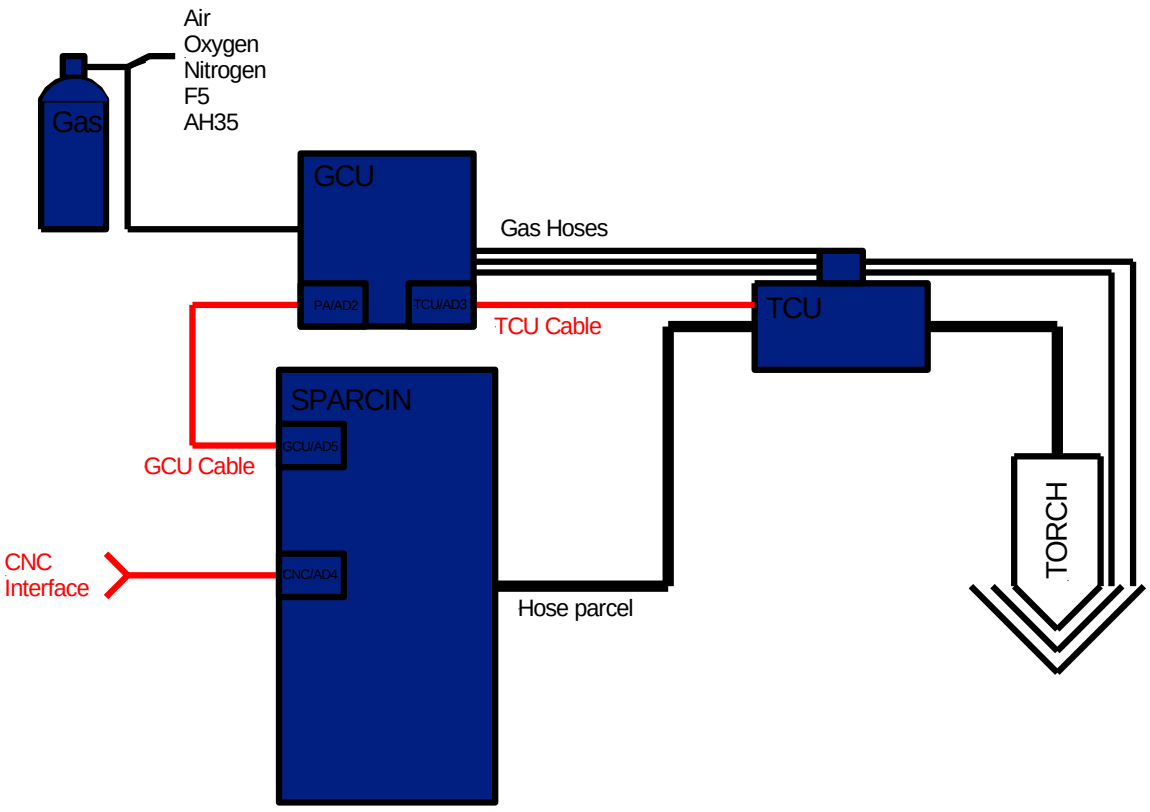
Remote control from robot or CNC

The plasma system is controlled via a multi-pole connector marked “CNC” on the rear panel of the power source. This should be connected according to diagram further back in this manual. The system is highly sensitive and it is therefore vital to connect it properly. Pins in the connector that are not used by the remote control must be left unconnected. If they are connected to a wire that is left unconnected in the other end this works as an antennae and this will lead to unwanted behavior.
In some cases it may be necessary to screen the cables.

Safety

Only specially trained personnel should install the SPARCIN 4000 system. National law and regulations must be followed. Note that parts of the system are electrically live when connected even though the main power switch is off.

System principle



Connecting the system

Note! Do not connect electricity until the very last. Parts of the system are live even if the power switch is off!

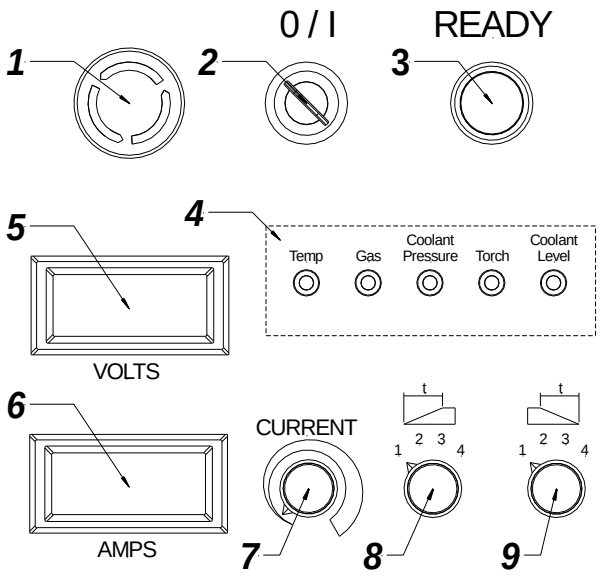
- Mount the torch connection unit TCU on an appropriate place on the robot or torch carriage. Make sure that the torch can move without stretching or excessively bending the hose assembly.
- Mount the torch in a suitable holder on the robot or torch carriage. Make sure that the torch head is easily accessible for replacement and that the holder is electrically isolated from the torch. Connect the torch to the TCU. Check that the hoses are not stretched or bent.
- Connect the 25 pole control cable marked GCU-PA between the GCU contact on the plasma power source and the contact marked Power Source or PA on the GCU.
- Connect the 9-pole control cable marked GCU-TCU between the GCU and the TCU.
- Mount the hose assembly TCL between the power source and the TCU. Make sure that the hoses are not stretched, bent or twisted as this can lead to excessive wear on the hoses and also block the coolant flow. The TCL should be drawn via the opening in the front panel. The connection can be made by opening the side door on the right hand side of the machine. Open the lid on the TCU and connect the cables and hoses. Make sure that the ground cable is properly fastened.
- Mount the gas hoses 1,2 and 3 between the GCU and the TCU. Be careful to avoid dirt from entering the hoses. Make sure that there are no creases on the hoses.

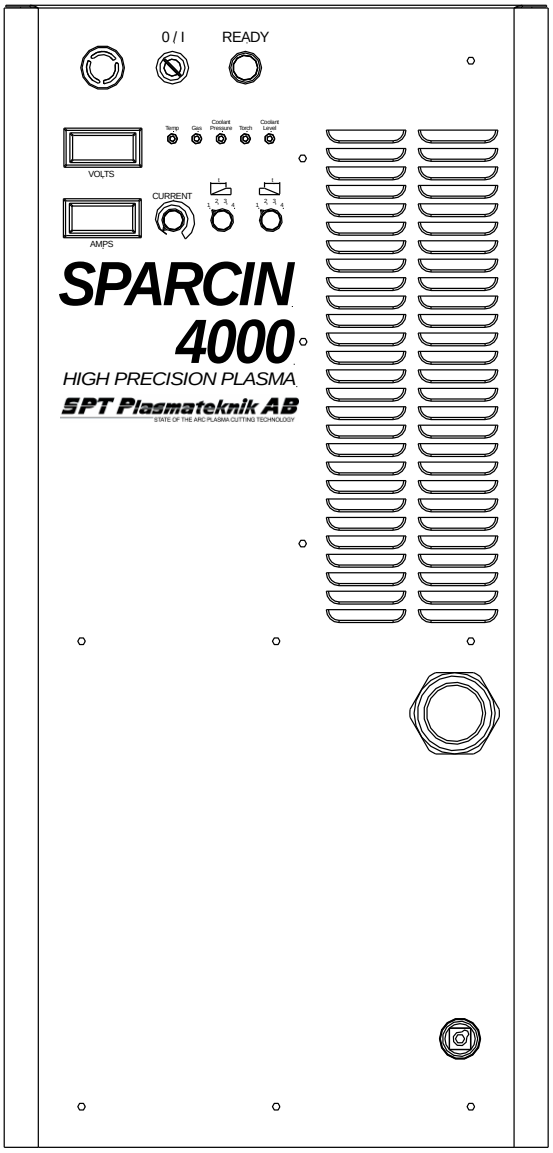
- Connect the hoses from the pressure regulators on the gas bottles to the gas console. Make sure that explosion protectors are mounted on the regulators connected to flammable gas and oxygen. Check that the installation is in accordance with national/regional laws and regulations. Make sure that the different gases are connected to the right input on the GCU.
- If necessary, fill up with coolant. Only use pure mono-ethylene as anti freeze agent and de-ionised or distilled water. Any other coolant may be electrically conductive which leads to ignition problems. The original coolant consists of 30% glycol and 70% distilled water which gives freeze protection down to -5°C.
- Connect the the power source to the CNC-control system or robot via the 25-pole contact marked CNC on the rear of the power source. Be very careful to follow the instruction in the diagram as a faulty connection can lead to disturbance in the function of the plasma system.
- Make sure that all system components and hose assembly screens are grounded together and that all doors and panels are closed.
- Connect gas and make sure that all hoses and connections are tight. Be extra careful with flammable gases and oxygen. Remember that a gas leak can lead to fire or explosion with injury to person and property.
- Connect the return lead to the front panel of the power source and attach the clamp directly to the work piece.
- The machine is now ready to be connected to electricity and startup.
- It can take up to 2-3 minutes before all hoses are filled with coolant when starting the machine for the first time. Avoid cutting during this time. Remember that the hoses can take up to 25% of the coolant volume, refill the tank with coolant.

3. OPERATION

The power source

The front panel





1. **Emergency stop –** Cuts the control voltage in the power source and activates the external emergency stop signal to the CNC-interface on the rear panel.

2. **0/1 –** Off/On, this key switch activates the control circuits and the ventilator.

3. **Ready –** Green push button with light. When this button is pushed and the key switch is on the coolant pump starts and as soon as the right coolant pressure is achieved the gas console starts its gas purging cycle. When the green light comes on the system is ready for cutting.

4. **Fault indications:**
    - **Temp** – Overheat - the maximum allowed temperature of the power source electronics has been exceeded. Leave the system switched on to cool down. As soon as the power source has cooled down the light goes out and the machine is again ready for cutting.
    - **Gas** – Low gas pressure – Check that the gases used are connected and that the valves are open. The input pressure should be adjusted to 9-10 bar. When the proper pressure is connected the light goes out and the machine is ready for cutting.
    - **Coolant pressure** – Low coolant pressure – check that the coolant level is above the minimum marker, that the pump is working and there are no leaks.
    - **Torch** – Torch fault – the system is equipped with a torch voltage monitoring circuit. If the voltage drops below a preset level the system shuts off the control voltage to protect against damage in case of a short circuit. This can happen if the torch consumables are worn out or there is a problem with gas flow in the torch. To reset this fault the key switch must be switch off and the machine must be restarted.
    - **Coolant level** – Low coolant level – this indication does not stop the machine from working, but to avoid overheating of the torch it is advised to refill the coolant tank as soon as possible.

5. **Volts LED display –** Shows the actual cutting voltage.

6. **Amps LED display –** Shows the preset cutting current.

