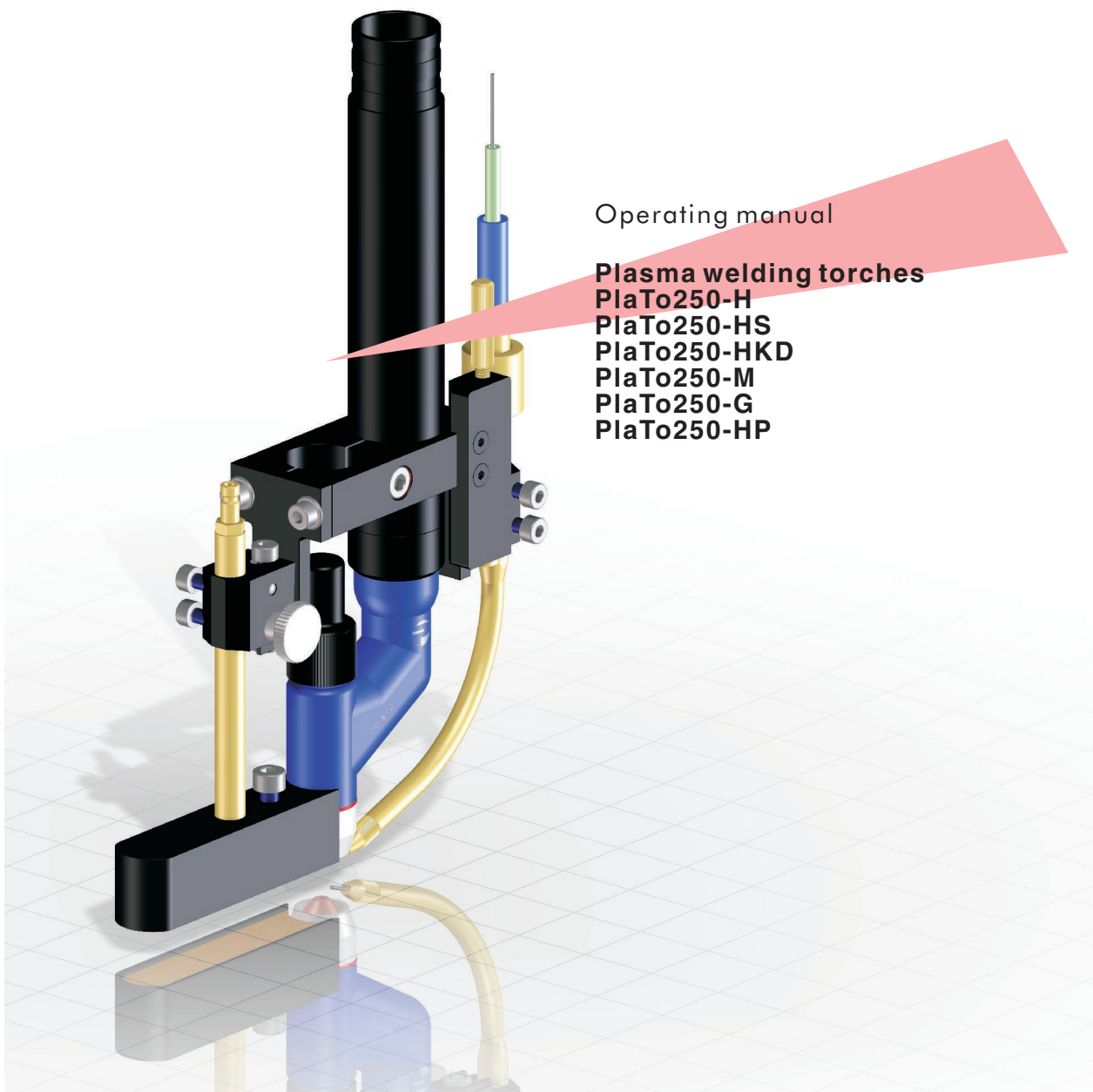




Operating manual

Plasma welding torches

PlaTo250-H
PlaTo250-HS
PlaTo250-HKD
PlaTo250-M
PlaTo250-G
PlaTo250-HP

PlaTo250-M with accessories

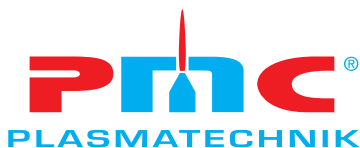
Plasma hand welding torch	PlaTo250-H	cpl. with 4m hose package	Article No. PWI.01445
Plasma hand welding torch	PlaTo250-HS	cpl. with 4m hose package	PWI.01446
Plasma hand welding torch	PlaTo250-HKD	cpl. with 4m hose package	PWI.01447
Plasma machine welding torch	PlaTo250-M	cpl. with 4m hose package	PWI.01448
Plasma machine welding torch	PlaTo250-G	cpl. with 4m hose package	PWI.01449
Plasma spot welding torch	PlaTo250-HP	cpl. with 4m hose package	PWI.01450

Sach-Nr. PWI.01488 • 1104

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1. Edition

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Products with certified quality

You made a good decision when you purchased this top-quality product. This torch has been manufactured with the greatest care and attention, continuously monitored by in-process quality controls. Each system is individually tested to make sure it functions properly both before and after assembly. Exceptionally high quality is assured by continual testing, as well as using carefully selected materials and high-quality custom-built machinery.



Now and then, even a top-quality product, such as this will require a spare part. In this event, you can be sure to receive the right, genuine **PMC - Original parts** - swiftly and reliably, and thus preserve the value of your investment.

1. Torch

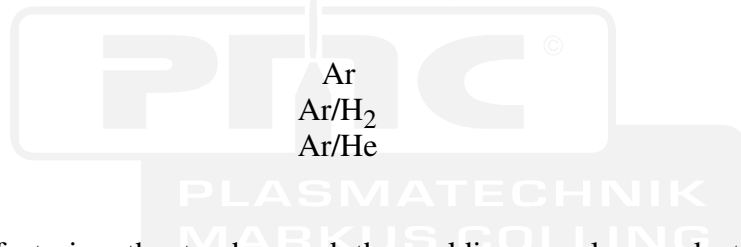
1. Torch

By means of systematic miniaturization of the individual components and using of a special two-circuit cooling system the PlaTo250 series provide the best power rate at smallest torch dimensions. Because of the wide-ranging accessories these plasma welding torches are suitable for all standard applications as well as for the most of specialized applications.

The following variants are available: (see also page 4)

PlaTo250-H:	Hand welding torch with round handle
PlaTo250-HS:	Hand welding torch with ergonomic handle and switch
PlaTo250-HKD:	Hand welding torch with integrated cold wire supply
PlaTo250-M:	Machine welding torch with 30mm offset
PlaTo250-G:	Machine welding torch without offset (Gooseneck-type)

The torches are designed for plasma welding with the following plasma gas combinations:



When manufacturing the torches and the welding nozzles production tolerances are tightly monitored. This is required to assure that the quality of the nozzles remains the same and it is an essential feature for a mechanized plasma welding process.

1.1 EU Declaration of Conformity

Hereby declare the **PMC** - Plasmatechnik Markus Colling GmbH & Co. KG, Gewerbegebiet Wallfeld 2 in 66649 Oberthal, Germany,

that the plasma welding torches of the **PlaTo250**-series described in this operating manual comply in their design and construction with the basic safety and health requirements of

■ EC Low Voltage Directive 73/23/EEC

Any modifications and/or improper repairs not agreed with us will void this declaration.

