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company

Short Instruction Manual



Short instruction manual Smart Focus 300 with FC-300




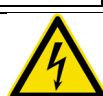









- Safety
- Consumable change of the plasma torch
- Cutting charts















Art.-No.: .11.037.3002KBA

1 Short instruction manual Smart Focus 300 with FC-300









1.1 Safety

The short instruction manual is valid for the properly installed and with decrease protocol handed over plasma cutting machine! The detailed safety references are to be inferred from the manual the point „safety“!

 	<div data-bbox="248 528 1461 600" style="background-color: orange; text-align: center;">  WARNING </div> <p>Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact. Before opening (for example error search) or starting any maintenance and repair work principally the power supply source has to be switched off and visibly disconnected from the mains. Opening the plasma unit may be carried out only under responsibility of a qualified electrician!</p>
 	<div data-bbox="248 824 1461 896" style="background-color: orange; text-align: center;">  WARNING </div> <p>Do not touch under electrical voltage related conductive parts!</p>
	<p>The safety circuits may not be suspended!</p>
 	<p>The operator has to wear an adequate eye shield and insulating protective clothing!</p>
	<p>Suitable ear protection measures have to be taken in every case (e.g. wearing of ear muffs or ear plugs)!</p>
	<p>In any case the user of the unit installation has to carry out measurements of the concentration of toxic substances to proof the effectiveness of the exhaust equipment!</p>
	<div data-bbox="248 1662 1461 1776" style="background-color: orange; text-align: center;">  WARNING </div> <p>Do not store flammable substances in the cutting area!</p>

	<div data-bbox="735 241 938 286">  WARNING </div> <p>Place the cylinders in an upright position and lock it against tilting over! Don't use damaged cylinders, pressure reducers and armatures!</p>
 	<div data-bbox="735 434 938 479">  WARNING </div> <p>All parts that come into contact with oxygen must be kept oil and grease free! When using oxygen, the explosion protection for oxygen must be connected to the pressure-reducer (protects against backfiring)!</p>
	<div data-bbox="735 663 938 707">  WARNING </div> <p>Use only „Kjellfrost“ as coolant!</p>
    	<div data-bbox="735 824 938 869">  CAUTION </div> <p>All details given on the label of the new anti-freezer have to be followed consequently!</p> <ul style="list-style-type: none"> • „Kjellfrost“ is injurious to health • Don't drink Kjellfrost • Keep it away from food, drinks and fodder • Always clean your hands before a break and after end of work • Avoid the contact with eyes and skin • Safety goggles recommended during filling • Wear protection suit • Wear gloves from Nitril or Viton (see safety data sheet) • Immediately taking off soiled, watered clothes • Special danger of skidding by run out or spilled "Kjellfrost" • Keep away from children
	<p>First aid</p> <ul style="list-style-type: none"> • after swallowing Don't bring up, clean the mouth, drink much water, open the window for fresh air and call the doctor , present packing or label. • after eye contact Clean the eyes with much flowing water some minutes and call the doctor • after skin contact Quickly clean it with much water and soap

1.2 Consumable change at the plasma torch

 	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>In order to change consumables, the plasma cutting system shall be switched OFF and secured against any accidental start. An unauthorised start-up is prevented by e.g. pulling out the key of the key-operated switch after switching off the plasma cutting system!</p>
	<p>Under no circumstances pliers or other unsuitable tools have to be used for consumable change, they entail inevitably the damage of the consumables, for example burr formation and thereby malfunctions of the plasma torch.</p>
	<p>You are only allowed to use ORIGINAL Kjellberg spare parts and consumables! The use of other manufacturer consumables leads to the loss of the warranty claim.</p>
	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>All components and parts coming in touch with oxygen have to be kept free of oil and grease! This refers specially to the torch head and the consumables.</p>
	<p>Use only exact the consumables which are destined for the technological operation!</p>



After screwing off the protective cap to replace the swirl gas cap without any further replacement of consumables, the tightness of the nozzle cap must absolutely be checked and, if required, tightened again before mounting the protective cap!

apply to plasma torch:

PerCut 2000/2000A

PerCut 4000/4000A



Make sure that all wearing parts are complete and correct installed!

Especially the cooling tube has to be inserted. Other wise the cooling is ineffective and the torch gets damaged.

No other parts as mentioned before have to be changed unauthorised on the plasma machine torch.

A further opening of the torch from the front side is not possible.

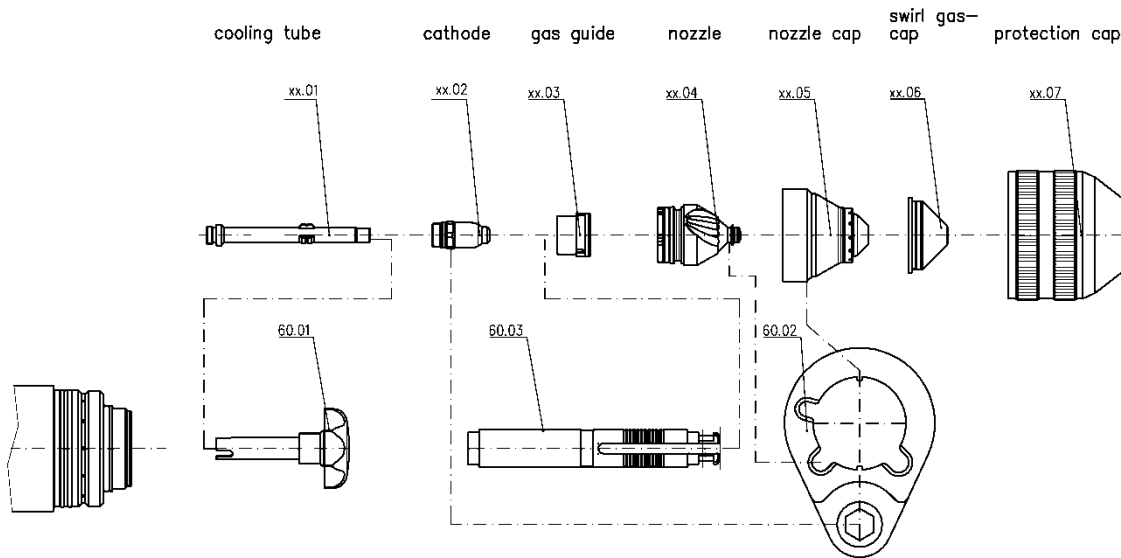


You have to mind on tightness of the plasma torch after consumable change, coolant does not leave!