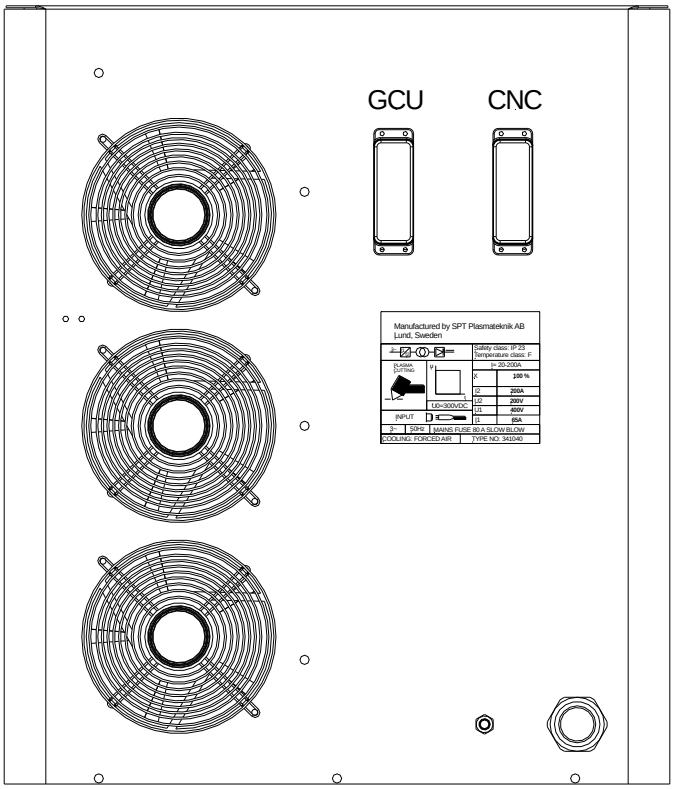
7. **Current –** With this knob the cutting current is set if the machine is not remote controlled via the CNC interface.

8. **Ramp up –** Time constant adjustment for the ramp up function.

9. **Ramp down –** Time constant adjustment for the ramp down function.

On the front panel the opening for the hose assembly (TCL) and the connector for the return lead can also be found.

The rear panel



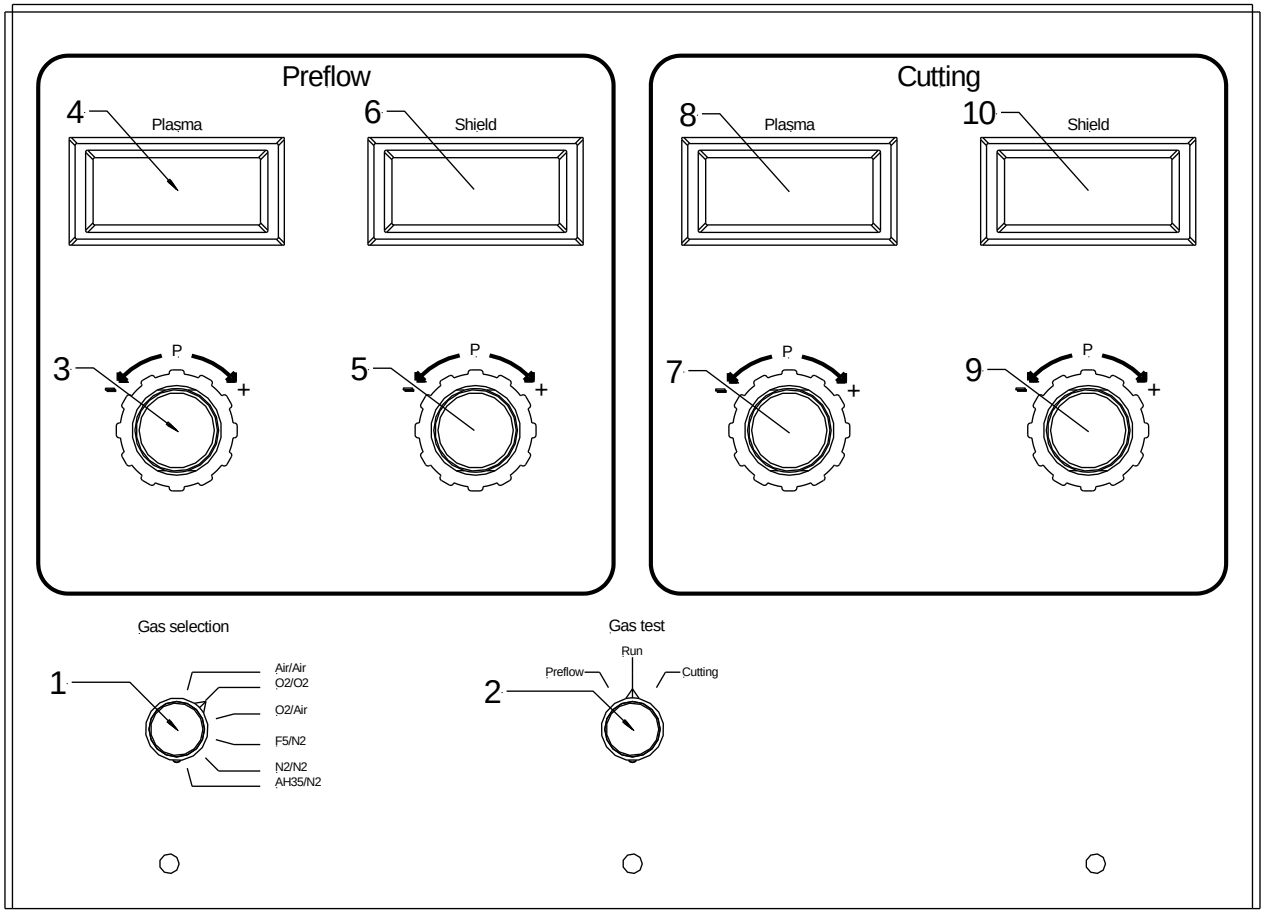
GCU – Connector for interface with the gas console GCU. The PA-GCU cable should be connected here.

CNC – Connector for interface with CNC or robot control system this connector is described in detail under chapter **12. Diagrams**.

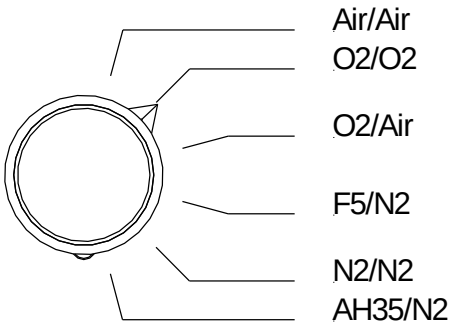
On the rear panel is also an M10 earth (PE) screw for grounding of the power source together with the rest of the cutting system.

The GCU gas console

The front panel

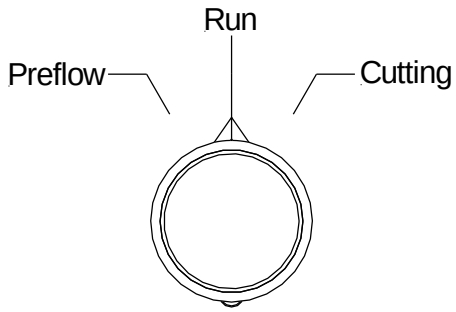


1. Gas selection switch



With this switch the process gases are selected according to the cutting data tables.

2. **Gastest switch**



This switch activates the gastest function on the GCU.

Preflow – Gastest for Preflow
Run – Normal run mode setting.
Cutting – Gastest Cutflow

Preflow – The gas that is used during ignition.

3. **Pressure regulator –** With this regulator the preflow plasma gas pressure **(P)** is set according to the cutting table.
4. **Display –** Shows set pressure on preflow plasma.

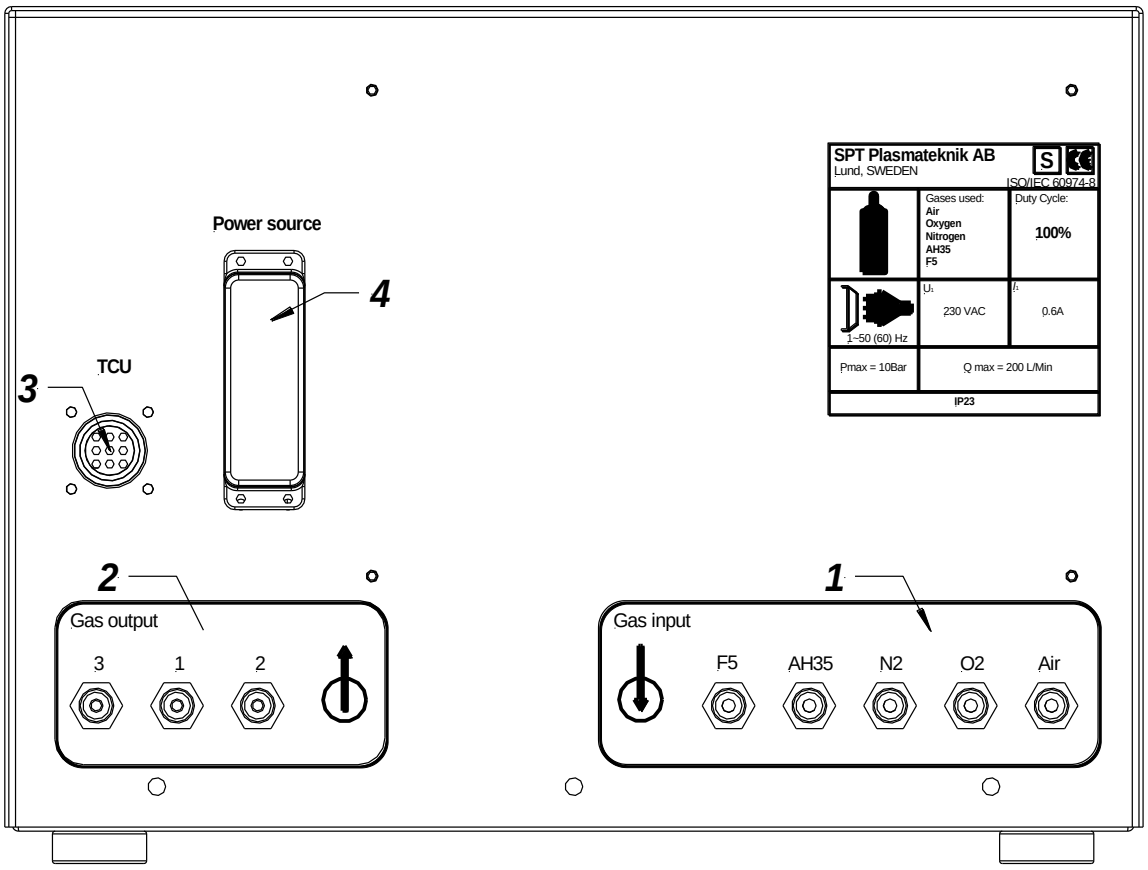
5. **Pressure regulator –** With this regulator the preflow shield gas pressure **(P)** is set according to the cutting table.
6. **Display –** Shows set pressure on preflow shield.
   All pressure should be set with gastest active on preflow.

Cutting – The gas that is used during cutting.

7. **Pressure regulator –** With this regulator the Cutting plasma gas pressure **(P)** is set according to the cutting table.
8. **Display –** Shows set pressure on Cutting plasma.

9. **Pressure regulator –** With this regulator the Shield plasma gas pressure **(P)** is set according to the cutting table.
10. **Display –** Shows set pressure on Cutting shield.
    All pressure should be set with gastest active on Cutting.