■ Harmonized standard applied: DIN EN 60974-7

1. Torch

1.2 Use contrary to the designated use

PlaTo250 – plasma welding torches are determined for commercial or industrial plasma welding by trained specialist staff exclusively. All technical boundary conditions mentioned in this operating manual as well as all appropriate safety regulations must be observed and also to adhere. In individual cases (e.g. at particularly strong heat reflection) additional measures can be required to avoid torch damages or breakdowns. In principle, to recognize this and to take up the right corrective measures lies in the responsibility of the user.

The plasma torches may be operated only with original wear and tear parts of the torch manufacturer. The use of parts not released by us leads to the guarantee loss automatically!

For damages which have resulted from an improper handling, lacking cooling, overload, missing or faulty maintenance as well as for consumable parts no guarantee is given.

- ☞ **It is the responsibility of the competent head of department, master or safety engineer to make sure that the persons who have to work with the plasma welding unit read this information and have understood it before they work with it.**

1.3 Handling

Before using the manual torch for the first time, practise sweeping the torch over the workpiece without ignition, in order to get used to handling it.

A correct handling is important so that an inadmissible contact of the nozzle with the workpiece can always be avoided during the welding process. Otherwise the nozzle as well as the complete plasma torch can be damaged early.

1. Torch

1.4 Technical Data:

<u>Weldable material thickness</u>	:	0.05 - 6 mm (if copper approx. 50% less)
<u>Max. current-carrying capacity</u>	:	250 A DC- at 100% duty cycle 175 A AC at 100% duty cycle (only in conjunction with a powerful recooling plant and suitable pump curve)
<u>Pilot arc current</u>	:	6-12 A
<u>Cooling system</u>	:	Dual-circuit cooling
<u>Cooling medium</u>	:	*G-Frost*
<u>1. Cooling circuit</u>	:	Intensive direct water cooling of the nozzle
<u>Coolant requirement</u>	:	2.5 lpm
Best entry pressure	:	6.0 bar
Min. allowed entry pressure	:	3.5 bar
Max. allowed entry pressure	:	10.0 bar
Min. allowed flow rate	:	1.5 lpm
<u>Coolant temperature</u>	:	
Best entry temperature	:	approx. 15 °C
Max. allowed entry temp.	:	approx. 25 °C
Max. allowed back temp.	:	approx. 40 °C
<u>2. Cooling circuit</u>	:	Intensive indirect water cooling of the electrode
<u>Coolant requirement</u>	:	2.0 lpm
Best entry pressure	:	4.0 bar
Min. allowed entry pressure	:	3.0 bar
Max. allowed entry pressure	:	10.0 bar
Min. allowed flow rate	:	1.5 lpm
<u>Coolant temperature</u>	:	
Best entry temperature	:	approx. 20 °C
Max. allowed entry temp.	:	approx. 35 °C
Max. allowed back temp.	:	approx. 40 °C

These data refer to negative pole welding. If positive pole welding the coolant demands for the second cooling circuit are the same as for first cooling circuit.

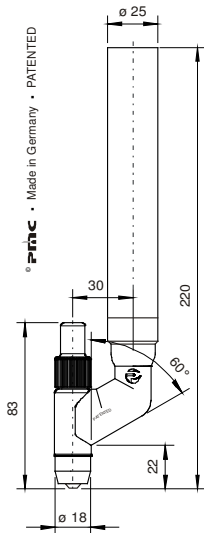
Weights:

Weight without hose package	:	approx. 200 g
Weight with 4m hose package	:	approx. 2000 g
Weight with 8m hose package	:	approx. 4300 g

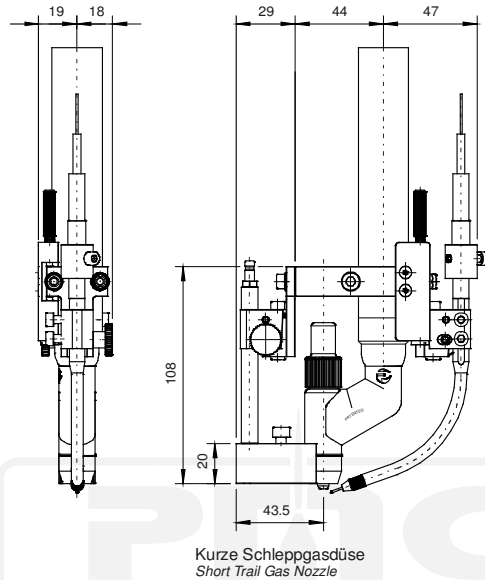
1. Torch

1.5 Torch dimensions:

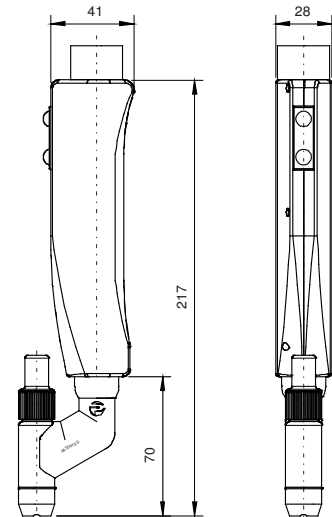
PlaTo250-M



PlaTo250-M mit Zubehör / with accessories



PlaTo250-HP



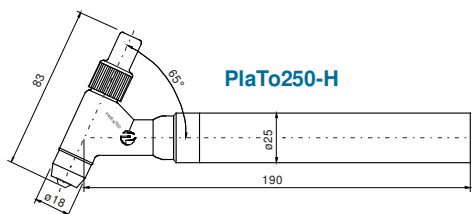
PLASMA-Punktschweißbrenner
PLASMA spot welding torch

PlaTo250-G

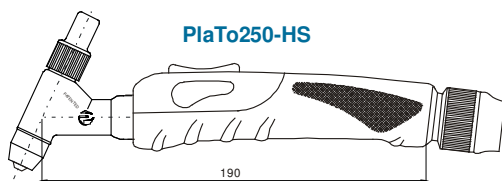
PlaTo250-G

mit Zubehör / with accessories

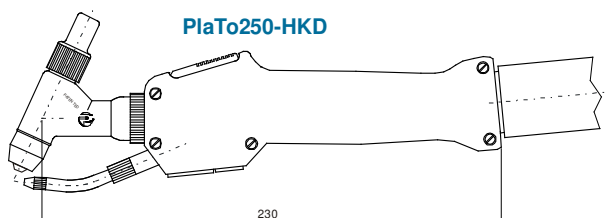
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MARK'S COLLING



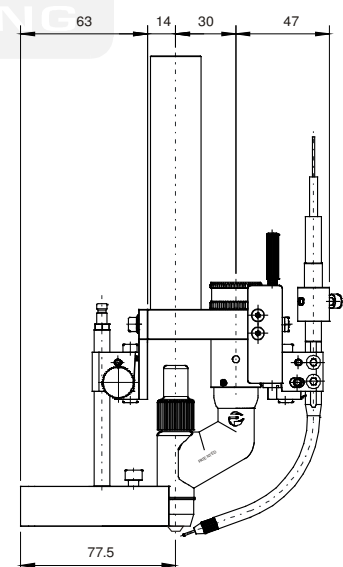
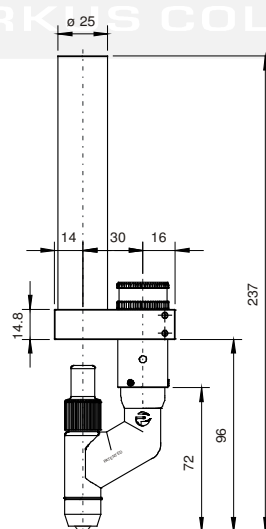
PlaTo250-H