The discharge chamber between cathode and nozzle has to be blown absolutely dry (press tumbler switch "gas test" approx. 20 seconds - see "operation sequences")

1.2.1 Plasma machine torch PerCut 2000/2000A / PerCut 4000/4000A



Dismounting of used consumables

Before dismounting the consumables of the PerCut please insert the change head in the "Station for the change heads" (see chapter "Dismantling of the change head") and remove with the aid of compressed air the coolant from the change head.

1. Manually unscrew the protective cap (xx.07) together with the swirl gas cap (xx.06).
(Press out swirl gas cap from protective cap.)
2. Unscrew nozzle cap (xx.05) by aid of a torch tool - PerCut 440-450* (60.02).
3. Take out the nozzle (xx.04) together with the gas guide (xx.03) by aid of a torch tool - PerCut 440-450* (60.02).
4. Pull out the gas guide (xx.03) from the nozzle (xx.04) by aid of the specific wrench (60.03).
5. Unscrew the cathode (xx.02) by aid of a torch tool - PerCut 440-450* (60.02).
6. Remove the cooling tube (xx.01) using the socket wrench (60.01) when changing technology or changing data set in accordance with the cutting data.

Mounting of new consumables

1. Screw in the cooling tube (xx.01) by aid of a socket wrench (60.01).
2. Tightly screw in the cathode (xx.02) by aid of a torch tool - PerCut 440-450* (60.02).
3. Insert the gas guide (xx.03)
4. Insert the nozzle (**xx.04**) into the torch head (see picture on next page). Turn the nozzle such that the nozzle's wide groove is positioned exactly above the oval opening in the torch head. Then insert the nozzle until stop. Now the nozzle is locked and cannot be turned anymore.
5. Position the nozzle cap (xx.05) by aid of a torch tool - PerCut 440-450* (60.02) and fasten hand tight
6. Position the swirl gas nozzle (xx.06) and manually fasten with the protective cap (xx.07).

O-rings only need replacement in case of deformation or damage.

* The torch tool - PerCut 440-450 (60.02) is a multifunctional tool to:

- screw and unscrew the cathode by means of hexagon 11 mm,
- pull out the nozzle by means of the engraved notches 6 mm, 7 mm and 8 mm and
- screw and unscrew the nozzle cap by means of opening Ø 37 mm.