The rear panel



1. **Plasma gas input.**

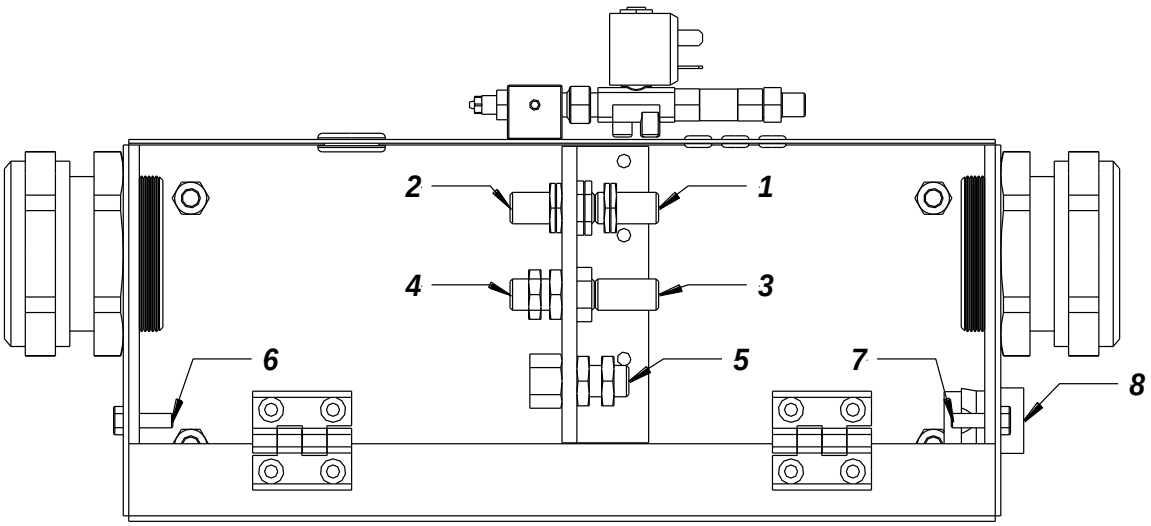
Air – ¼”R	Inlet for air.	Black hose with yellow marker.
O2 – ¼”R	Inlet for oxygen.	Blue hose.
N2 – ¼”R	Inlet for nitrogen.	Black hose with green marker.
AH35 – ¼”L	Inlet for AH35.	Red hose.
F5 – ¼”L	Inlet for F5.	Red hose green marker.

2. **Gas output.**
   Connect the TCL gas hoses here. Hose 1 to connector 1 and so on.

3. **TCU.**
   Connector for the interface cable between TCU and power source.

4. **Power source.**
   Connector for interface cable between power source and GCU.

Torch connection unit with ignition system TCU.



1. **Connection for current/water TCL.**
   Connect the thick current cable and the left hand thread ¼" nut on the water hose on this connection.

2. **Connection for torch current/water.**
   Connect the left hand thread ¼" nut of the torch hose here.

3. **Connection for return water TCL.**
   Connect the right hand thread ¼" connection of the TCL water hose here.

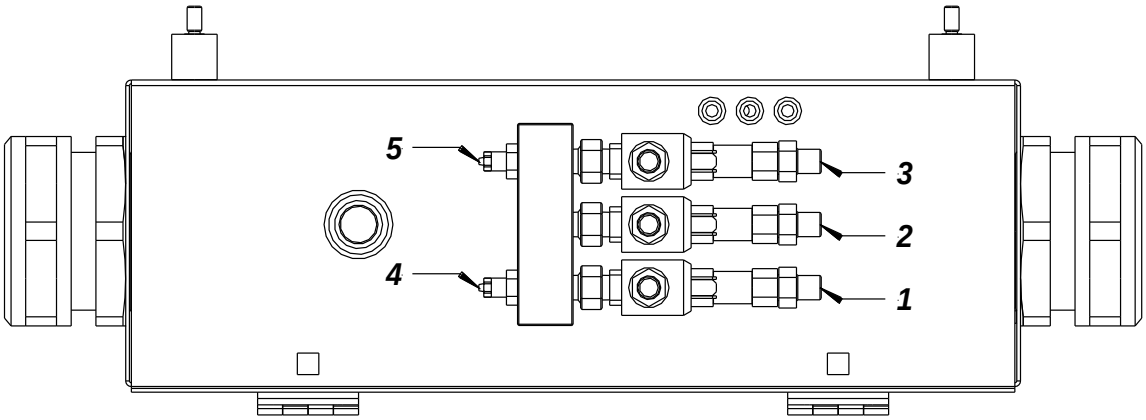
4. **Connection for torch pilot current/water.**
   Connect the torch pilot lead and the right hand thread ¼" connection of the water return hose here.

5. **Connection for TCL pilot current cable.**
   Connect the TCL pilot current cable here.

6. **Earthing point.**
   Connect the torch hose assembly screen here.

7. **Earthing point.**
   Connect the TCL screen here.

8. **GCU.**
   Connector for the interface cable between TCU and GCU.



1. **Connection gas hose TCL.**
   Connect the number 1 gas hose of the TCL here.

2. **Connection gas hose TCL.**
   Connect the number 2 gas hose of the TCL here.

3. **Connection gas hose TCL.**
   Connect the number 3 gas hose of the TCL here.

4. **Connection plasma gas.**
   Connect the clear hose marked 1 from the torch here.

5. **Connection swirl gas.**
   Connect the black hose marked 2 from the torch here.

4. STARTUP

1. **Choose cutting parameters**
   See chapter 12.

2. **Mount proper consumables in the torch**
   See chapter 10.

3. **Open gas valves and adjust pressure to 9 bar.**

4. **Choose gas mixture setting according to cutting data chart with the gas selector (1) on the GCU.**
   See chapter 3.

5. **Switch on the key switch (1) on the power source.**
   See chapter 3. Ventilator and control voltage activates.

6. **Push the green button (3) on the power source.**
   The pump starts and the gas purging cycle starts. Await the green light on the button.

7. **Adjust pressure and flow settings on the GCU according to the cutting data chart.**
   See chapter 3.

8. **Adjust the cutting current with the current knob (7) according to the cutting data chart.**
   See chapter 3.
   If the machine is remote controlled via the CNC-interface this setting is made on the CNC-system or the robot. Consult your system literature for more information.

9. **Ready for cutting.**

5. MAINTENANCE

Daily: Inspect and if necessary change the torch consumables.
Check coolant level and refill if necessary.
Carefully inspect the torch and the hose assembly for any damage or leak.

Important notice: Never use the system if the torch or hose assembly is damaged!

Quarterly: Disconnect the system from electrical power and remove the cover plates.
Check coolant level and refill if necessary.
As anti freeze agent it is only allowed to use 99% pure mono-ethylene glycol.
The conductivity of the coolant must be < 5µS/cm.
Blow away dust and dirt with clean oil free compressed air.
Make sure that all cable and connections are properly attached.

Remove the cover plates from the GCU.
Blow away dust and dirt with clean oil free compressed air.
Inspect hoses and cables.
Perform a pressure test on all gas channels.

Open the cover of the TCU and check connections.

.Yearly: Exchange the coolant.

IMPORTANT! Always disconnect the power source physically from electrical power before accessing the inside. Parts of the system are live even if the power switch is off.

6. TROUBLE SHOOTING

If the plasma system is not working properly, firstly exchange all torch consumables and make sure that the torch head is not damaged. Make sure that the right consumables for the application are used.
Also check that the right gas types are selected and that the settings on the GCU are ok. Check all hoses and connections.

Check if any of the LED indicators on the front panel ar lit:

- **Temp** – The machine is over heated. Leave the machine switched on until the light comes off and the green light comes back on. The machine is again in working order.
- **Gas** – Low gas pressure. Check that the gases used are on and that the pressure is correct – 9-10 bar.
- **Coolant Pressure** – Low pressure in the cooling system. Check the coolant level and pump function. Also make sure that there is flow through the hose assembly. Check the torch consumables and o-rings.
- **Torch** – Short circuit in the torch or gas flow problem. Check consumables and gas system. Exchange consumables if necessary.
- **Coolant Level** – Low coolant level. Fill up with the specified coolant.

I the above does not rectify the problem, contact an authorized service engineer.

7. SAFETY INSTRUCTIONS

All endangerments through plasma cutting are related with the process itself. Endangerments may occur due to:

- High contact voltage
- HV ignition
- Electromagnetic interferences
- Heat and light radiation
- Gases, fumes and smoke
- Noise
- Hot metal and spatter
- Handling of pressure cylinders

The Plasma Cutting Machine has been developed in conformity with following standards:

• EN 60974-1 safety requirements for installations for arc welding and welding power sources

• EN 50199 electromagnetic compatibility

Before starting the Plasma Cutting Machine carefully read this Instruction Manual. Only advised personnel are allowed to operate the plasma installation!

Endangerment due to high contact voltage

Warning!

Before opening the plasma rectifier generally the input power has to be disconnected physically from the mains (unplug mains cable)! Only advised personnel are allowed to carry out any repairs to the machine.

Attention! Connect the work piece cable and earth the workplace before starting the machine!

The power source is equipped with a cooling unit and there is an electric potential between the housing and work piece in case the work piece isn't earthed and the machine is switched on. Because of the high resistance of more than 10 kOhm in the coolant the contact voltage is absolute not dangerous but sensible.

Special hints:

- Connect power source only to correctly earthed mains socket with proper connected safety conductor
- Wear insulating protective clothing (safety shoes, leather apron, gloves), place torch on insulated holder,
- Wear cutting area and plasma machine components dry and clean, arrange regular inspections, never shorten safety circuits.

Working under elevated electrical endangerment

This plasma cutting machine in conformity with valid standards (EN 60974-1) can be used for operation under elevated electrical endangerment

• The power source and the plasma torches are forming a safety-proofed installation which can be separated only by using tools.

• The patented design of the torch prevents electrical danger when the torch consumables are disassembled.

Therefore the power source is marked with the S-sign and operation under enhanced electrical endangerment is allowed.

Attention! Always follow the local safety rules!

Endangerment through high voltage (HV)

A HV-igniter starts the pilot arc. The HV-supply is cut-off automatically after pilot arc has struck.

Attention! Never touch nozzle or nozzle cap when power source is switched ON!

HV-ignition may establish electromagnetic fields and can influence:

- heart pace-makers
- electronic devices

Endangerment through electromagnetic interferences

The plasma cutting unit is in conformity with the conditions of the EN 50199 "Electromagnetic compatibility". This standard is valid for arc welding and related processes (plasma cutting) that come in use in commercial and private fields.

Warning!

Special precautions may be required if the plasma unit is used in private fields (for instance screened cables etc.)

The user takes the full risk when installing and using the machine. He has to follow strictly the instructions of the supplier. If electromagnetic interferences are noticed the user is to contact the producer to solve the problem.

Recommendations to classify the environment (EN 50199):

Before the installation takes place the user has to value the environment for electromagnetic problems and to take into consideration:

- Other mains supplies, control cables, signal and telecommunication lines along, above, below or beside the installation
- Broadcasting or television installations
- Computers or other controls
- Safety devices, protection circuits
- The health of people in the area (heart pace makers, hearing aids etc.)
- Devices for measuring and calibrating
- The noise immunity of equipment around the installation, so that they are compatible with electromagnetic interferences. Special measures may be required.
- The time of day that plasma cutting is performed

Recommendations to minimise interferences:

If interferences take place, the following should be done:

- Apply filter for mains connection
- Screening of mains cable of the plasma installation (safe contact between screen and housing required)
- Constant maintenance
- Always keep cover plates and doors of the plasma machines closed
- Avoid excessive length of cutting cables
- Arrange potential equalisation between metallic parts around the installation (the operator has to be insulated from those parts)

- Earthing of the work piece
- Selective screening of other cables and installations

Endangerment through heat and light radiations

The plasma arc produces intense ultraviolet and infrared radiation that can hurt the eyes and skin. Therefore the following precautions have to be arranged:

- Wearing of flame-retardant welding clothes (helmet, apron, gloves, safety shoes)
- Hand or head shield with protective glasses of medium shade for watching the cutting process
- Preparing the cutting area so that reflection and transmission of ultraviolet light is reduced:
  - -painting of walls in dark colour
  - -use of protective walls and screens

Endangerment through fumes and smoke

Due to the plasma process itself hazardous substances may be produced. To avoid risks on health the following has to be done:

- Keep cutting place well ventilated
- Remove fumes and smoke by exhaustion devices
- Remove all chlorinated and other solvents from the cutting area. They could form phosgene gas when exposed to ultraviolet radiation
- Wear a breathing mask when cutting galvanised materials
- Ensure that toxic limits are not exceeded

Endangerment through noise

Be aware that during plasma cutting a high noise level arises.