PlaTo250-HS



PlaTo250-HKD



Lange Schleppgasdüse
Long Trail Gas Nozzle

2. Process

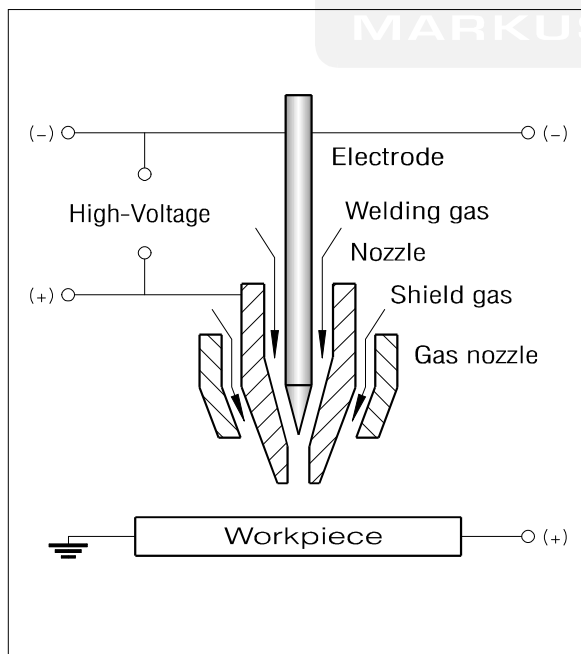
2. Process

"Plasma" is, physically speaking, a gas that conducts electricity and consists of a mixture of molecules, electrons and ions. Depending on which plasma gas is being used, temperatures of 20.000 to 50.000 K can be reached within the plasma jet.

The plasma welding torch PlaTo250 works on the principle of the transferred arc, i. e. the arc burns during the welding process between the electrode and the workpiece and is constricted by the nozzle. In this way, high quality connections can be made at great speed.

In order for the passage of air to become electrically conductive the pilot arc has to firstly be ignited. This happens when a high frequency is obtained between electrode and the nozzle. This causes the welding gas to become ionized and when it leaves the nozzle the space between the electrode and the workpiece becomes electrically conductive. When the ionized gas jet reaches the surface of the workpiece the main current circuit is closed, after which the main arc is formed between the electrode and the workpiece and the welding process starts.

Since the capacity of the high frequency impulse is not sufficient to ignite the pilot arc, part of the welding current, limited by a resistance, is supplied to the arc passage.



Schematic sketch of the plasma welding torch

The proper cooling of the torch and the high welding speed contribute to the fact that the heat affected zone and the thermic distortion are kept to a minimum.

2. Process

2.1 Range of application

The plasma welding torches of the PlaTo250-series are the smallest plasma welding torches in this power range in the market. They can be used in the electrical industry, measuring instrument techniques and household appliances, instrument-making, sieve manufacture, research and aerospace industry wherever you have problems with conventional plasma torches for applications with limited access.

With the PlaTo250-series almost all electrically conductive materials like steel, high alloyed non-ferrous steel, copper, titan, cast iron etc. can be welded.

With the max. current output of 250A material thicknesses up to 6 mm can be welded economically. Displacements of the melting point and the thermal conductivity of the welding materials also cause a displacement of the range of plate thickness.

- ☞ **Welding of lead, also in form of foils, zinc or cadmium parts, beryllium foils, copper as well as other materials which develop poisonous fumes during welding, can only be worked upon when proper protective gear with smoke absorber and proper filter is used.**

3. Safety instructions

3. Safety

Many years of experience with plasma welding have shown that this process is very safe. As it is mostly the case with industrial processes there are certain dangers, which can be reduced with the necessary care and attention. With the following sections the known dangers and methods for their reduction are described.

- 👉 **It is the responsibility of the competent head of department, master or safety engineer to make sure that the persons who have to work with the plasma welding unit read the information and have understood it before they work with it.**

Reference is made to the accident prevention measures to be taken, which are valid (for the Federal Republic of Germany for instance BGV D1 "Welding, cutting and related working processes"). Within the European economic area the operator is obliged to observe and keep the current national version of guideline no. (89/391/EWG) as well as the single guidelines belonging to it. Among them, especially guideline no. (89/655/EWG) concerning the minimum regulations for safety and health protection of employees while using working materials must be adhered to.

The operator must consider all regulations on accident prevention of the country in question. Furthermore the safety precaution measurements of the service manual for the plasma welding unit are to be followed.

3.1 High-Voltage

- 👉 **Before any maintenance work is started, the plasma welding unit must be isolated reliably from the mains i. e. disconnect the mains plug! It is not sufficient to switch OFF the unit or remove the fuses. A switch ON by a third person by error must be made impossible.**

Likewise the power switch of the plasma welding unit is always to be kept open in case it is without supervision.

For safety reasons, defect or damaged parts of the torch, hose assembly or the plasma welding unit must be replaced immediately.

3.2 Gases

The accident prevention regulations VBG 61 "Gases" should be read carefully before handling plasma gases.

3. Safety instructions

3.3 Hydrogen

When plasma welding with hydrogen as a gaseous mixture there is no danger of explosion if the following safety measures are taken:

- a) The pipings, tubes, bolted connections and appliances through which the gas flows must be kept gastight. Therefore the tightness must be checked at regular intervals (weekly) with a leak search spray or with soapy water.
- b) A ceiling fume extraction fan is recommended.
- c) The gas bottles should be stored and opened in a spark free environment. It is also important that they are not dropped or knocked over.
- d) The connecting piece of the gas bottle valve and the reducing regulator should not be pointed towards other gas bottles.
- e) During the welding process the flowmeters which are not required must remain closed.
- f) After completing the welding work close the valves of the bottles of gas, release the pressure on the reducing regulator and unplug the unit.

PLASMATECHNIK
MARKUS COLLING

3.4 Ultra violet radiation

The plasma arc emits ultra violet radiation of high intensity; the same intensity that is emitted during welding with high currents. The radiation can damage eyes and skin. The nearer the operator gets to the arc, the more he is exposed to this radiation. The operators and other persons, who are working in the area of the arc, must wear suitable protection clothing and equipment.

For the protection of the eyes and the face all people working in the area of the arc must wear a welder's helmet or protection shield.

According to DIN EN 169 the following degrees of precaution are recommended during plasma welding:

Welding current	Protection range
< 1 A	A 5
1...2,5 A	A 6
2,5...5 A	A 7
5...10 A	A 8
10...15 A	A 9
> 15 A	A 10

Chart 3.1

3. Safety instructions

In order to prevent the ultra violet radiation reaching the skin, gloves and dark clothing should be worn. It is recommended that the stationary plasma welding unit be in an area that reduces the reflection and emissions of UV radiation. In order to reduce radiation walls and other surfaces should be painted with special UV absorbing paints. In order to avoid unnecessary UV radiation, special glass plates or curtains should be installed where welding is performed.

Under the influence of UV radiation, certain ammonium chlorides (eg Trichlorethylene abbreviation: "Tri") are disintegrated, out of which phosgen gas develops. For this reason, you must be careful that no such solvents be on materials which will be welded by the plasma welding unit. Also no containers with these solvents and detergents must be stored near the plasma welding unit.

3.5 Smoke

In order to avoid health dangers for the operators, plasma welding is only permitted without additional fume extraction in well-ventilated halls or outside. In closed rooms, good fume extraction is necessary. The fume extraction must be adequate for this purpose. This is especially the case when painted sheets are being welded, since additional vapors can come out, which, in turn, can contain lead, zinc, mercury, beryllium or other poisonous elements.