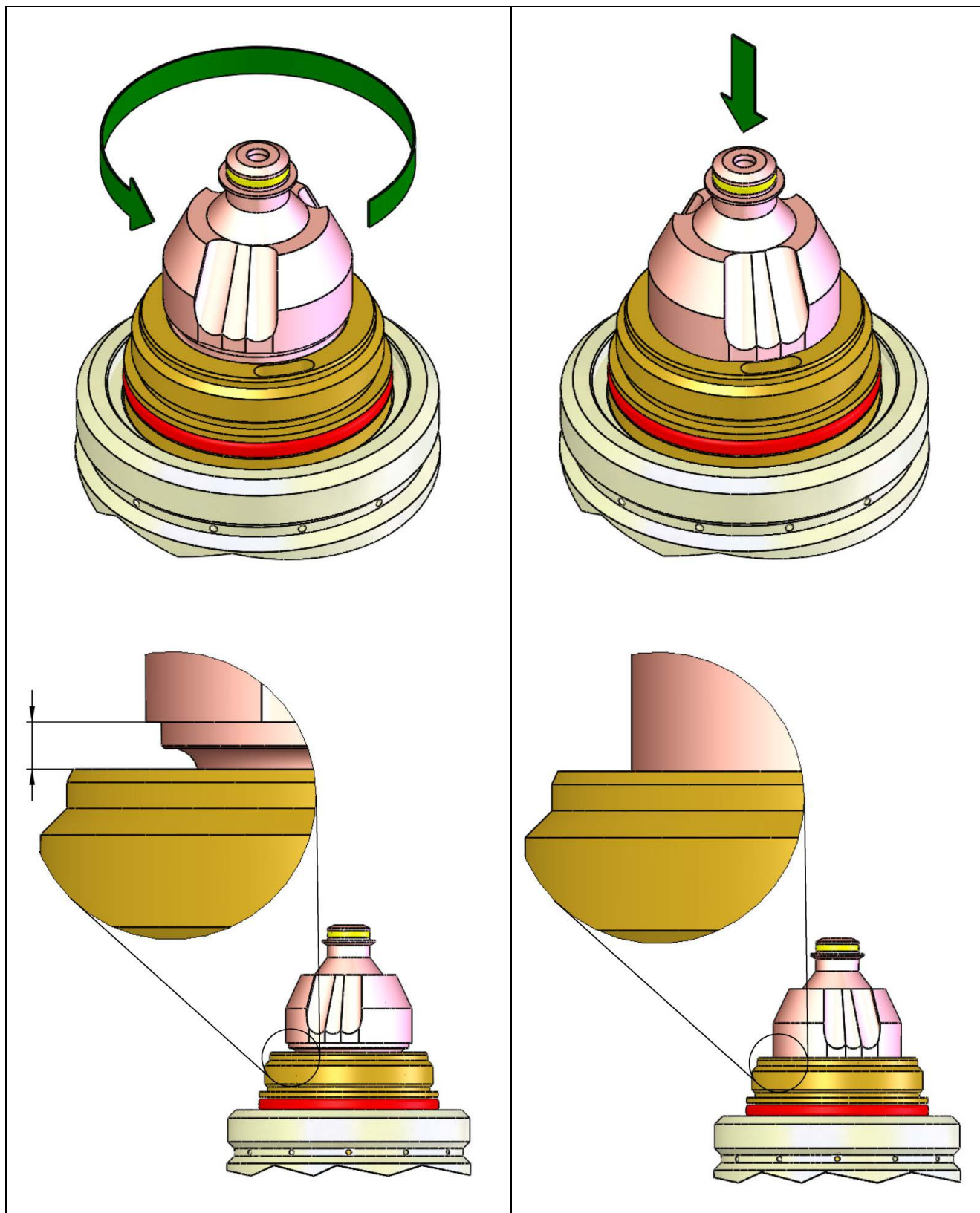


Fig. 1: Insert the nozzle into the torch head

1.3 Operating and display elements of the power source

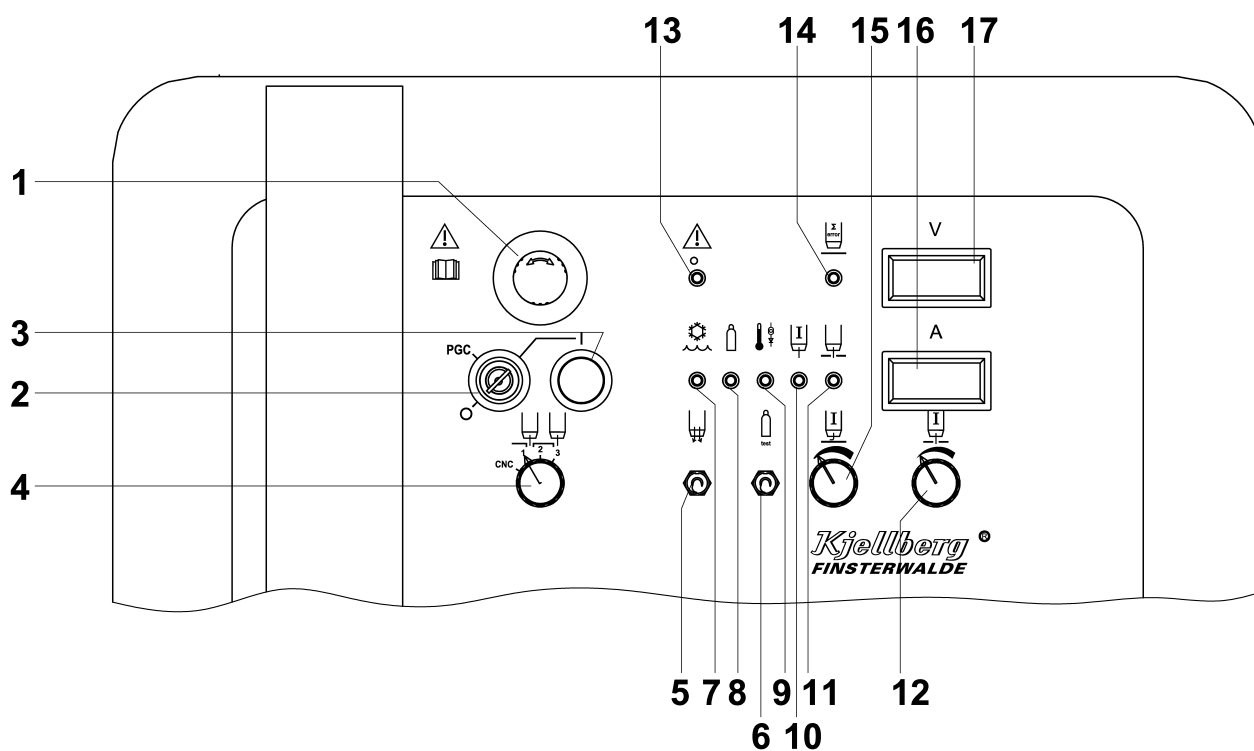


Fig. 2: Control and display elements

Operation sequences

Check before starting the gas supply, corresponding to the point "connection of the gas supply" of gas console.

1.	Red emergency stop device S3 "emergency stop" (1)	Unlock the button by turning it in one direction.
2.	Key switch S1 "Mains ON" (2)	Turn the key switch to the position „I“. switch to "PGC" when change consumables. <ul style="list-style-type: none"> • Mains voltage is applied to the control transformer. • Display of consumables at operation screen "data set parameter" of the PGC (only for FlowControl).
3.	Illuminated button green S2 „PA ON" (3)	<p>Activate the plasma unit with the illuminated push button. Main transformer, fan, pump and control are switched on.</p> <p>Inspection:</p> <ul style="list-style-type: none"> • The display screens appear for a short moment after starting the unit following messages: • <ul style="list-style-type: none"> at the voltage display (17): <i>U-I</i> = device-no. example: device 1 <i>SF</i> = device typ example: Smart Focus <i>0</i> = voltage actual value example: 0 V at the current display (16): <i>100</i> = software-version example: V 1.00 <i>300</i> = max. current power source example: 300 A <i>130</i> = current nominal value example: 130 A • green illuminated push button S2 "PA ON" (3): lights • LED signal lamp green H30 "Temperature OK" (9): lights • LED signal lamp green H29 "Coolant OK" (7): lights • An automated gas purging is started. • LED signal lamp green H28 "Gas OK" (8): lights • LED signal lamp yellow H31 "Cumulative error" (13): does not light <p>Unit is ready for operation!</p>
4.	Selector switch S7 "technology" (4)	Dial the technology range according cutting chart.
5.	Operation gas console	See instruction manual of corresponding gas console. <ul style="list-style-type: none"> • Select the necessary plasma regime. • Adjust plasma - and swirl gases according to the cutting charts.
6.	potentiometer P5 "cutting current" (12)	<ul style="list-style-type: none"> • Adjust the cutting current with the potentiometer. • Look at the value shown at the current display (16).

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7.	potentiometer P7 "marking current" (15)	<ul style="list-style-type: none"> • Adjust the marking current with the potentiometer. • Look at the value shown at the current display (16).
8.	tumbler switch S2 "gas test" (5)	<p>Adjust the tumbler switch "Gas test":</p> <ul style="list-style-type: none"> • press the tumbler switch "gas test" (5) at the power source or • the switch/button "gas test" at the gas console <p>The gas test starts automatically:</p> <ul style="list-style-type: none"> • when unit becomes switched ON • when changing gases of PGV <p>inspection:</p> <ul style="list-style-type: none"> • blowing out of the plasma torch for example blowing out of the coolant residue after consumable change • LED signal lamp yellow H31 "cumulative error" (13): lights • The voltage display (17) shows "GAS" (6RS)
9.	position the plasma torch	<ul style="list-style-type: none"> • Bring the plasma torch in the start position. • Adjust the ignition height according to the cutting chart. <p>Hole piercing occurs over the work piece.</p> <p>Flying cutting is only possible with switch position 3 of the tumbler switch S7 "technology" (4).</p>
10.	plasma torch ON	<p>Plasma torch can be switched on through:</p> <ul style="list-style-type: none"> • the "torch ON"-signal of the CNC-control from the guiding system or • pressing the ON-button at the remote control (FB) <p>Pilot arc ignition:</p> <ul style="list-style-type: none"> • LED signal lamp white H11 "current flows" (10) : lights • after pilot arc contacts work piece, main arc ignites automatically • LED signal lamp white H10 "main arc" (11) : lights
11.	plasma cutting	Plasma cutting according to the cutting chart.
12.	plasma torch OFF	<p>Plasma torch can be switched off through:</p> <ul style="list-style-type: none"> • discontinuation of the "torch ON"-signal of the CNC-control from the guiding system or • pressing the OFF-button at the remote control (FB) <p>Plasma arc extinguishes</p>
13.	plasma unit OFF	<p>Turn key switch S1 „Mains ON" (2) to</p> <ul style="list-style-type: none"> • Position „0 “ or • Position „PGC“ (for consumable change) <p>The unit is switched off..</p>
14.	Red emergency stop device S3 "emergency stop" (1)	<p>Press the red emergency stop device S3 "emergency stop" (1).</p> <p>All integrated components of the emergency stop circle are switched OFF, after pressing the button.</p>