Cutting current	Thickness	Noise level in distance of	
		0,5 m	1,0 m
No load			56dB(A)
80A	4mm	82 dB(A)	79 dB(A)
160A	l6mm	86 dB(A)	83 dB(A)
240A	l6mm	96 dB(A)	92 dB(A)

Above levels are general. Variations may occur.

Therefore wear proper ear protection.

Endangerment through spatter

During plasma cutting sparks, slag and hot metal are produced. The risk of burns and fire exists! To avoid these endangerments the following has to be advised:

- remove all potential flammable materials from cutting area, at least in a 10 m distance
- cool down freshly cut material before handling
- make fire extinguisher available in the cutting area

Handling of pressure cylinders

In some cases compressed gases are required for the plasma cutting process. To avoid endangerments the following has to advised:

- Place cylinders upright in secured position
- Never use damaged cylinders, pressure reducers and armatures
- Use pressure reducers only for the gas it is determined

- Never lubricate pressure reducers with grease or oil
- All parts coming in contact with oxygen must be free from oil and grease
- When using oxygen and/or flammable gases the pressure reducer has to be equipped with an explosive-proofed device (backfire-device)
- Regularly check the gas hoses and other equipment for leaks etc.
- Always follow regulation regarding gas equipment

Handling of coolant

In all liquid cooled machines produced by SPT a coolant normally consisting of 30% mono-ethylene glycol (99,9 %) and 70 % de-ionized water is used.

When handling the coolant the following must be observed:

- Never drink coolant
- Store coolant away from food and drink
- Avoid all contact with the skin and eyes
- Always wash your hands after handling coolant
- Never wear clothing that is contaminated with coolant

First aid measures:

- **After breathing fumes:** Fresh air and rest
- **After skin contact:** Remove contaminated clothing and rinse with water
- **After eye contact:** Rinse with water. Consult a doctor if problems arise
- **After swallowing:** If it is more than an insignificant amount medical treatment is necessary. If it takes more than 30 minutes to receive treatment, and the patient is fully conscious, try to induce vomiting. The patient should drink water before vomiting.

Upon request, a product information sheet for the coolant is available from SPT. Call +46 46 18 48 00.

8. WARRANTY

SPT Plasmateknik AB grants a warranty for its products. The warranty covers damage caused by faulty raw material or production errors. A faulty part will be replaced by a new one, or, if possible, we will repair the faulty part without cost.

The warranty period is 1 year provided the machine is used under normal conditions (one shift working).

The warranty does not cover damage caused by improper or careless handling, overload, irresponsible maintenance or natural wear.

Any use of non-original parts or consumables renders the warranty void.

Travel costs in connection with warranty repairs or freight costs is not included in the warranty.

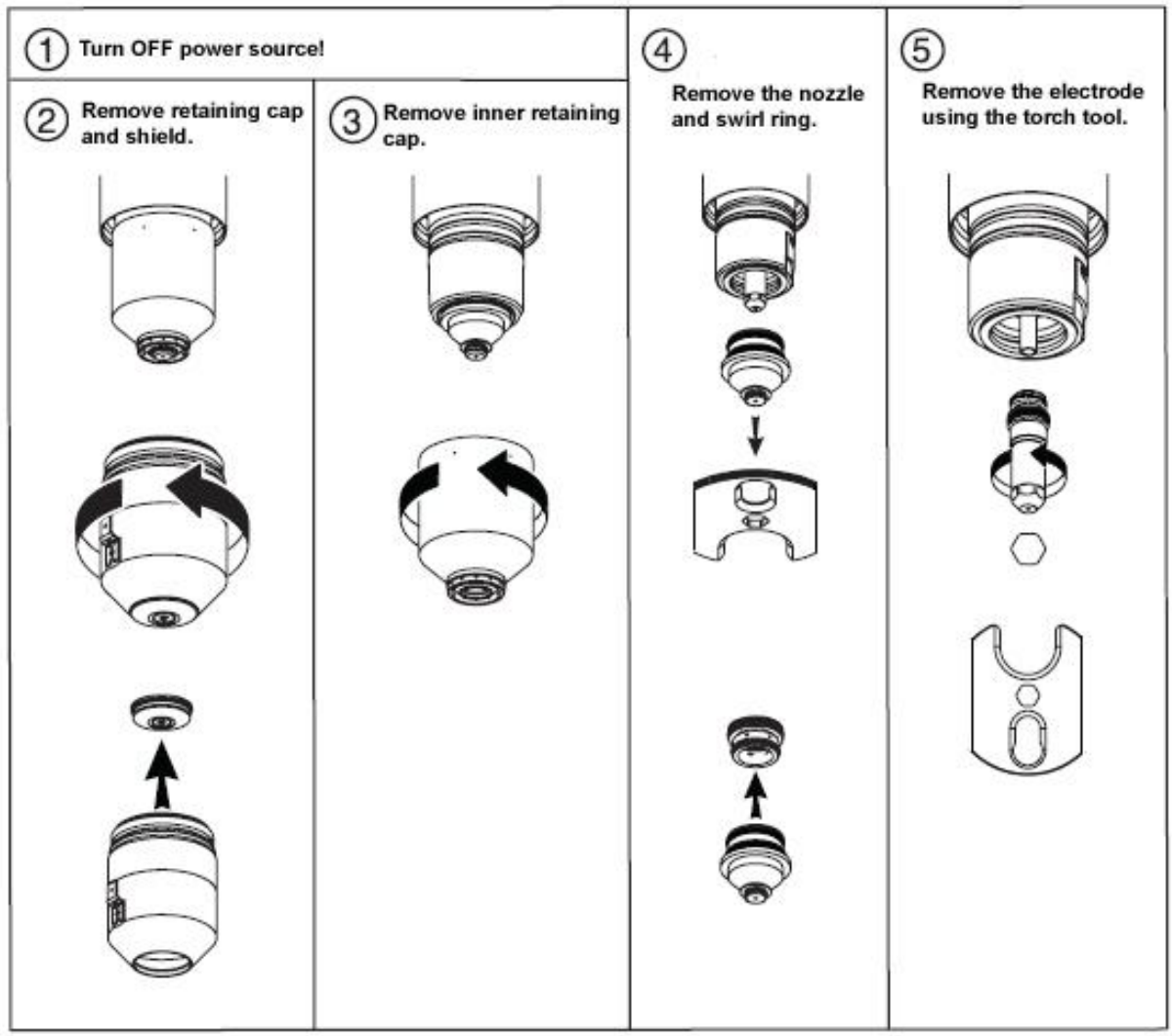
Warranty repairs may only be performed by SPT Plasmateknik AB or a representative assigned by SPT.

9. TORCH

Changing consumables

Shut off the plasma system before disconnecting the torch head.
Remove the torch head by turning the locking nut counter clockwise. Carefully pull off the torch head.
Never exchange the consumables while the torch head is mounted. Do not use any other tools than the removal tool .

Consumable assembly

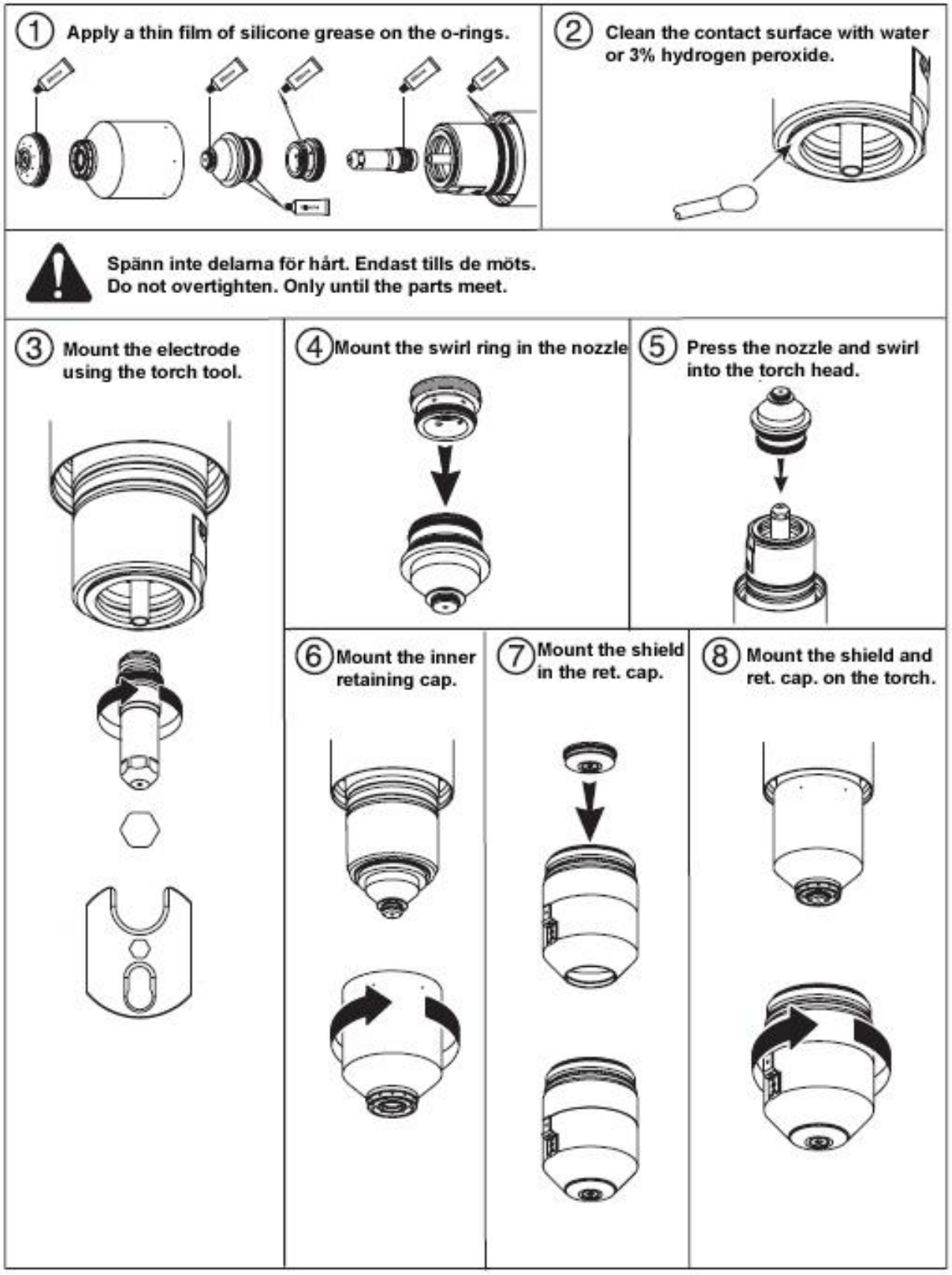


Consumable wear

It is mostly the nozzle and electrode that are worn during cutting. Exchange the swirl ring distributor if it is cracked, deformed or burned. Make sure that the holes in the distributors are unobstructed. Exchange nozzle/electrode if they are worn out or damaged.
If the nozzle orifice is oval, enlarged or damaged around the edges the nozzle should be exchanged. If the active insert in the electrode is worn down to a depth of more than 2 mm or the electrode is otherwise damaged, burned or deformed it should be exchanged.