Before welding begins an authorized person must take readings from the atmosphere of the work place.

3.6 Fire

During the plasma welding process any danger of fire or explosion has to be prevented. All burnable materials, which are not directly necessary, must be placed out of reach. A fire extinguisher must be installed at reach.

Plasma welding is not allowed where there is a high concentration of dust, burnable gases or liquids.

3.7 Protective clothing

For protection against electrical accidents and burns, welders must wear the aforementioned helmet, special gloves, a leather welding apron and dry clothes.

4. Working medium

4. Working medium

4.1 Gas supply

The most important factors to consider when choosing a gas are its energy content, thermal conductivity, how it reacts to the material be melted and how it reacts to the atmosphere.

For plasma welding you have to keep the following gas purity of the different gases because poor gas quality causes a higher consumption of wear and tear parts as well as a bad welding result:

Ar: 99,996%	(4.6)
H ₂ : 99,996%	(4.6)
He: 99,996%	(4.6)

4.1.1 Plasma gas

Argon is mainly used for the arc forming gas or centre gas. It is easy to ionize and therefore enables a low-energy arc to endure over a long distance. Bad thermal conductivity, along with the Lorenz-forces that are formed cause a cool gas envelope to build up between the central core of the arc and the constriction wall (nozzle), which is an essential part of the process.

On rare occasions a mixture of argon and up to 10% hydrogen or helium can be used. In certain circumstances larger admixtures can destroy the torch.

The right use of hydrogen and helium admixtures enable the increase of the welding speed up to 20%.

4.1.2 Shield gas

Argon is the most widely used gas as shield gas. However, in order to achieve the desired constriction effect, up to 10% hydrogen - in special cases up to 30% - must be added. Hydrogen reduces the surface tension of the molten puddle and thereby allows it to moisten more easily. Furthermore, due to its high thermal conductivity, hydrogen is an important energy carrier within the plasma arc. During the burning process it binds the oxygen in the air turning it into steam which then escapes into the atmosphere.

Negative effects owing to hydrogen absorption in the molten pool don't occur with steel and a lot of non-ferrous metal.

It is a known fact that you can't use hydrogen with copper or copper alloy because of the hydrogen illness. Welding reactive metals such as titanium, tantalum, zirconium etc. is

4. Working medium

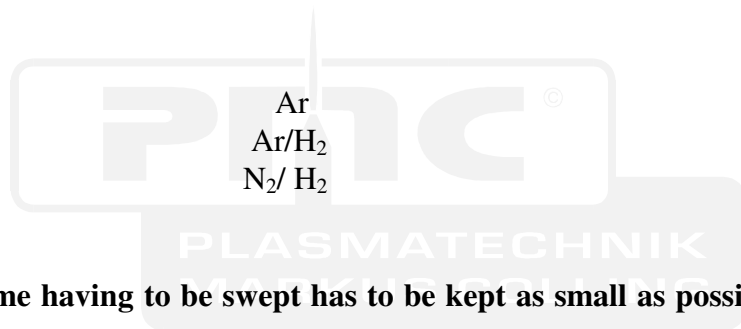
not always possible in an atmosphere with hydrogen content. In such cases helium gas should be used as shield gas.

Please note that hydrogen contents in the shield gas decrease the ignitability of the welding arc and they can halve the maximum possible arc length. This demands a steady hand in the lower current range up to 10A, because the arc can more easily cut-off.

4.1.3 Forming gas

The forming gas or root shielding gas protects at first the lower side of the seam against oxidation and secondly, it avoids by its support effect an excessive sagging of the root.

Depending on the working materials having to be welded, the following gas mixtures are used:



- ☞ ■ The volume having to be swept has to be kept as small as possible by special devices.
- Let escape the root shielding gas slowly, constantly and covering a large surface by the use of perforated plates, steel wool or sintered metal.
- Take into consideration the relative density of the used forming gas.

4.2 Coolant

- ☞ ■ The life time of the torch itself and in particular of the nozzles and electrodes depends on the effectiveness of the cooling.

In the factory, water-cooled units are provided with the original ***G-Frost*** filling. Frost protection is guaranteed up to -10°C. Furthermore ***G-Frost*** reduces the electrolyte-corrosion and takes care of the pump, hose assembly, torch and cooler. For refilling, use only the original ***G-Frost***. Mixtures with other coolants or cooling liquids will impair the functional reliability of the unit and result in the loss of guarantee claims.

When changing the torch the lost coolant is to be refilled immediately.

4. Working medium

- ☞ **In the cooling circuit of the plasma welding machine a safeguard mechanism must be present, which prevents or interrupts the welding process, if the necessary cooling water quantity and/or the necessary cooling water pressure is fallen below or the water temperature is exceeded (see chapter 1, "Technical Data").**

For cooling the torch the required total flow rate is about 3.5 lpm. The required inlet pressure is about 5 to 6 bar. The cooling water temperature should be 15°C if possible.

High cooling water temperature and low coolant pressure result in a bad torch cooling system, which reduces the life-time of the electrodes, the nozzles and the torch.

When changing the torch the lost coolant is to be refilled immediately. Before starting the welding process the pump should run for approx. one minute to remove included air from the cooling circuit.

When the torch is used with a welding current over 70A, the capacity of normal closed circuit cooling devices does not anymore satisfy the requirements. The same holds for any welding procedure with a high duty cycle. The cooling agent would continuously be heated, until the admissible torch temperature is exceeded. In course of time, torch and insulation parts would be damaged.

If such a situation has to be expected, the user is responsible either to attach a continuous temperature supervision at the inlet of the torch, or to install a recooling plant with sufficient power. The cooling agent quality is to be verified regularly (approx. quarterly), deposits inside the cooling unit as well as in the entire tubing system including the torch are not permissible. They result in a blocking of the cooling channels inside the torch.

We recommend the installation of a suitable fine filter ($\leq 100\mu\text{m}$) for the water inflow.

5. Torch connection and putting into operation

5.1 Torch connection

The hose packages of the plasma welding torches PlaTo250 - if ordered accordingly - are delivered with single connections or central adapters required for the respective power source. Gas and watertight connecting to the welding source should therefore not pose any problems.

In case of difficulties, properly trained and approved maintenance personnel should be consulted that is capable of preparing adapters that might become necessary. Apart from this, the safety requirements as per chapter 3 are referred to.

Unless agreed differently with the customer, the following color code is being used:

Pilot gas (Plasma gas):	red	Hose OD:	ca. 4.0 mm
Shield gas:	yellow	Hose OD:	ca. 4.0 mm
Nozzle, water IN-/OUT:	green	Hose OD:	ca. 8.0 mm
Electrode, water IN:	blue	Hose OD:	ca. 6.0 mm
Electrode, water OUT:	red	Hose OD:	ca. 11.0 mm

- ☞ **The cooling effectivity needs to be maintained. By this reason, it is not allowed to prolongate the water hoses or to incorporate supplementary instruments to the cooling process.**

Depending on the used welding current the main cooling circuit for the cooling of the nozzle (green) requires a sufficiently dimensioned heat exchanger (>1.5kW) with a powerful pump (>5bar).

Depending on place conditions differently dimensioned tubes are used for optimization of the cooling. If this is the case, then the bigger one is for water inlet. If the hose dimensions are the same, the flowing direction is not relevant.

The electrode cooling circuit (blue/red) needs a little lower cooling capacity during the default welding at negative pole. Therefore it also can be attached to an recirculating air cooling device integrated in the welding unit. For reverse polarity welding this circulation also should be attached to a suitable heat exchanger.