Fig. 1: Operation sequences

1.4 Operating and display elements of the gas console

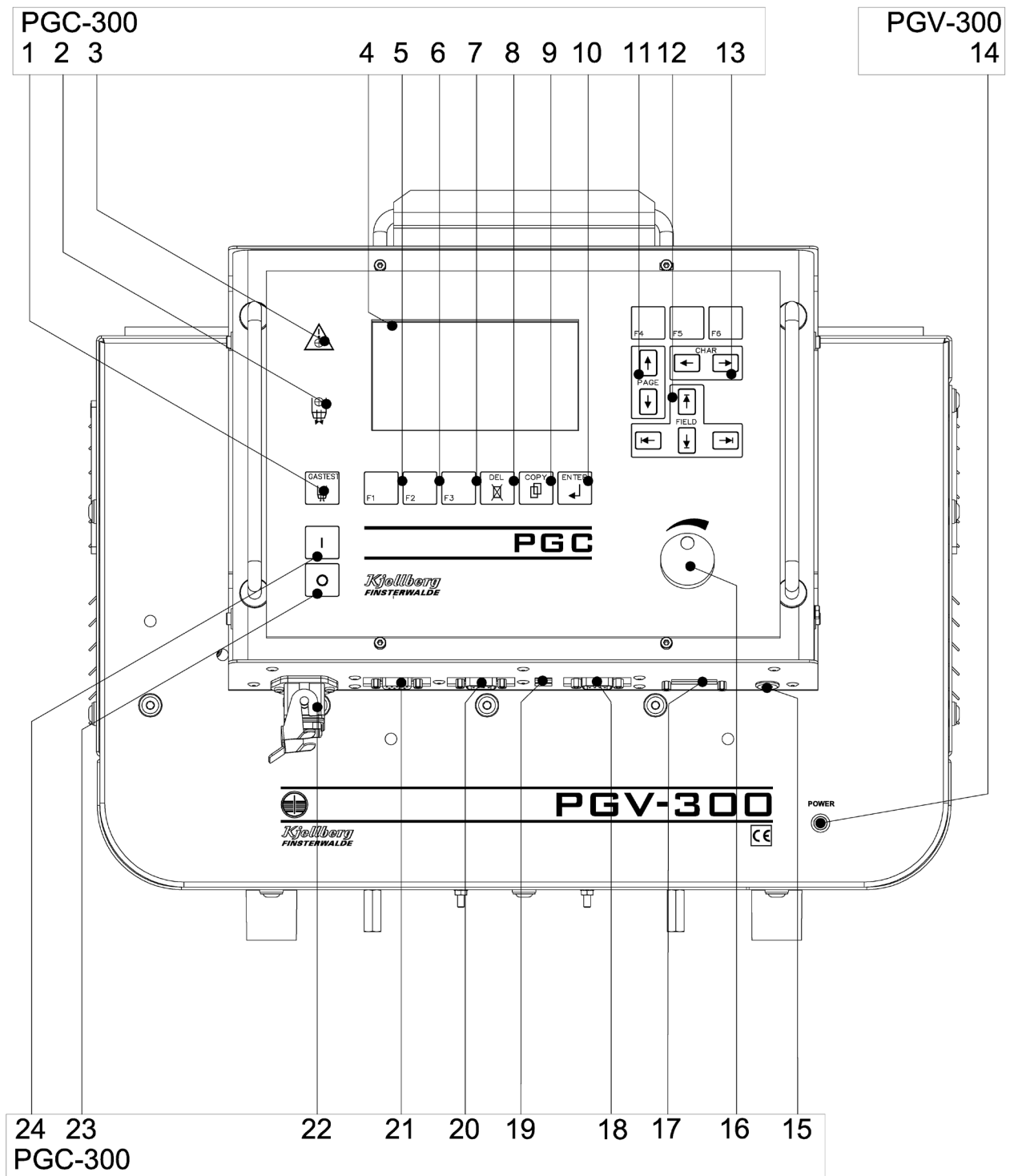


Fig. 3: Control and display elements PFC 300

1	button „GASTEST“
2	display for gas control signal
3	display error
4	LCD Display
5	F1 button "technology data
6	F2 button "to set selection"
7	F3 button "set change"
8	DEL button "delete button"
9	COPY button "new data set"
10	ENTER button "input confirmation"
11	PAGE button "changes display pages"
12	FIELD button "position change field"
13	CHAR-buttons "position change sign modification"
14	LED-Power - power supply ON
15	contrast adjustment display
16	hand wheel for parameter selection
17	option: binary data transmission to guiding system (X6)
18	serial interface RS-232 (X5)
19	switch of interfaces RS-485 – RS-232
20	connection to power source RS-485 (X4)
21	CAN1 signal connection to PGV (X2)
22	socket current supply PGC (X1)
23	store key of data set 0
24	store key of data set I

1.5 Information for trouble shooting

error	reason / solution
1. After activating the key switch S1 "mains ON" (2) to position „I“ and switching on the green illuminated push button S2 "PA ON" (3), Pa does not switch ON	<ul style="list-style-type: none"> • emergency-stop device S3 "emergency stop" (1) is activated (reset switch) • „emergency stop“ of CNC is activated • link X102 (C3-C4) and X106 (1-2) for operation without CNC • cover plate on back wall of PA or door of PBA open • control cable plasma torch not connected to X121/X122 • filling level in the coolant tank too low
2. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H28 "Gas OK" (8) is OFF	<ul style="list-style-type: none"> • low pressure of selected gases (see cutting chart)
3. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H29 "Coolant OK" (7) is OFF	<ul style="list-style-type: none"> • coolant flow < 3.0 l/min • no or less coolant filled up
4. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H30 "Temperature OK" (9) is OFF	<ul style="list-style-type: none"> • thermal overload on rectifier → cool down by running fan
5. LED signal lamp white H11 "Pilot arc" (10) OFF:	<ul style="list-style-type: none"> • no ignition • check the pilot current
6. LED signal lamp white H10 "Main arc" (11) OFF: plasma cutting machine switches OFF after ca. 10 s	<ul style="list-style-type: none"> • no cutting power, main power source OFF • pilot arc time > 10 s; • pilot arc without contact to workpiece • no current flow to workpiece <ul style="list-style-type: none"> - workpiece cable not connected - ignition height not correct

The plasma sequence control of the plasma cutting system is displaying certain error codes, if during service or operation errors are noticed. The current display indicates the corresponding error messages and additionally the respective LED light.