Consumable assembly

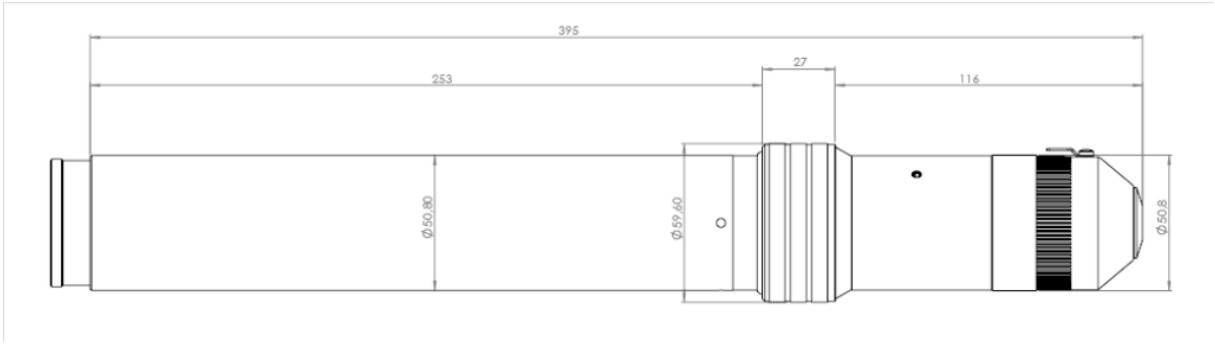
Check which consumables that are suitable according to the cutting charts in this manual. Assemble the parts as shown below.



Mount the head on the torch

TORCH DIMENSIONS

X-Cut 400



10. OPTIMISING THE CUTTING

Piercing

Piercing is the most sensitive operation in the plasma cutting technology. It demands very accurate process control from the robot or CNC-system as well as the operator. The piercing procedure must programmed in such a manner that no molten material or slag is allowed to blow back onto the torch. Also upon cut start/end the cutting must be so programmed that the torch does not touch any slag that may be present at the piercing location.

How to get a better result

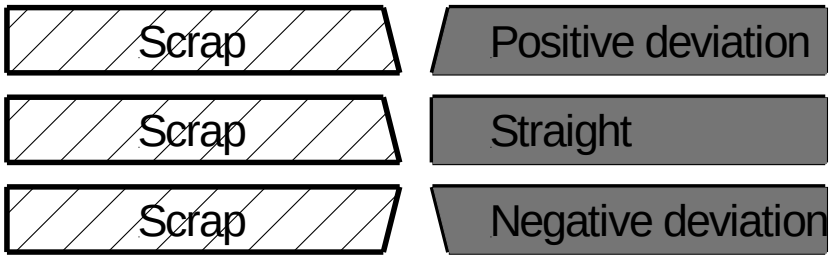
To obtain the best possible result the system must be properly installed and adjusted. The cutting quality is mainly determined by the angle deviation, slag adherence and the cut surface.

Angle deviation

The angle deviation is either negative or positive. A positive angle deviation arises as a result of more material being removed at the top of the cut than the bottom. A negative deviation is a result of the reversed situation. Problems with angle deviation is either that the cut has too much angle, or that the angle deviation is inconsequent, i.e. positive on one side, negative on the other.

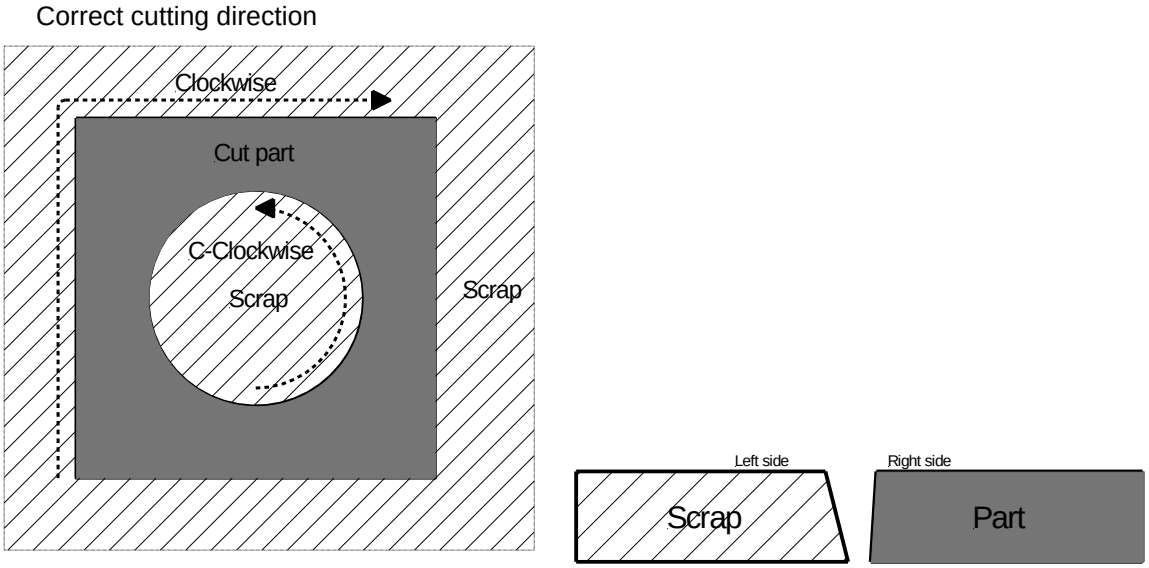
Too much angle deviation

- Wrong distance between torch and work piece. Adjust the distance
  Too much distance > positive angle deviation (decrease the arc voltage)
  Too little distance > negative angle deviation (increase the arc voltage)



- Worn or damaged consumables. Check and exchange.

- Wrong cutting direction. The plasma is rotating and as a result there is more angle on one side than the other. Make sure that the machine is properly programmed so that the bigger angle is on the scrap side of the cut.



- Too high cutting speed. By cutting slower the angle can be straightened.

- Too high amperage for the material thickness. Choose different cutting parameters.

Inconsequent angle deviation

- Worn or damaged consumables. Check and exchange worn or damaged parts.

- The torch is not perpendicular in relation to the work piece. Check the torch alignment and adjust if necessary.

- Magnetic remanence in the material. Materials that are handled with magnetic lifting devices can become magnetic. The plasma arc may be attracted or repelled by the magnetism. Make sure that the material is not magnetic.

Slag adherence

Slag free cuts requires that all the parameters for the cutting process are optimized.

Slag adherence as a result of too low cutting speed.

- This slag arises when the cutting speed is too low. The slag is excessive and porous. It can however easily be removed. By increasing the cutting speed the slag can be minimized.

Slag adherence as a result of too high cutting speed.

- This slag arises when the cutting speed is too high. The slag looks like drops of molten metal and is difficult to remove. By lowering the cutting speed the slag can be minimized. If that does not remove the slag it may help to lower the torch distance to the work piece.

Sporadic slag adherence

- Worn or damaged consumables. Check the and replace if necessary.

- This type of slag can depend on the material that is being cut. It is not possible to cut without slag adherence in all materials.

- The slag can arise as a result of the material temperature. As the cutting in the work piece proceeds the temperature rises and the slag adherence also increases.

The cut surface

The surface can be either convex or concave. A proper adjustment of the speed and distance can help in getting a straighter cut.

Concave surface

- Too little distance between torch and work piece. By raising the torch the surface becomes straighter.

Convex surface

- Too much distance between torch and work piece or too high current. First try to straighten the cut by lowering the torch. If this does not help, try to lower the cutting current. Some combinations of material and cutting gas can result in convex cuts.

Optimizing the consumable life time

The liquid cooled torch and its patented parts guarantee the longest possible life time and optimum cutting economy. However, to optimize the life time the following instructions must be followed.

Optimizing the electrode life time

- When piercing the torch must not be too close to the work piece.

- Program the cutting sequence so that the plasma arc goes out while it still has contact with the work piece. If the end of the cut is outside the plate or in a hole the electrode life time is dramatically reduced.

- The electrode life time can be prolonged if the cutting is programmed so that several details are cut in one sequence without restarting the arc, and thereby reducing the number of starts.

- Always flush the gas system when changing gas.

Optimizing the nozzle/shield life time

- When piercing the torch must not be too close to the work piece. The piercing distance must be minimum double the cutting distance to avoid molten material spattering back onto the torch. Refer to the cutting charts.

- A torch height distance control must be in operation so that the distance between torch and work piece is kept constant.

11. CUTTING DATA

In this chapter are cutting data charts. These data are approximate and should only be used as a guide. Many factors have influence on the cutting result, such as plate size, hose assembly length, material temperature, ambient temperature and so on. It is the responsibility of the operator to gain such knowledge about the plasma cutting process that he can make such adjustments to achieve the best possible result and economy.

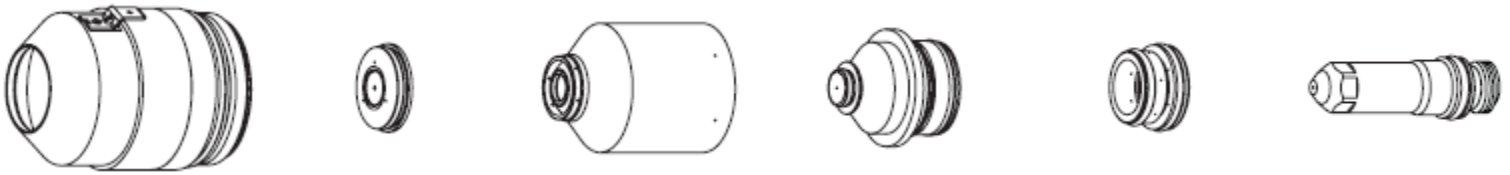
In the charts the distance is given in mm and the voltage in V. The voltage can depend on many different factors. Therefore the actual distance in mm has priority over the voltage.

When changing process gas the built in gas purging cycle may not be long enough to fully flush all remaining gas from the system. It is advised to flush the system for 10-15 s extra by means of the gas test switches.

To keep high and even quality and to maintain consumable life time it is important to properly take care of the torch.
Oil and grease on the consumables when cutting with oxygen dramatically shortens the life time and can even lead to destruction of the torch. Therefore torch heads and consumables must be properly stored and handled so that they are not subjected to dirt, oil etc.
O-rings on the torch head must be changed as soon as they show signs of wear or damage. They should be lubricated according to the recommendations in this manual. It is however forbidden to lubricate the o-rings on the consumables.

Consumables should be changed when the cutting quality is no longer acceptable.

Mild steel 30A O^2/O^2

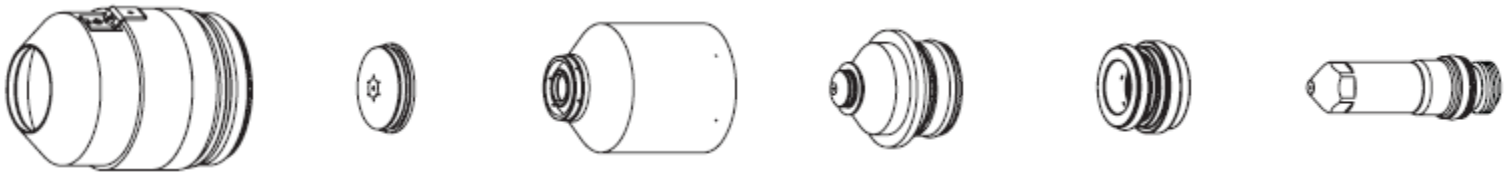


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	810489	819962	810503	819939	810512

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
0.5	30	2.3	2.3	1.3	114	0.1	5355	52	15	67	15	1.1
0.8		2.3	2.3	1.3	115	0.2	4225					1.24
1		2.3	2.3	1.3	116	0.3	3615					1.3
1.5		2.3	2.3	1.3	119	0.3	2210					1.35
2		2.7	2.7	1.5	120	0.4	1490					1.45
2.5		2.7	2.7	1.5	122	0.4	1325		35		5	1.47
3		2.7	2.7	1.5	123	0.5	1160					1.47

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.
When cutting with oxygen O2 in mild steel and the cut surface is uneven, this indicates that the cutting height is too low. Raise the torch (arc voltage) a little.