5.2 Putting into operation

As soon as the plasma welding unit and the torch are installed properly you can start:

- ☞ **Please check before operating if the cooling water has been refilled and the pump is turned on.**

Gradually open the gas cylinder valves. To achieve optimum welding results, it is now necessary to readjust the gas flow and the current until the optimum setting has been established (refer chap. 5.3 and the manual of the corresponding plasma welding unit).

5. Torch connection and putting into operation

5.3 Adjustments

As reference values for the different adjustment parameter may serve for the first welding experiments the following experience values:

Gas pressure:	1.5-3,5	bar
Plasma gas quantity:	0.2-1.5	lpm (depending on the nozzle size)
Shield gas quantity:	2-10	lpm
Pilot arc current:	5-10	A
Welding current:	1-1.5	A/for 0.05mm material thickness
Start current:	0.7-3	A
Gas preflow:	1	s
Gas postflow:	4	s
Working distance:	1-1.5	x Nozzle size (mechanized welding)
	2-3	x Nozzle size (manual welding)

These values should be considered approx. guide values. For other applications different values could be set for better welding results.

☞ **The plasma gas - generally Argon – has to escape with a minimum quantity depending on the nozzle bore and the strength of current. In case of lower values, damages of the torch have to be taken into consideration.**

By adjusting the gas you can produce different arcs. The more plasma gas, the harder the arc and the less plasma gas, the softer the arc. The plasma arc should never be set too hard.

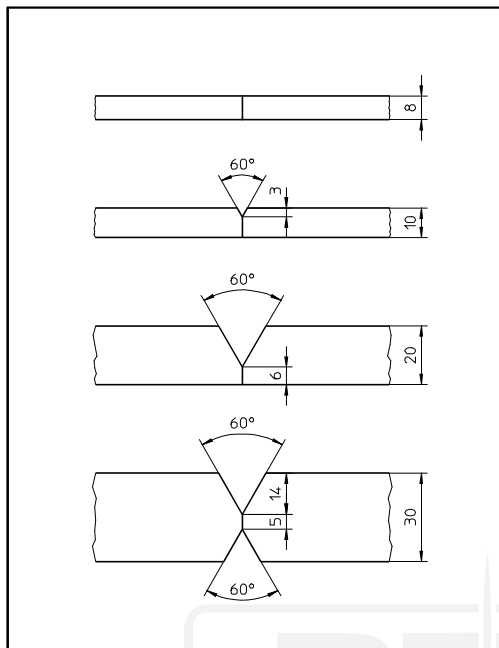
The nozzle bore has a conclusive influence on the shape of the plasma beam. Generally, a plasma arc should not be too “hard”. If the current is too low, the arc is unstable. Ignition problems may arise, the arc breaks down at the standard length. The upper current limit is determined by the capacity of the plasma nozzle and the tool life.

To prevent starting problems when using shield gas with a high hydrogen content the values for the start current should be higher.

5.4 Seam preparation

A good welding result is depending on the right seam preparation. In the total plate thickness range are reached perfect seams without additional wire in case of a good lining fit (gap < 0.1 x plate thickness), in the upper section even with a slight exaggeration. In case of a plate thickness over 3 mm is added an additional wire in case of an inexact fit, provided the gap is more than abt. 0.08 x plate thickness. In that way is avoided a collapse of the seam.

5. Torch connection and putting into operation



Seam preparations for plasma-arc welding

In the upper plate thickness range from abt. 10mm are recommended the following seam preparations to improve the root penetration.

Thin sheets have to be fixed in a special fastening device with supporting rails adapted to the work piece. Normally, they are produced of hard copper. In cases, in which the caloric capability of the work piece is especially high or if an impurity of the work pieces to be welded by the copper jaws is feared, stainless steel can be used.

- ☞ **The conditions for a good result of the welding task are a clean surface, tight fastening, constant pressure, little mismatch of the edges, trouble-free condition of the torch and a forward feed unit working without shocks.**

5.5 Backing support

As in the case of low-alloy kinds of steel the melting bath is relatively liquid, has to be acted against the gravity by means of a mechanical support or by gas padding, especially in case of thicker plates. During the arrangement of the bath support has to be observed that in case of the application of plug welding the plugging plasma gas can escape without producing a disturbing overpressure.

The high viscosity of the melting bathes of austenitic kinds of Cr/Ni-steel allows working without mechanical bath support.

5. Torch connection and putting into operation

5.6 Push-through technology

In case of **plate thicknesses up to 3 mm** is applicated, as during the TIG-welding process, the so-called push-through technology. In that way, the arc energy is fed only at the surface of the component and the melting bath is produced by heat conduction.

Here, the high-energy concentration of a strongly constricted plasma-arc is not appreciated. It is better to work with a "soft" arc, which is reached i. e. by a reduction of the plasma gas quantity and the use of a nozzle with a comparable large diameter of the nozzle bore.

5.7 Keyhole resp. plughole effect

At a **plate thickness of more than 3 mm** as well as at tubes and containers, which are not accessible from the interior, is applicated the so-called keyhole effect technology. Here, the arc energy is provided over the total plate thickness in the component and in that way, the efficiency of the heat feeding is considerably improved.

For that, the normally without time-consuming edge preparation meeting plate edges are melt on by the plasma beam and pushed away laterally. In that way is produced by the kinetic energy of the plasma beam a continuous hole, which is conducted along the cross joint.

The surface tension of the liquid material is causing their junction behind the proceeding beam and so the production of a seam. The produced seam is very narrow and slightly conical. To reach the plughole effect still better, it is recommended to increase the plasma gas quantity at the beginning a little bit and to reduce it again after the development of the plughole.

The at the bottom side of the work piece penetrating and there good visible plasma beam is a reliable verification for a safe root penetration of the seam.

During the welding of tubes, the plug hole at the end of the welding seam is reliably closed, when the used unit control is able to reduce the current as well as the welding speed and the plasma gas quantity in a suitable way towards the end of the seam.

To compensate excessive gap dimensions and to close the plug hole may be fed cold wire, additionally.

5.8 Current limit

The nozzles resp. the electrodes have a limited power consumption capacity, which shall not be exceeded. The limited values may be obtained from the following table:

5. Torch connection and putting into operation

Nozzle ø [mm]	Electrode ø [mm]	Max. Current [A]
1.0	1.5	40
1.2	1.5	50
1.4	1.5	60
1.6	1.5	75
1.8	1.5/2.4	90
2.0	1.5/2.4	105
2.2	2.4	120
2.4	2.4	135
2.6	2.4	150
2.8	2.4	165
3.0	2.4	180
3.2	2.4	195
3.4	2.4	210
3.6	2.4/3.2	225
3.8	2.4/3.2	230
4.0	2.4/3.2	240
4.2	2.4/3.2	250

Tabelle 5.1

5.9 Torch distance

The torch distance is in case of keyhole or plughole welding over 3 mm plate thickness normally 4-5 mm. In case of plate thickness below 3mm the melting bath is only pushed through as during the TIG-welding process. Here is recommended a torch distance of 1.5-3 mm.

6. Replacement of wear and tear parts

6. Replacement of wear and tear parts

When the welding quality gets worse, usually worn out electrodes and/or nozzles are the reason.

 **In order to prevent damage of the torch, wear and tear parts should be replaced in time.**

 **Before servicing the plasma welding unit in any way, unplug the unit. Switching off or screwing out the fuses is not sufficient. A switch on by accident by a third person must be avoided. Otherwise **L I F E I S E N D A N G E R E D !** An eventually connected external cooling unit also must be turned off.**

The threads of the spare parts are all right-hand threads. That means, when you unscrew the parts you have to screw counter-clockwise and for to screw in the parts you have to screw clockwise. The threads always have to be cleaned before screwing the parts together once more.