The description of these errors and the rectification is given in the following chart:

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current-display	relevance	LED-display	cause	end or fault clearance	
Er 2	Error power source	LED-signal lamp yellow H31 "Cumulative error" (13) lights and LED-signal lamp yellow H32 "Process error" (14) flashes	current relay K1.x "main source" or K2 "current flows" or K3 "current pilot source flows" is pulled or voltage at the torch without "torch ON"-signal	remote control: press "FB OFF" stop "torch ON"	inform the service!
Er21	Transfer arc		current relay K3		
Er22	Main arc		current relay K1		
Er24	Pilot arc		current relay K2		
Er27	Fuse PBA defect		check measuring cable cathode voltage and fuse F1 in PBA		
Er28	Torch solenoid valve		Voltage of torch solenoid valves not OK		
Er29	Actual current detected		Current flow without ON signal		
Er 3	Error torch	LED-signal lamp yellow H31 "cumulative error" (13) ON	current flow during gas preflow → short circuit at the torch	switch OFF unit, check torch and consumables	
Er31	Transfer arc		Current relay K3		
Er32	Main arc K1		Current relay K1		
Er34	Pilot arc		Current relay K2		
Er39	Actual current detected		Current flow with ON signal		
Er 4	Pilot arc time	LED-signal lamp yellow H32 "Process error" (14)	pilot arc time exceeded	remote control: press FB OFF CNC: stop ON	
Er 5	Ignition time	LED-signal lamp yellow H32 "Process error" (14)	HV ignition time exceeded or no ignition	remote control: press FB OFF CNC: stop ON	
Er 6	Main arc interruption	LED-signal lamp yellow H32 "Process error" (14)	arc interruption during cutting (main source)	end after ca. 1 s	

current-display	relevance	LED-display	cause	end or fault clearance
Er 8	Gas test period	LED-signal lamp yellow H32 "Process error" (14)	max. time exceeded, stop gas test and start again if required	tumbler switch "gas test" OFF
Er 9	Pilot arc interruption	LED-signal lamp yellow H32 "Process error" (14)	plasma arc interruption during ignition (pilot source) main arc is not formed	end after ca. 1 s
Er10	Communication error	LED-signal lamp yellow H32 "Process error" (14)	X110 (B2) interrupted CAN communication between PGC↔PGV interrupted	Control connection X102 (B2) and PGC - PGV
Er43	Coolant error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H29 "coolant OK" (7) OFF	coolant missing	settle disturbances
Er51	Temperature error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H30 "temperature OK" (9) OFF	high temperature	settle disturbances
Er60	Sequence error	LED-signal lamp yellow H32 "Process error" (14)	Error in the cutting sequence	external release missed
Er70	Gas error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H28 "gas OK" (8) OFF	gas missing	check gas bottle if necessary replace
Er71			gas missing at start of power source	open gas bottle
Er72			gas pressure too low	check gas, start the power source again

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Instruction Manual



- Power source
- Plasma gas control unit
- Plasma machine torch
- Plasma torch connection unit

Smart Focus 300
FlowControl-300
PerCut 2000/2000A
PerCut 4000/4000A
PBA-300

Art.-No.: .11.037.3002BA

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1 General information

1.1 Warranty claim

We point out explicitly that only spare parts and consumables of Kjellberg original have to be used! Otherwise a warranty claim does not exist. Kjellberg Finsterwalde as manufacturer of the equipment can not make any guarantees for the safety of the equipment according to the valid regulations.

1.2 Standards and Directives



The CE mark indicated on our plasma cutting and welding machines shows the conformity of our products with the latest effective European CE Directives.



Development and production take place according to the following standards:
EN 60974 (VDE 0544).



All plasma systems and welding systems are in possession of the S-mark and therefore applicable to work places with increased electrical endangerment.



The production takes place according to DIN EN ISO 9001.

All products are manufactured under strict quality assurance control and proved by certificates and product-related test records.

1.3 Information to the instruction manual - target groups

Our products are of first-rate quality and high reliability and are in operational condition at any time. You fully will enjoy all these benefits, as long as you carefully observe these instructions for operation, maintenance and handling.

For any request you are kindly asked to quote model name and serial number.



Please keep this instruction manual always carefully!
The instruction manual always must accompany the machine.



For damages due to misuse or wrong service we will not take any responsibility!



To avoid dangers for itself and others, operations at the unit may be carried out only by persons who have read and understood this instruction manual as well as were introduced to the correct handling.

Target groups for this instruction manual are:

Operator:

Persons recognising risks and avoiding endangerments by electricity with suitable training and suitable education by which they are enabled to operate the product and to execute basic maintenances and which are informed sufficiently and enabled with that by an authorised electrician.

Authorised electrician:

Persons with a suitable training, suitable education and experience, by which they are enabled to recognize risks and to avoid endangerments, which can go out of the electricity.

Work which may be executed only by authorised electrician is indicated clearly by warning signs and mandatory signs.

Kind of work	Target group	
	Operator	Authorised electrician
Connection and putting into operation		X
Operation of the machine	X	X
Maintenance:		
basic maintenance	X	
special marked maintenance		X
shut down at the end of the lifetime		X