Mild steel 50A O^2/ O^2

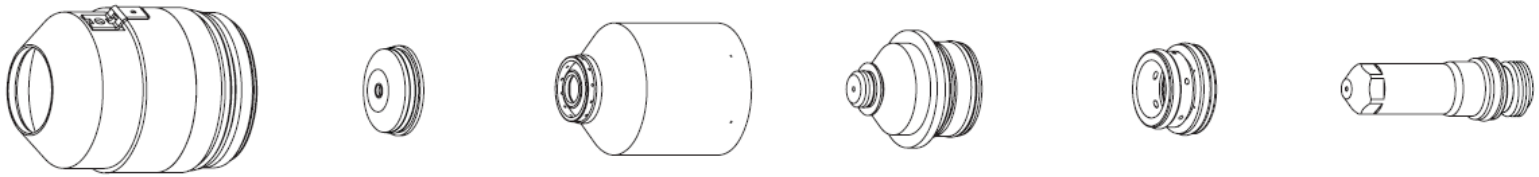


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	810490	819962	810504	810305	810513

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
0.8	50	2.0	2.0	1.0	110	0	6500	70	30	75	15	1.4
1		2.0	2.0	1.0	111	0	5000					1.4
1.5		2.6	2.6	1.3	114	0	3200					1.5
2		2.6	2.6	1.3	115	0	2700					1.6
2.5		2.6	2.6	1.3	117	0.1	2200					1.7
3		3.0	3.0	1.5	119	0.2	1800					1.75
4		3.0	3.0	1.5	121	0.3	1400					1.8
5		3.0	3.0	1.5	122	0.4	1200					1.8
6		4.0	4.0	2.0	126	0.5	950					1.85
8		4.0	4.0	2.0	130	0.5	630					1.9

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Mild steel 80A O^2/Air

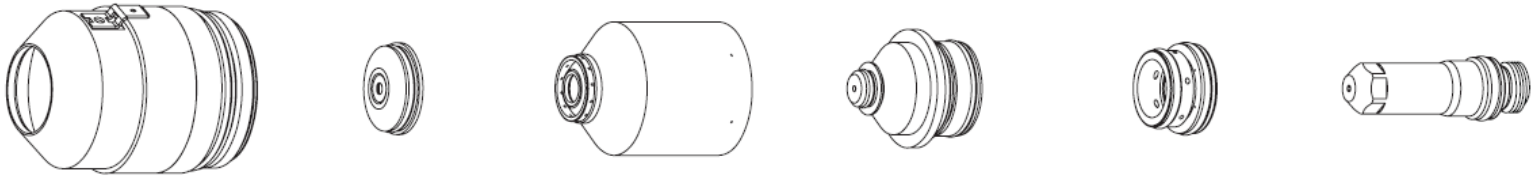


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819838	819963	810505	819938	810514

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
2	80	3.8	3.8	2.5	112	0.1	9810	42	30	65	30	1
2.5		3.8	3.8	2.5	115	0.1	7980					1.05
3		3.8	3.8	2.5	117	0.2	6145					1.2
4		4.0	4.0	2.0	120	0.2	4300					1.4
5		4.0	4.0	2.0	122	0.3	3660					1.6
6		4.0	4.0	2.0	123	0.3	3045					1.65
8		4.0	4.0	2.0	125	0.4	2520					1.8
10		5.0	5.0	2.0	127	0.5	1810					1.9
12		5.0	5.0	2.0	130	0.7	1410					2.0
15		5.0	5.0	2.0	133	0.8	1030				15	2.1
20		6.3	6.3	2.5	135	0.9	545					2.7

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Mild steel 130A O^2/Air



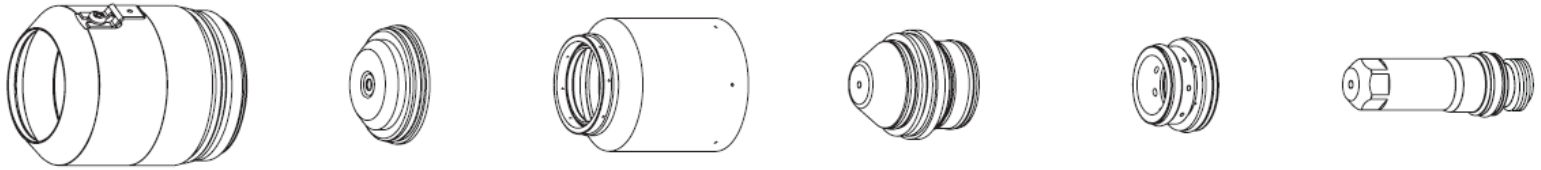
Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819839	819963	810506	819938	810515

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow Plasma	Preflow Shield	Cutting Plasma	Cutting Shield	Kerf width
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
3	130	5.0	5.0	2.5	124	0.1	6505	27	40	70	35	1.65
4		5.6	5.6	2.8	126	0.2	5550					1.73
5		5.6	5.6	2.8	127	0.3	4970					1.75
6		5.6	5.6	2.8	127	0.3	4035					1.8
8		6.0	6.0	3.0	129	0.3	3150				28	2.0
10		6.0	6.0	3.0	130	0.3	2680					2.1
12		6.6	6.6	3.3	132	0.5	2200					2.2
15		7.6	7.6	3.8	135	0.7	1665					2.65
20		7.6	7.6	3.8	138	1.0	1050		65			2.8
25		7.6	7.6	4.0	141	1.8	550					3.4
30*		4.5	NR	4.5	158	NR	375					4.1

*Edge start recommended

Cutting parameters may vary depending on material and the shape of the detail.

Mild steel 200A O^2/Air

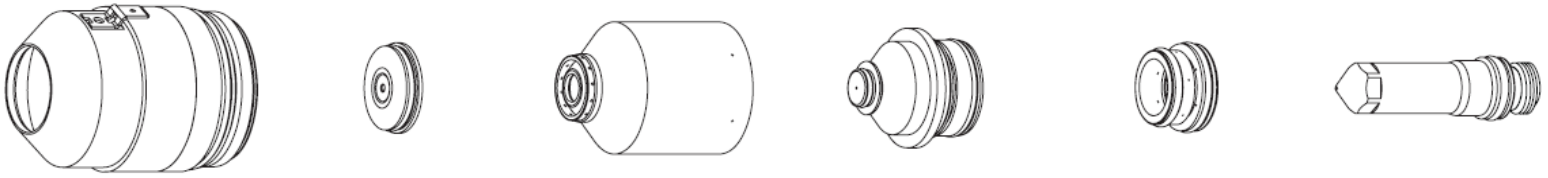


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819964	819965	819966	810507	819968	810516

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
6	200	6.6	6.6	3.3	124	0.2	5250	19	49	59	20	2.18
8		6.6	6.6	3.3	125	0.3	4780					2.2
10		6.6	6.6	3.3	126	0.3	3460					2.2
12		6.6	6.6	3.3	128	0.5	3060					2.25
15		8.2	8.2	4.1	131	0.6	2275					2.6
20		8.2	8.2	4.1	133	0.8	1575					2.95
25		10.2	10.2	5.1	143	1.0	1165					3.1
30		10.2	10.2	5.1	144	1.3	750					4.2
40*		5.1	NR	5.1	154	NR	480					4.9
50*		5.1	NR	5.1	163	NR	255					5.5

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 45A N^2/ N^2

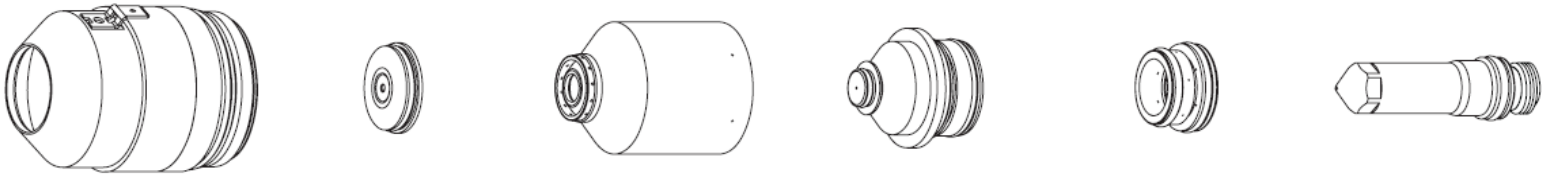


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819975	819976	810508	819939	810517

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
0.8	45	3.8	3.8	2.5	94	0.0	6380	35	5	55	60	0.55
1		3.8	3.8	2.5	94	0.1	5880					0.55
1.5		3.8	3.8	2.5	95	0.2	4630					0.5
2		3.8	3.8	2.5	97	0.2	3935					0.45
2.5		3.8	3.8	2.5	101	0.2	3270					0.4
3		3.8	3.8	2.5	103	0.3	2550					0.3
4		3.8	3.8	2.5	103	0.3	1580					0.25

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 45A F5/ N^2

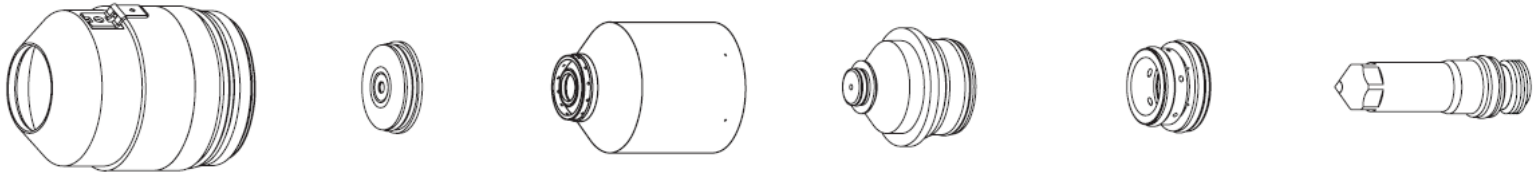


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819975	819976	810508	819939	810517

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
0.8	45	3.8	3.8	2.5	99	0.2	6570	35	25	55	60	0.55
1		3.8	3.8	2.5	99	0.2	5740					0.55
1.5		3.8	3.8	2.5	99	0.2	3890					0.6
2		3.8	3.8	2.5	101	0.2	3175					0.55
2.5		3.8	3.8	2.5	102	0.2	2510					0.5
3		3.8	3.8	2.5	103	0.3	2010					0.45
4		3.8	3.8	2.5	104	0.3	1435					0.49
6		3.8	3.8	2.0	110	0.5	845				15	0.55

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 80A F5/ N^2

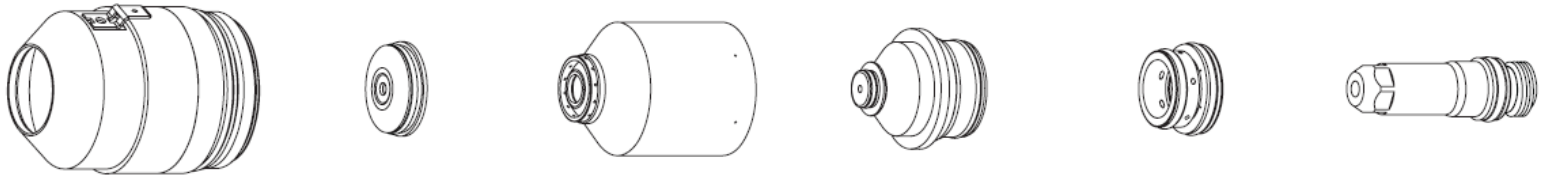


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819979	819976	810509	819938	810519

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
4	80	4.5	4.5	3.0	108	0.2	2180	35	30	60	45	0.9
6		3.8	3.8	2.5	112	0.3	1225					1.15
10		4.5	4.5	3.0	120	0.5	560					1