For all work on the plasma torch work careful and concentrated. Assembly faults as well as the forget or the damage of a part can result in a consequential damage of the torch.

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6.1 Changing the electrode

The electrode has to be replaced if the tip of the electrode is too much worn out, too much clouded or burnt back asymmetrically. You can grind worn out electrodes several times up to a minimum length of 50mm in conjunction with standard nozzles. Too short electrodes are no longer clamped for certain and can lead to the destruction of the torch.

The decisive factor for the life time of the electrode and welding nozzle is how carefully the perfect centrally regrinding of the electrode is carried out. The regrinding of the electrode tip has to be carried out mechanically with a grinding angle of 30°. For special applications you can vary the grinding angle.

As grinding lines crosswise to the axis of the electrode cause defections of the arc, it is recommended a vertical grinding with the grinding device "WIG-Spitz" and a smooth grinding disk. This grinding disk should be reserved exclusively for the grinding of electrodes, as impurities with other kinds of metal may cause a loss of quality.

The manual grinding of the electrodes causes an increased wearing of the nozzles and reduced welding quality and therefore, it is not recommended.

Mechanical grinding offers the following advantages:

- Electrode tip is placed exactly in electrode axis
- Reproducibility of the adjustment
- Stabilisation of the welding current

6. Replacement of wear and tear parts

- Increased service life of the electrode
- Increased service life of the nozzle
- Improved welding quality

Low-grade electrode qualities have a considerable influence on the ignition behaviour of the arc and impair the service life of the nozzles as well as the torch. Due to these facts use only original - **PNC** - spare parts!

6.2 Changing the nozzle

☝ While changing the welding nozzle the torch body has to be directed vertically towards the bottom to avoid that possibly leaking cooling water will penetrate in the back parts of the torch body and its insulation parts. When the nozzle is changed also the electrode should be checked.

The nozzle should be changed in the case when the nozzle channel is damaged and therefore, it is no more exactly circular. When replacing the nozzle please also check the electrode, the gas guiding insert (centering piece), the gas lens as well as the existing seals.

6.3 Changing the gas guiding insert (centering piece)

You must change the gas guiding insert when it has a black layer that cannot be removed, cracks or is damaged.

6.4 Changing the gas lens

You must change the gas lens when it has become clogged too much through back-splashing materials. Otherwise a laminar shield gas flow can no longer be guaranteed.

6.5 Changing the O-rings

The O-rings should be exchanged if wear, rips or an non-round crosscut appear. Grease slightly o-rings with silicone paste (accessory) against an unnecessary abrasion.

6. Replacement of wear and tear parts

6.6 Disassembly of the wear parts

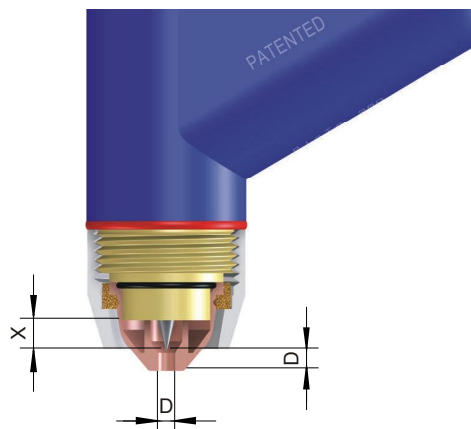
☞ While changing the welding nozzle the torch body has to be directed vertically towards the bottom to avoid that possibly leaking cooling water will penetrate in the back parts of the torch body and its insulation parts. When the nozzle is changed also the electrode should be checked.

1. The electrode is disassembled / the electrode clamping is neutralized by turning the clamping module by hand approximately a half-turn counter-clockwise. The clamping module with its remaining thread may stay inside the torch and should not be unscrewed completely when changing the electrode. Now the electrode can be pulled out of the torch toward the front. The clamping module only has to be removed completely from the torch for maintenance (for example if you want to check or replace the o-ring).
2. Unscrew shield gas nozzle and remove gas lens from the shield gas nozzle or plasma nozzle, respectively.
3. Remove the plasma nozzle from the torch carefully by hand or with the nozzle drawing tool (accessory) if necessary. The sealing surface may not be damaged.
4. Carefully pull out the gas guiding insert (formed ceramic part) of the plasma nozzle or draw it off from the electrode.

☞ Specially the insert for 2.4 mm electrodes is extremely fragile!

6.7 Assembly of the wear parts

1. Check the o-rings of clamping module with regards to their surface quality. The surface areas should be even, without visible wear and without tears. To avoid unnecessary attrition, they should have a very fine lubricating film (vaseline or, if authorized, silicon grease).
2. The electrode has to be inserted into the clamping module. Rescrew the clamping module by hand to the torch – up to the last point, at which the electrode is still slidable by hand (to find after-wards its exact position). As rule of thumb the electrode distance should be $1 \times D$ ($D = \text{Nozzle-}\varnothing$) from the nozzle front side.



6. Replacement of wear and tear parts

Depending on used nozzle size the electrode tip should stick out the measure X from the torch body. The measure X is found out as follows.

$$X = 5.6\text{mm minus nozzle-}\varnothing$$

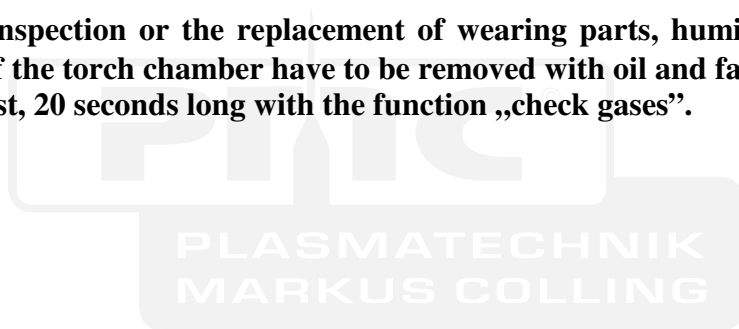
When using a 2.4mm nozzle, the measure X is $5.6\text{mm} - 2.4\text{mm} = 3.2\text{mm}$

3. Lightly grease the o-rings of the new nozzle and push it together with the gas guiding insert into the torch.

👉 **Note! When operation of the torch without or with a damaged gas guiding insert the torch can be damaged or even destroyed during ignition!**

4. Putting the gas lens with the dressed opening in the shield gas nozzle pointing in the direction of the nozzle and tightly screwing on both to the torch by hand.

👉 **After each inspection or the replacement of wearing parts, humidity and possible impurities of the torch chamber have to be removed with oil and fat free compressed air or, at least, 20 seconds long with the function „check gases”.**



7. Maintenance / Repair

7.1 Maintenance

- ☞ **Before all maintenance works, the plasma-arc welding unit has to be made powerless by switching off the main supply switch. An inadvertently switching-on by third persons has to be excluded (Lock switching-off switch by shackle-type connector unit).**

In regular intervals, the plasma torch has to be checked with regard to damages, wearing and impurity, to keep it, if necessary, always in a trouble-free condition by repairs, replacements and cleaning. Only if these instructions are observed at any time, it can be guaranteed that the torch is working safely, trouble-free and with high quality, for a long period.

By the use of hydrogen as plasma gas there is danger of explosion in the case of defective hoses. To ensure the reliability of operation and to avoid a loss of gas or water, defective hoses have to be replaced.