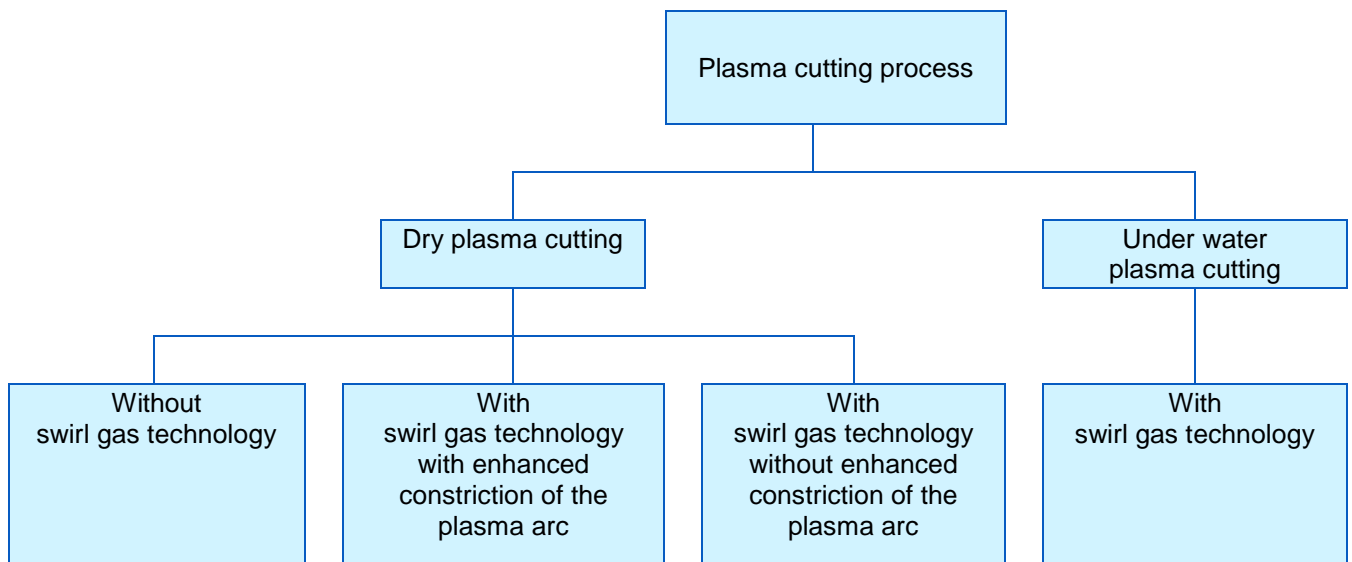
1.4 Plasma cutting as procedure

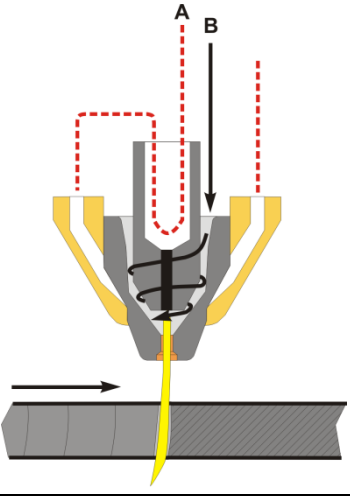
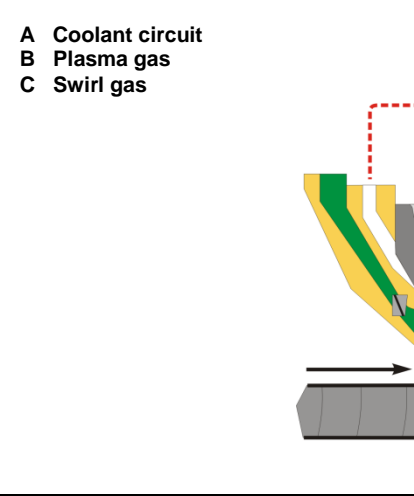
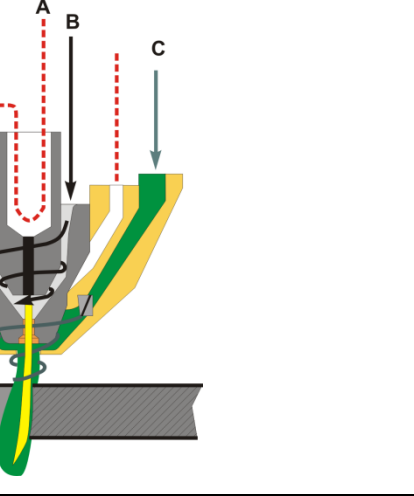
The plasma is defined as a gas having atoms and molecules which are partly split into ions and electrons and having therefore a high electrically conductivity.

In the plasma torch this gas becomes heated up extremely and leaves it through the nozzle with a high speed. Due to the high heat concentration all electrically conductive materials will melt and due to the high speed and pressure of the plasma arc the molten material will be blown away forming a very small kerf in the material.

The plasma arc hereby is transferred from the cathode, installed in the plasma torch and conducted to the negative pole of the plasma power source, to the workpiece (transferred arc).

The plasma cutting is a technology for cutting of electrically conductive metals, like constructional steels, stainless steels, aluminium, copper, etc. It is suitable for straight, profile, template and bevel cutting. Thus semi-finished products such as sheet metal, sheet metal packages, tubes, profiles, blanks, forged forming parts, cast products and scrap metal can be thermally cut or worked.



Plasma cutting process		
Dry-plasma cutting	Under water-plasma cutting	
without swirl gas	with swirl gas	with swirl gas
		
<p>A Coolant circuit B Plasma gas C Swirl gas</p> <p>In plasma cutting without swirl gas the plasma arc hits the workpiece immediately after crossing the nozzle. The nozzle can be damaged by Spatter and resulting double arcs. A damage of the nozzle causes a poor cutting quality.</p>	<p>Plasma torches with swirl gas technology are using the swirl gas for shielding the plasma arc from the environment. The nozzle of the plasma torch is protected against spatter by the swirl gas cap and the intermediately streaming swirl gas (vitaly important while hole piercing). By the possibility to vary also the swirl gas in composition and flow rate, the cutting quality can be improved further.</p>	<p>The under water plasma cutting process reduces the pollution of the environment by dust, aerosol, and noise level considerably in comparison to the dry plasma cutting process, in addition, ultraviolet radiation is filtered in the water. The distortion of the cutting material is very low. The energy consumption compared with the dry plasma cutting is however higher. By using swirl gas technology the cutting process expires with high process stability. This guarantees also high cutting quality for under water cutting.</p>

Dry plasma cutting process with swirl gas without enhanced constriction of the plasma arc	Dry plasma cutting process with swirl gas with enhanced constriction of the plasma arc (HiFocus-technology)
Angle deviations of the cutting surface are possible, especially at thin materials.	The new HiFocus-technology reduces the angle deviation of the cutting surface by an enhanced constriction and stabilization of the plasma arc.
At sheets up to 5 mm the angle deviation can amount 5 to 10 degrees.	The cutting surfaces in the thin sheet metal range are nearly rectangular, that results in much higher accuracy, comparable with laser cuts.
	Reworking of the metallic blank and dress free cutting surface is normally not necessary.

Safety instructions



2 Safety instructions

2.1 Explanation of the safety symbols



DANGER, **WARNING** and **CAUTION** are signal words, which describes a degree of exposure.

	 DANGER
	DANGER describes an endangerment with a high degree of risk , when it is not avoided, it results in death or a severe injury .