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 130A N^2/ N^2

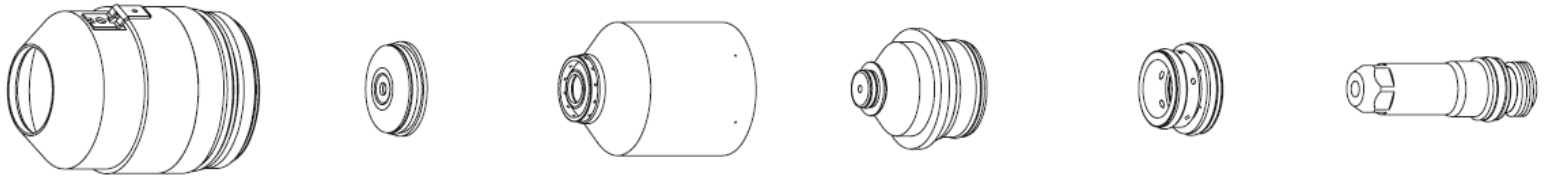


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819982	819963	810510	819938	810518

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
6	130	6.0	6.0	3.0	153	0.3	1960	20	65	70	30	1.8
10		6.0	6.0	3.0	156	0.5	1300					1.95
12		7.0	7.0	3.5	162	0.8	900					2.3
15		3.8	NR	3.8	167	NR	670					2.5
20		4.3	NR	4.3	176	NR	305					3

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 130A H35/ N^2

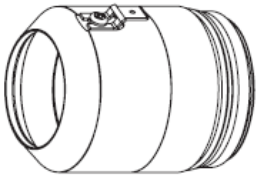


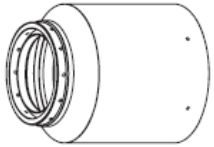
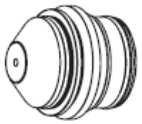
Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819982	819976	810510	819938	810518

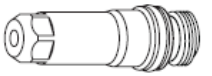
Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	130	7.7	7.7	4.5	154	0.3	980	20	40	70	60	2.7
12					158	0.5	820				45	2.75
15					162	0.8	580				30	3
20					165	1.3	360					3
25*		4.5	NR		172	NR	260				20	3.2

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 200A N^2/ N^2



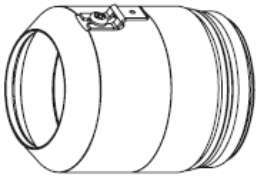


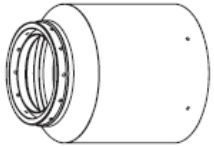
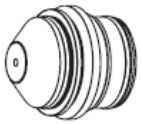
Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819964	810493	819986	810511	819988	810518

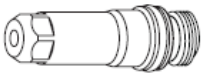
Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	200	7.6	3.8	3.8	160	0.5	2700	21	65	82	65	2.2
12					161	0.6	2400					2.3
15					163	0.8	1800					2.5
20					167	1.0	1000					2.9
25		3.8			171	NR	750					3.2

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Stainless steel 200A H35/ N^2



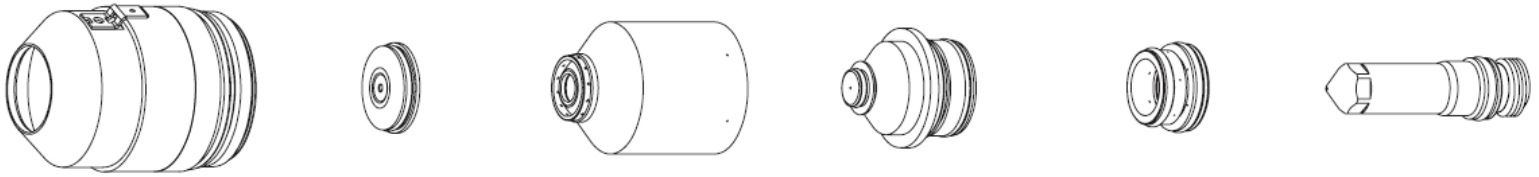


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819964	810493	819986	810511	819988	810518

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	200	9.0	9.0	9.0	175	0.5	1620	21	65	82	75	3.7
12		7.5	7.5	7.5	170	0.6	1450					3.8
15					176	0.7	1200					3.9
20					177	0.8	820					4.0
25					179	NR	550					4.5

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Aluminium 45A Air/Air

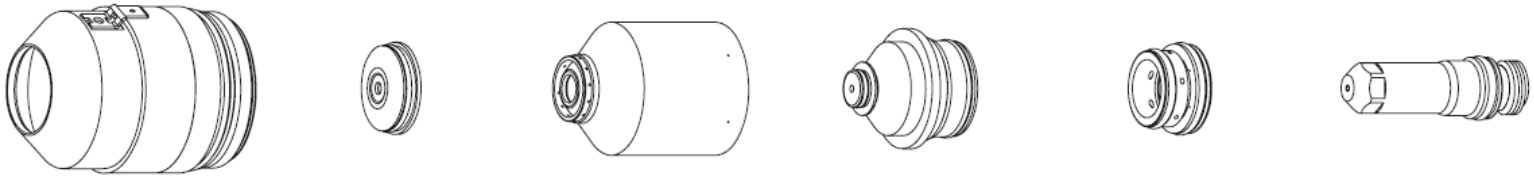


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819975	819963	810508	819939	810517

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
1.2	45	3.8	3.8	2.5	130	0.2	4750	35	25	65	60	1.2
1.5					115		4160					1.1
2.0					113		3865					1.2
2.5					110		3675					1.15
3					107		2850					1
4		2.7	2.7	1.8	102	0.3	2660				40	1.25
6		4.5	4.5	3.0	117	0.6	1695					1.25

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Aluminium 130A Air/Air



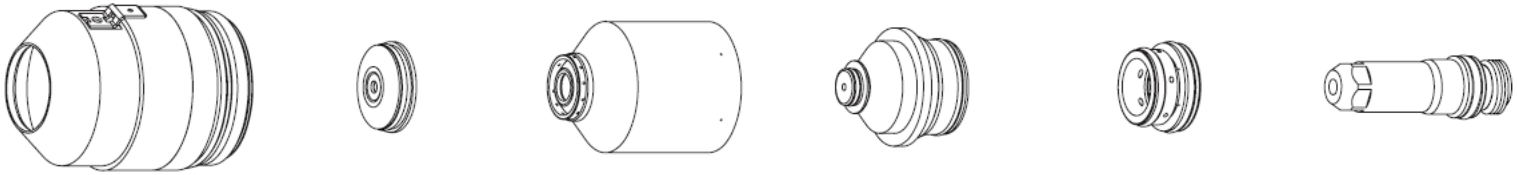
Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819982	819963	810510	819938	810506

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
6	130	5.6	5.6	2.8	153	0.2	2370	20	40	70	30	2.1
10		6.0	6.0	3.0	154	0.3	1465					2.1
12		6.0	6.0	3.0	156	0.5	1225					2.15
15		6.6	6.6	3.3	158	0.8	1050					2
20		7.0	7.0	3.5	162	1.3	725					1.9
25*		4.0	NR	4.0	172	NR	525					2,25

*Edge start recommended

Cutting parameters may vary depending on material and the shape of the detail.

Aluminium 130A H35/N2

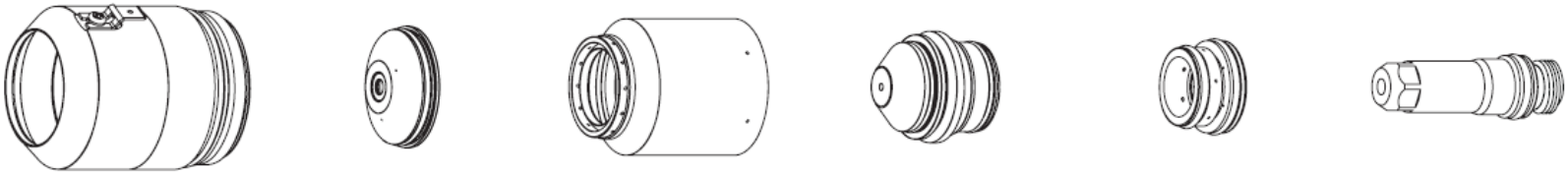


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819961	819982	819976	810510	819938	810518

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	130	6.5	6.5	5.0	158	0.3	1615	20	40	70	60	2
12		7.7	7.7	4.5	156	0.5	1455				45	2.7
15					156	0.8	1305				30	2.75
20					157	1.3	940					2
25*		4.5	NR		176	NR	540				20	2.9

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Aluminium 200A N2/N2

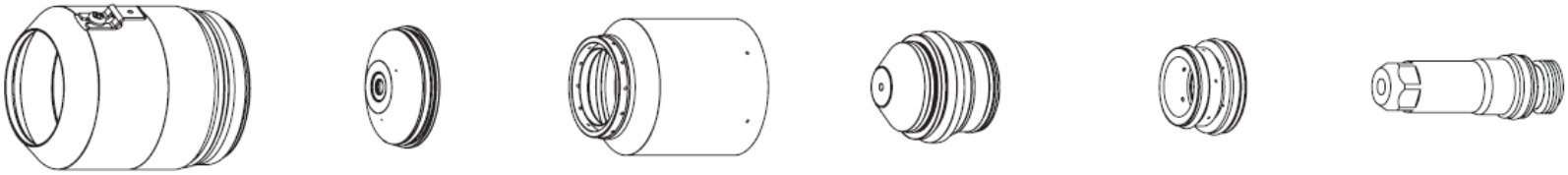


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819964	810493	819986	810511	819988	810518

Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	200	9.0	9.0	6.4	158	0.5	4750	21	65	70	65	2.2
12					158	0.6	3500					2.3
15					166	0.7	2350					2.5
20					165	0.8	1000					2.9
25		6.4	6.4		169	NR	750					3.3

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

Aluminium 200A H35/N2

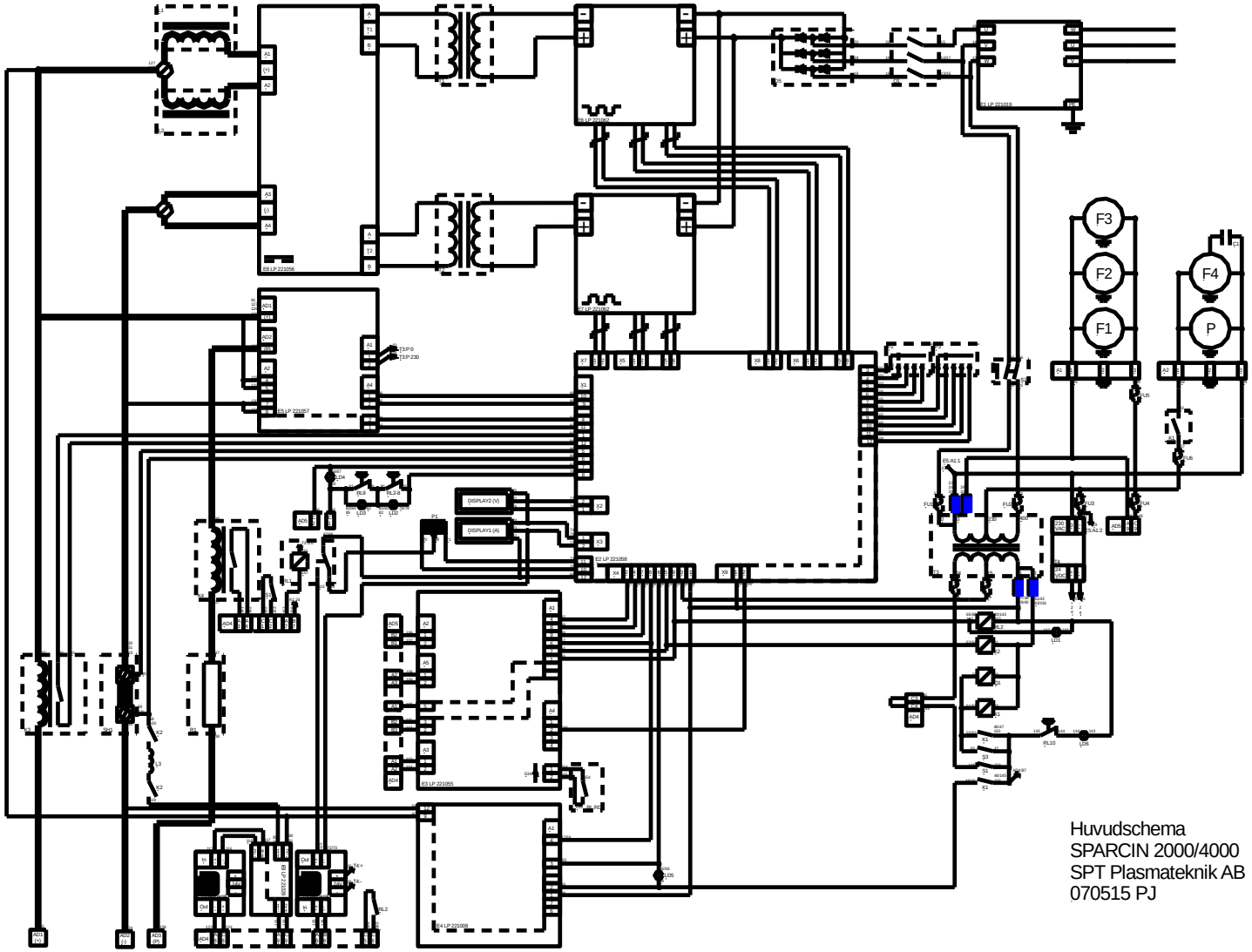


Consumables:					
Retaining cap	Shield	Inner ret. cap	Nozzle	Swirl ring	Electrode
819964	810493	819992	810546	819988	810518