Check cooling water and, if necessary, refill only with the original - **PMC** - coolant ***G-Frost***.

- ☞ **Check in the case of ambience temperatures of around 0°C regularly the frost safety of the cooling medium by means of an anti-freezer testing device, which may be obtained as an option (please see accessories).**

If the torch is operated without anti-freezer at ambience temperatures below 0 °C, then, after a longer rest period (maybe by night or at the weekend), the cooling water remaining in the hose package has to be blown out to avoid damages of the hose package and the torch by freezing cooling water.

7.2 Repair

Repairs must be carried out by a trained specialist.

- ☞ **In case of defect generally the torches should send back to our factory for repair. Only here all spare parts, special testing devices and the required know-how are available, which are necessary for a perfect and quick repair. It is very important for an error and cause analysis, that all worn or damaged parts, which were mounted at the time when the error happened, remain unchanged in the torch. An exact error description should be added.**

8. Troubleshooting

8. Troubleshooting

In the following are mentioned possible defects and their clearance. Further instructions may be obtained from the operation manual of the used welding unit.

8.1 No ignition of pilot arc

- a) Electrode has come into contact with the nozzle
- b) Electrode worn out
- c) No high frequency

8.2 Pilot arc does not ignite reliably

The pilot arc must come out of the nozzle, brightly illuminated and making a constantly growing hissing noise at approx. 2-3 mm length.

- a) Electrode and/or nozzle worn out
- b) Distance of the electrode not o.k.
- c) Centering piece worn out
- d) Humidity inside of the torch (Creeping distance!)
- e) Either too much or not enough plasma gas

8.3 Pilot arc ignites, but mains arc does not come out

- a) Distance between torch and workpiece too large
The main arc ignites only when the workpiece is below the torch axis and the distance, according to the intensity of current, does not exceed 2 to 3 mm.
- b) Earth lead to workpiece is insufficient
This can be caused by having a strong oxide layer on the support ribs of the welding table. Connect the earth cable directly to the workpiece.
- c) Strong layer of scale or paint on the workpiece

8. Troubleshooting

8.4 Electrode goes blue

- a) Insufficient water cooling (s. chap. 1.1)
- b) Humidity inside of the torch (please check the o-rings)
- c) Plasma gas not clean enough
- d) Pre- or after-flow-time for plasma gas (argon) not enough

8.5 High electrode wear out

- a) Plasma gas not clean enough
- b) Distance of the electrode is too large
- c) Insufficient water cooling (s. chap. 1.1)
- c) Humidity inside of the torch (please check the o-rings)
- e) Pre- or after-flow-time for plasma gas (argon) not enough
- f) Poor material of the electrodes. **Use only Original - PNC - Electrodes!**

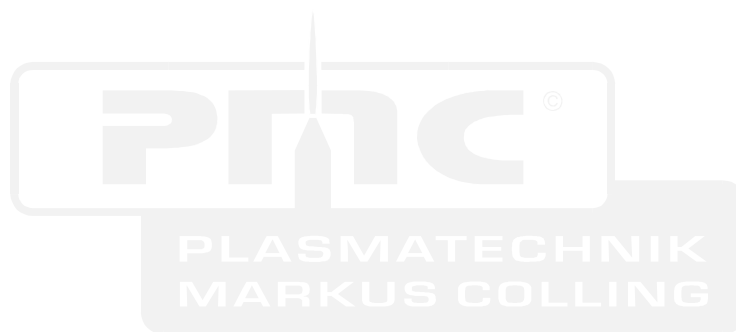
8.6 High wear and tear of nozzles

- a) Distance of the electrode is too large
- b) Tip of the electrode is not in line with the torch axis
- c) Insufficient water cooling (s. chap. 1.1)
- d) Current limit is exceeded (s. chap. 5.8)
- e) Insufficient quantity of plasma gas
- f) Poor quality of nozzles. **Use only Original - PNC - Nozzles!**

8.7 Instable arc and bad welding seams

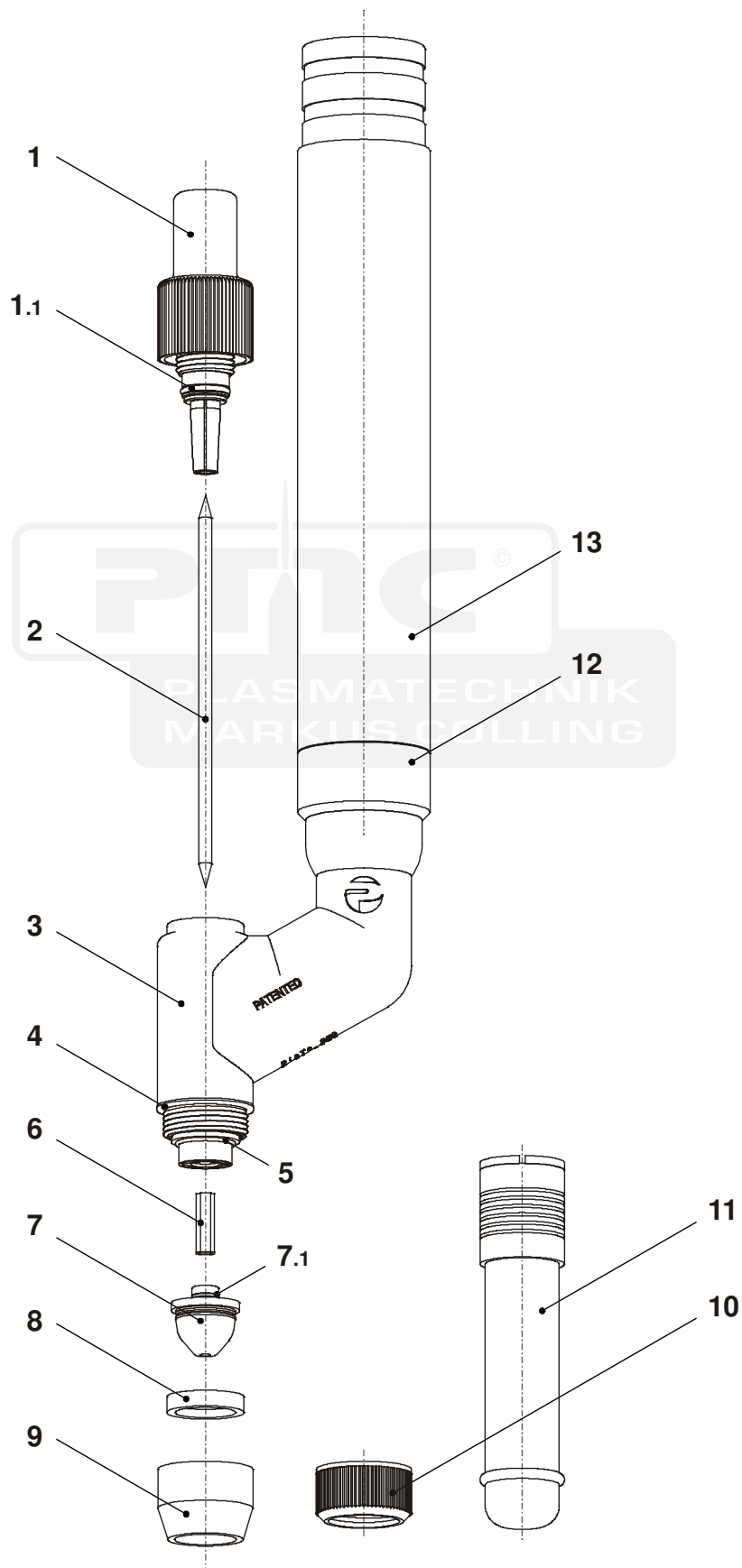
- a) Working material very dirty (colour, oil, rust, etc.)
- b) Too less, too much or unclean shielding gas.