	 WARNING
	WARNING describes an endangerment with a middle degree of risk , when it is not avoided, it could result in death or a severe injury .




	 CAUTION
	CAUTION describes an endangerment with a low degree of risk , when it is not avoided, it could result in a slight or a moderate injury .

The Safety information are developed after the SAFE-structure:

	S ... Symbol with signal word  CAUTION
	A ... Art und Quelle der Restgefahr - Kind and source of the residual danger
	F ... Folge bei Missachtung - Consequence at ignoring
	E ... Entkommen - Escape

Example:

	 CAUTION
	Endangerment through free standing wheels by manual moving of the unit. Foot injuries are possible. Caution by the manual moving of the unit - wear foot guards!

	 WARNING
	Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact. Before opening (for example error search) or starting any maintenance and repair work principally the power supply source has to be switched off and visibly disconnected from the mains. Opening the plasma unit may be carried out only under responsibility of a qualified electrician!

Warning symbols (choice):



A black graphic symbol within a yellow triangle with a black edge defines a safety sign, which describes an endangerment.



Warning of general hazard area



Warning of dangerous electrical voltage!



Warning of flammable substances



Warning of explosive substances



Warning of poisonous substances



Warning of optical radiation



Warning of electromagnetic radiation



Warning of noxious or irritant substances



Warning of gas cylinder



Warning of hot surface



Warning of slip danger

Safety instructions

Mandatory sign (choice):



A white graphic symbol within a blue circle defines a safety sign, which indicates that an action shall be carried out, in order to prevent an endangerment.



General mandatory sign



Use eye shield



Use ear protection



Use inhalation protection



Use foot guard



Use hand guard



Use protective clothing



Before opening disconnect the mains plug









Consider instruction manual



Pressure gas cylinder locked by linkage

Prohibition sign (choice):

	A black graphic symbol within a red circle with a red diagonal bar defines a safety sign, which indicates that an action shall be stopped or not be carried out.
	Smoking is forbidden
	Fire, open light and smoking are forbidden
	Contact is forbidden
	Meal and drinking are forbidden
	Do not use in housing areas

Emergency sign (choice):

	First aid
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Fire protection sign (choice):

	Fire extinguisher
---	-------------------

Information is not a signal word that describes a degree of exposure.

	Information The symbol signalled hints or special useful information.
---	---

Safety instructions

Warning label

The warning label is visibly attached on the power source.

The operator and the maintenance personnel must familiarize themselves with the meaning of the symbols before working at the unit.






1. The operator and the maintenance personnel must read and understand the instruction manual as well as learning the operation of the unit before work with it to avoid endangerments. The safety regulations of the respective company have to be taken into account.
2. Smoke, dust and gases developed during the cutting process are harmful for health and may not be breathed in. Principally a suitable fume extraction device has to be used.
3. Wearing of protective clothing (helmet, welder's overall, leather apron, gauntlets, safety shoes). The protective clothing has to be isolating, dry and heavily inflammable
4. Noise can damage the hearing! During the plasma cutting operation suitable ear protection has to be used. The radiation of the plasma arc can lead to eye injuries and skin burns. Eyes and skin have to be protected from the radiation of the plasma arc therefore. Protection devices are safety goggles and hand shields, which must have a sufficient lens shade.

5. Electric shock can kill! Live electrical parts may not be touched. Opening the plasma unit may be carried out only by an advised electrician. Before carrying out any maintenance or repair work the unit has to be disconnected visibly from the mains! Wearing of protective clothing (helmet, welder's overall, leather apron, gauntlets, safety shoes). The protective clothing has to be isolating, dry and heavily inflammable.
6. Working with plasma cutting systems possibly can lead to fire and explosions. Flammable and explosive materials must therefore be kept away from the cutting area. It has to be ensured that suitable and easily accessible extinguishing facilities are located nearby. The appropriate fire protection regulations have to be taken into account.
7. Appropriate warning labels may not be removed, painted over or covered.

Further information and warning:

- to ensure stableness of the plasma unit, an inclination of 10° may not be exceeded
- connect the power source only with properly fitted protective conductor
- place the torch on an insulated place, to protect the operator against workpiece and ground potential
- keep dry the working area and all parts of the unit
- don't start the unit if components or parts are defective
- The plasma cutting machine has to be earthed and connected to the workpiece before switching on!
- switch off the unit before touching the plasma torch and prevent accidental restart
- arrange regular electric inspections (by an authorized electronics engineer)
- keep doors and flaps closed as long as the unit is connected to the power supply
- never avoid or suspend the safety interlock (for example door-, gas nozzle- and protection cap safety switch)
- do not cut closed containers
- The plasma cutting system may be used only for the appointed use. It may not be used e.g. to defrost frozen pipes.
- Do not touch the torch head, the workpiece or the water (if water table is used) when the plasma unit is working.
- Inflammable objects (e.g. lighters, matchsticks) may not be carried by the operator at the body.
- it can come to injuries caused by contacting sharp edges of the workpiece

2.2 Endangerment by high contact voltage

	 WARNING
	<p>Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact. Before opening (for example error search) or starting any maintenance and repair work principally the power supply source has to be switched off and visibly disconnected from the mains. Opening the plasma unit may be carried out only under responsibility of a qualified electrician!</p>

Before starting the machine connect the workpiece cable and earth the workpiece!

2.3 Working in environments with increased electric endangerment

The plasma cutting system is built in compliance with valid standards EN 60974-1 and therefore applicable in environments with increased hazard of electric shock.

The conditions for fulfilling these requirements are given by design measures in the plasma cutting system:




- The plasma power source and the plasma torch are forming a safety-proofed installation, which can be separated only by a tool (as far as a central connector with mechanical locking is present).
- The machine cannot be switched on as long no torch is attached or the attached torch isn't assembled completely.
- Opening the control circuit effects switching off the open circuit voltage, which drops down within the prescribed time below the limit
- Cutting with hand torch is only possible with mounted, electrically insulating protection cap, which protects against accidental touching the live nozzle cap. If the protection cap is not available the torch can not switched on (security circuit).



Therefore the plasma cutting system is S-marked and applicable in environments with increased hazard to electric shock.

	<p>The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!</p>
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2.4 Endangerment by high voltage ignition



For igniting the pilot arc a high voltage igniter is installed in the power source. When pressing the ON-button the high voltage is applied to the cathode and nozzle. After initiating the pilot arc the HV-supply becomes switched off automatically. After the cutting process has started the pilot extinguishes.