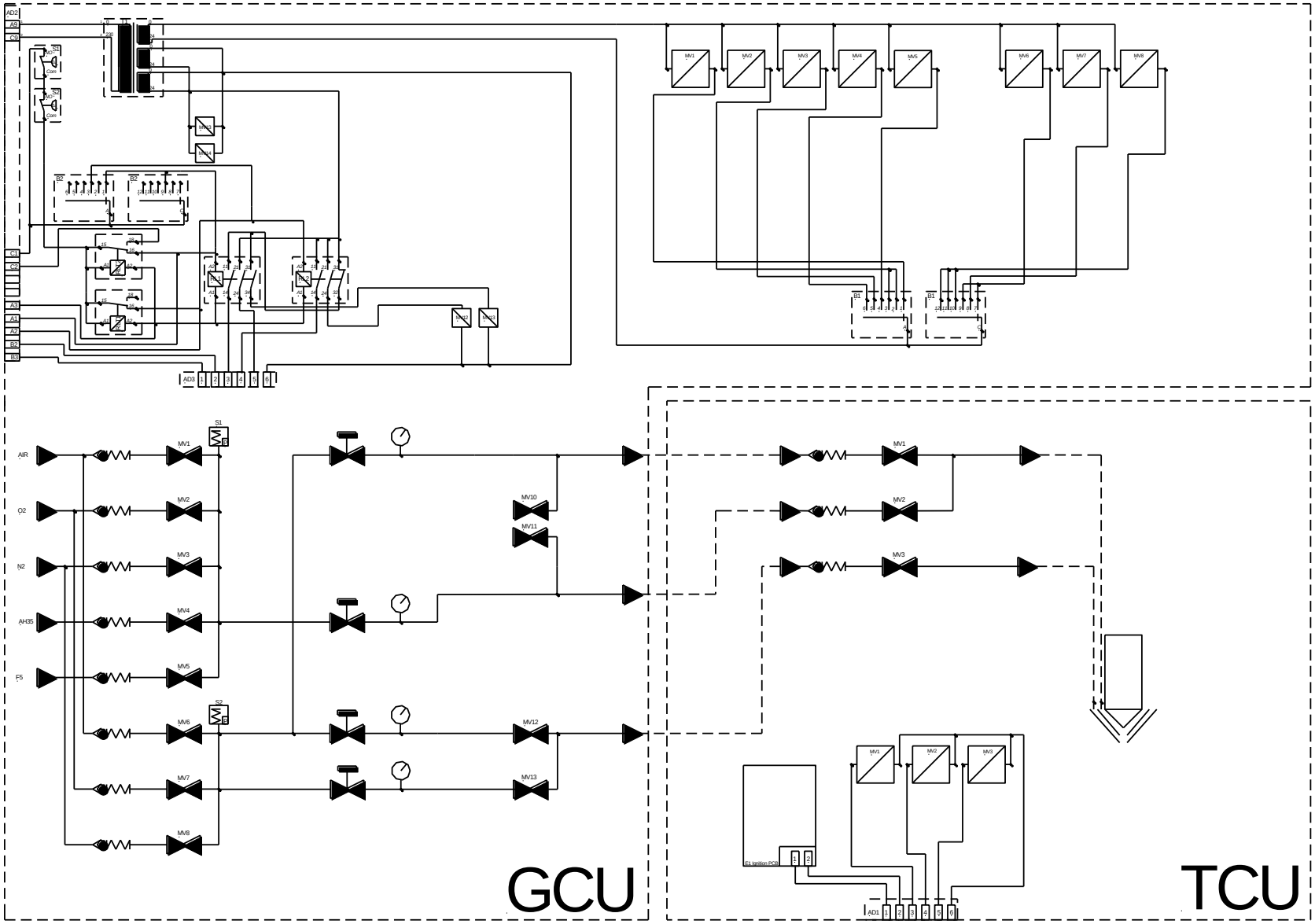
Material thickness	Current	Ignition height	Piercing height	Cutting height	Arc voltage	Pierce delay	Cutting Speed	Preflow		Cutting		Kerf width
								Plasma	Shield	Plasma	Shield	
mm	A	mm	mm	mm	volts	s	mm/min	P	P	P	P	mm
10	200	9.0	9.0	6.4	152	0.3	4400	21	65	70	65	2.7
12					150	0.4	3800					2.9
15					150	0.5	3000					3.1
20					159	0.6	1450					3.3
25		6.4	6.4		164	NR	980					3.6

*Edge start recommended
Cutting parameters may vary depending on material and the shape of the detail.

12. DIAGRAMS



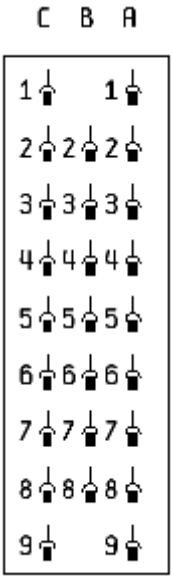
Huvudschema
SPARCIN 2000/4000
SPT Plasmateknik AB
070515 PJ

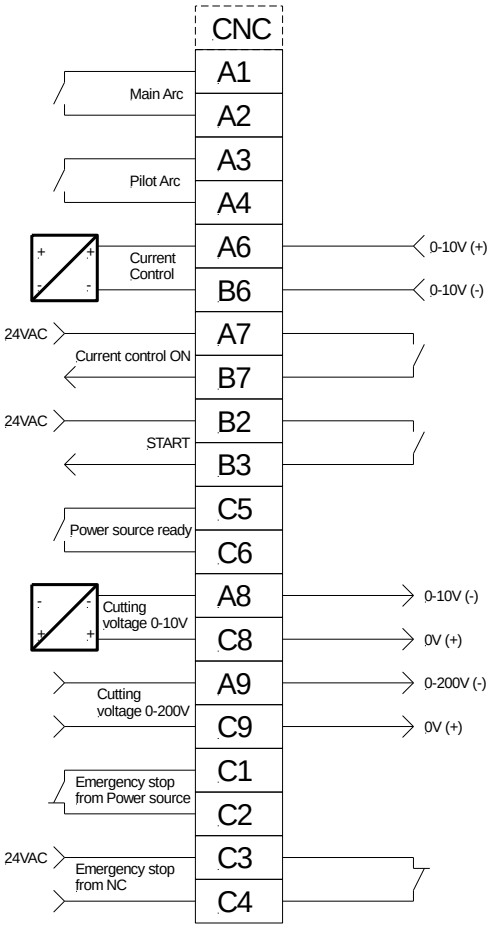

AD2
A3
C2
MV1
MV2
MV3
MV4
MV5
MV6
MV7
MV8
AD3
AIR
O2
N2
AH35
F5
S1
S2
MV10
MV11
MV12
MV13
GCU
TCU
AD1

CNC INTERFACE		
INPUT SIGNALS		
PIN	**Signal**	**Remarks**
B2-B3	START	Pot.free closing (NO) contact
A6	0-10V….10V=200A*	Current control (+) *
B6	GND*	Current control (-) *
C3-C4	Emergency stop from CNC	Pot.free opening (NC) contact
A7-B7	Emergency stop from CNC active	Pot.fre closing (NO) contact

OUTPUT SIGNALS		
A3-A4	Pilot arc on	Pot.free closing (NO) contact
A1-A2	Main arc on	Pot.free closing (NO) contact
C1-C2	Emergency stop from plasma	Pot.free opening (NC) contact
A8	Electrode pot. (…-10VDC)*	Cutting arc voltage 0-10V *
C8	Work piece potential (0V)*	Divided voltage 10V=200V*
A9	Electrode pot. (…-200VDC)	Cutting arc voltage 0-200V
C9	Work piece potential (0V)	Direct voltage
C5-C6	Plasma ready	Pot.free closing (NO) contact

* Galvanically isolated in power source





14. PARTS LISTS

According to wiring diagrams.

Power source:

Component	Denomination	Part No.
E1	EMC-Filter	221019
E2	PWM-PCB	221058
E3	Autmatics control PCB	221055
E4	Under voltage guard	221008
E5	Pilot PCB	221057
E6	Primary switching PCB	221062
E7	Primary switching PCB	221062
E8	Secondary PCB	221056
E9	Voltage divider	221028
E10	Galvanic separator	143012
E11	Galvanic separator	143012
T1-2	Main transformer	234021
T3	Control transformer	235016
T4	Power supply. 230VAC-24VDC	233004
L1-2	Coil	232009
L3	Coil	232008
R1	Resistor 3R9 300W	124002
SH1	Shunt 200A 200mv	156005
Q1	Main contactor	144007
K1	Mini contactor	144006
K2	Mini contactor	144006
S1	Emergency stop	141018
	Contact block NC S1	141023
S2	Key switch	141019
	Contact block NO S2	141021
S3	Green light pushbutton	141020
	Contact block NO S3	141021
S4	Turn switch	141022
S5	Turn switch	141022
Disp.1-2	Display 0-200	191051
P1	Potentiometer 10K	127007
LD1	Lamp holder 24VAC	143016
LD2-6	LED red	150004
RL1	Relay 2-pol 24VAC	143009
RL2	Relay 2-pol 24VAC	143009
RL3	Current coil (main arc)	152016
	Reed relay	143018
RL4-10	Thermal switch	152006
RL11	Pressure switch	152002
RL12	Current coil (pilot)	143013
RL13	Level switch	152015
F1-3	Ventilator Ø150	154001
F4	Ventilator Ø300	154005
P	Pump compl.	262028

FU1,2,6,7	Fuse 2A	151004
FU3,4,5	Fuse 1A	151014
FU8	Fuse 4A	151018

GCU:

Component	Denomination	Part No.
T1	Control transformer	235012
RLT1-2	Timer relay 24VAC	146002
RL1-2	Relay 3pol. 24VAC	143014
S1,2	Pressure switch	152011
B1-2	Turning switch 2pol 6-positions	141022
MV1-8,12,13	Solenoid valve 2/2 1/8”	152003
MV10,11	Solenoid valve 3/2 1/8”	152004

TCU:

Component	Denomination	Part No.
E1	Ignition PCB	221054
T1	Ignition transformer	236005
MV1-3	Solenoid valve 2/2 1/8”	152003