9. Spare parts PlaTo250



9. Spare parts PlaTo250

9. Spare parts PlaTo250



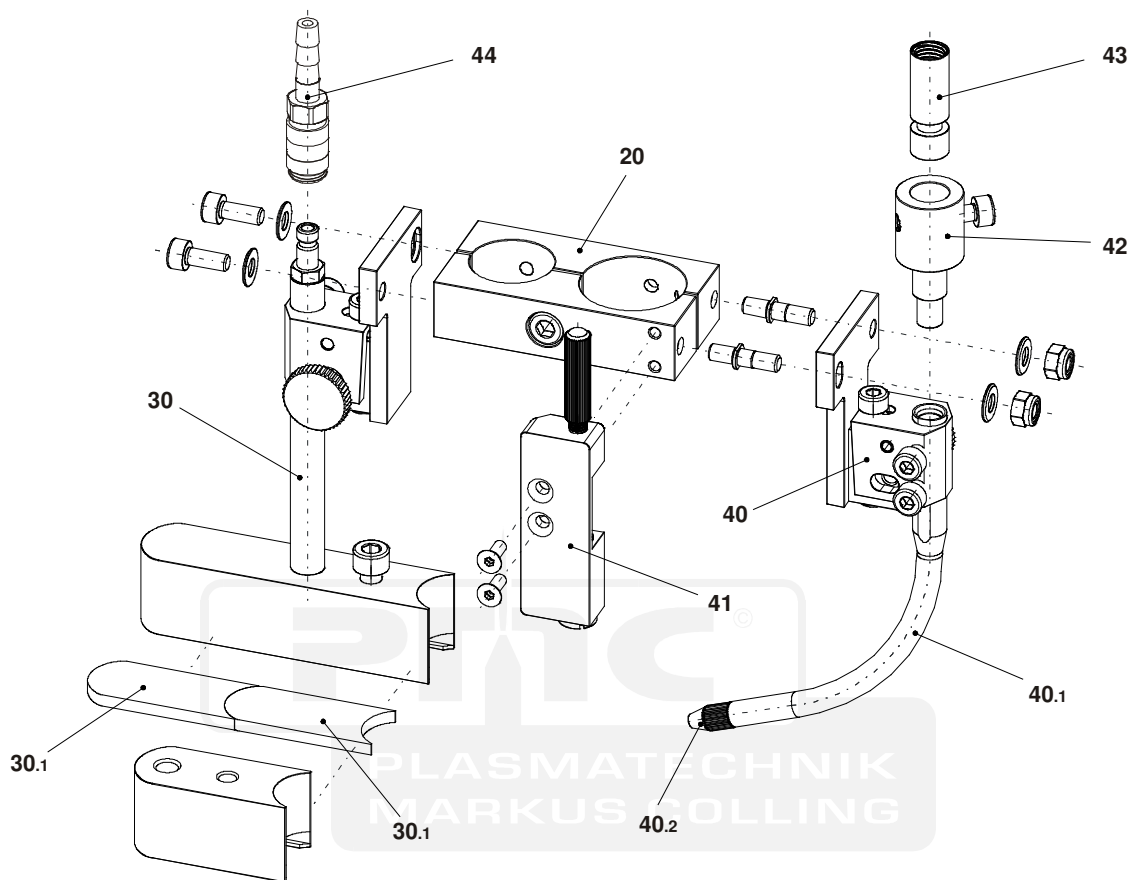
9. Spare parts PlaTo250

List of spare parts PlaTo250

Pos.	Description	Article No.
1	Clamping module ø 1.5	PWI.00846
	Clamping module ø 2.4	PWI.00848
	Clamping module ø 3.2	PWI.00849
1.1	O-ring for clamping module	PWI.00407
2	Special-Electrode ø 1.5 DC-	PWI.00839
	Special-Electrode ø 2.4 DC-	PWI.00841
	Special-Electrode ø 3.2 DC-	PWI.00842
	Special-Electrode ø 3.2 DC+/AC	PWI.00843
3	Torch body 65° (not shown)	PWI.01451
	Torch body 180°	PWI.01452
4	O-ring	PWI.00409
5	O-ring	PWI.01457
6	Gas guiding insert ø 1.5	PWI.00411
	Gas guiding insert ø 2.4	PWI.00767
7	Welding nozzle ø 1.0	PWI.01470
	Welding nozzle ø 1.2	PWI.01471
	Welding nozzle ø 1.4	PWI.01472
	Welding nozzle ø 1.6	PWI.01473
	Welding nozzle ø 1.8	PWI.01474
	Welding nozzle ø 2.0	PWI.01475
	Welding nozzle ø 2.2	PWI.01476
	Welding nozzle ø 2.4	PWI.01477
	Welding nozzle ø 2.6	PWI.01478
	Welding nozzle ø 2.8	PWI.01479
	Welding nozzle ø 3.0	PWI.01480
	Welding nozzle ø 3.2	PWI.01481
	Welding nozzle ø 3.4	PWI.01482
	Welding nozzle ø 3.6	PWI.01483
	Welding nozzle ø 3.8	PWI.01484
	Welding nozzle ø 4.0	PWI.01485
	Welding nozzle ø 4.2	PWI.01486
7.1	O-ring for welding nozzle	PWI.01455
8	Gas lens	PWI.01453
9	Shield gas nozzle ø11x13.5	PWI.00636
	Shield gas nozzle ø12x13.5	PWI.00382
	Shield gas nozzle ø11x15.5	PWI.00383
10	Nozzle cap (optional for -M/-G)	PWI.01545
11	Nozzle drawing tool	PWI.01460
12	Adapter	PWI.01438
13	Handle ø25	P50010002

10. Accessories

10. Accessories



Pos.	Description	Article No.
20	Mounting plate cpl. Ø 25	PWI.01356
30	Shield gas trailer cpl. w/ holder L74	PWI.01355
	Shield gas trailer cpl. w/ holder L40	PWI.01354
30.1	Sieve insert	PWI.01353
40	Cold wire supply cpl.	PWI.00805
40.1	Wire feeding tube 70°	PWI.00738
40.2	Wire feeding nozzle ø 0.7	PWI.01280
40.2	Wire feeding nozzle ø 0.9	PWI.00657
40.2	Wire feeding nozzle ø 1.1	PWI.00654
40.2	Wire feeding nozzle ø 1.3	PWI.00655
40.2	Wire feeding nozzle ø 1.7	PWI.00656
41	Transversal wire adjustment (optional)	PWI.00854
42	Connector socket	PWI.00808
43	Connector plug	PWI.00809
44	Quick disconnect coupling for hoses	2.5-3mm ID PWI.09231
	Quick disconnect coupling for hoses	4-5mm ID P53.99173

10. Accessories

10. Accessories

Pos.	Description	Article No.
	Silicone paste (lubricant for o-rings) 5 g	P51.05105
	Silicone paste (lubricant for o-rings) 100 g	P14.62230
	WIG-Spitz-Electrode grinder type T	P04.62833
	G-Frost -Whole year coolant (Frost protection to -10°C)	
	Tank 2,5L	P51.20039
	Tank 5,0L	P51.20040
	Tank 20,0L	P51.10094
	 Further equipment, such as welding nozzles of other dimensions or shapes upon request.	