 	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>Electric shock through touching of the torch head, if the plasma unit is switched on. Electric shock can be deadly. Further personal and material damages can result from impact. Never touch the torch head, if the power source is switched on!</p>
--	--

	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>Warning of electromagnetic interferences Through the operation of the plasma cutting system in particular by the temporary high voltage ignition procedure results electromagnetic fields, which can lead to the influencing of an medical equipment (e.g. cardiac pacemakers, hearing aids, insulin pumps) and body implants. Persons concerned must consult their specialist before beginning of work at plasma cutting system!</p>
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2.5 Endangerment by electromagnetic fields

The plasma cutting installation complies with the instructions of the EN 60974-10 (VDE 0544, part 10) "Arc Welding Equipment – part 10: requirements at the Electromagnetic Compatibility (EMC)". This standard is valid for Arc Welding Installations and related processes (e.g. plasma cutting).

	<div data-bbox="735 443 938 488" style="text-align: center;"> WARNING</div> <p>Warning of electromagnetic interferences Through the operation of the plasma cutting system in particular by the temporary high voltage ignition procedure results electromagnetic fields, which can lead to the influencing of an medical equipment (e.g. cardiac pacemakers, hearing aids, insulin pumps) and body implants. Persons concerned must consult their specialist before beginning of work at plasma cutting system!</p>
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 	<div data-bbox="735 786 938 831" style="text-align: center;"> WARNING</div> <p>The plasma cutting system is an attachment of the class A according to EMC classification to CISPR11: This class A cutting mechanism is not intended for the use in living quarters, in which the current supply is made by a public low-voltage utility system. It can be possibly difficult, both by line-bound and radiated disturbances, to ensure within these ranges electromagnetic compatibility.</p>
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General

The user is responsible for installing and using the installation according to the manufacturer's instruction. If electromagnetic disturbances are detected then the user is responsible to arrange the technical solution with the assistance of the manufacturer.

Recommendations for assessment of the area (EN 60974-10)

Before installing the equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area, and shall take the following into account:

- Other supply cables, control cables, signalling and telephone cables; below and adjacent to the installation
- Radio and television transmitters and receivers
- Computer and other control equipment
- Safety devices, e.g. protections for industrial equipment
- Health of the people around, wearing pacemakers or hearing aids and other body implants
- Equipment for calibration and measuring
- Immunity of other equipment in the environment. The user shall ensure that other additional protection measures in the environment are compatible
- Time of day that cutting has to be carried out.

The size of the observed surrounding area depends on the design of the building and other activities taking place there. The range can extend over the property boundary.

Recommendations of methods to minimize disturbances

If disturbances are detected it may be necessary to carry out further precautions, such as those:

- Filtering of the mains supply
- Shielding the mains cable of the permanently installed plasma cutting (safe contact is necessary between shielding and housing)
- Regular maintenance of the plasma cutting installation
- All cover plates, service openings and flaps have to be closed before starting the unit
- No alternations on adjustments and settings should be done at the plasma unit without the acceptance of the producer
- Cutting cables should be kept as short as possible and closely together or take course close to the bottom
- Potential equalization of all metallic components should be considered inside and adjacent to the installation. The operator should be insulated from all metallic components.
- Earthing of the workpiece
- Selective screening of all other cables and equipment



The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!

2.6 Endangerment by heat and light radiation

The radiation of the plasma arc can lead to eye injuries and skin burns. Eyes and skin have to be protected from the radiation of the plasma arc therefore.

Safety measures:

- Wearing of total protective clothing (helmet, welding overall, possibly apron, gauntlet gloves, safety shoes). The protective clothing has to be insulated, dry and flame-resistant.
- Protection devices are safety goggles and hand shields, which must have a sufficient lens shade.
- The cutting area should be prepared so that reflections and transmission of ultraviolet light is reduced:
 - use of protective walls
 - arranging painting of walls with dark colour




The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!

2.7 Endangerment by gases, smoke and types of dust

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

- Keep cutting place well ventilated
- Remove fumes, smoke and dust by exhaustion devices
- Removed all chlorinated and other solvents from the cutting area because they could form phosgene gas when exposed to ultraviolet radiation
- Ensure that toxic limits become not exceeded

	In any case the user of the unit installation has to carry out measurements of the concentration of toxic substances to proof the effectiveness of the exhaust equipment!
---	--

	 WARNING
	Danger by gases and fumes when cutting galvanized material Health damage by inhalation of these gases and fumes Carry special breathing mask when cutting galvanized material!

	The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!
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2.8 Prevention of formation of oxyhydrogen

(Does only apply for plasma cutting of aluminium in any combination with water)

The molten aluminium which is blown out of the cutting kerf forms in water an aluminium granule which is oxidizing in water very fast because of its large surface.

Hydrogen is generated due to the bond of oxygen of the water. The hydrogen raises in the water table to the surface, is ignited during the cutting process and burns out (reddish flame).


This reductive process can last for days in the slag of the water cutting table. Mainly compressed air is used for the automatic level control of the water table, and by that a hydrogen-air mixture will be generated, that explosively reacts in a hydrogen share between 4 and 76 Vol.-% (oxyhydrogen gas), if it is ignited by the plasma arc.

	 WARNING
	<p>Danger of formation of highly explosive oxyhydrogen</p> <ul style="list-style-type: none"> • at hollow spaces, • at the displacing chamber of the water cutting table and • below the sheet panel lying on the cutting table. <p>There is danger of injury by exploding oxyhydrogen and flying parts.</p> <p>The following information has to be observed to avoid the danger!</p>

For water tables **with** level control Nitrogen has to be used instead of air for cutting of aluminium. Nitrogen with small purity is here sufficient.

For water tables without level control it has to be ensured, that:

- hydrogen can escape freely everywhere and is burnt out
- the inside contour of the water table is even so that no granule can gather at inaccessible spaces
- the slag and the granule are removed from the water table without delay
- the guiding machine has to be positioned after the cutting outside the water table to avoid, that hydrogen or oxyhydrogen (hydrogen-air mixture) can gather in hollow spaces (like switch boxes)
- that no hydrogen can gather below the plate which is placed on the table grating

	<p>It is not allowed to store the plates on the cutting grating for a longer time!</p>
---	---

2.9 Endangerment by noise

Be aware that during the plasma cutting a high noise level is produced.

Depending on the technological process and the cutting parameters the following sound level is reached:

Process: Dry plasma cutting					
cutting current*	material thickness	max. sound level measured at a distance of:			cutting pressure
		1 m	3 m	6 m	
[A]	[mm]	[dB(A)]	[dB(A)]	[dB(A)]	[bar]
20	1,5	89	76	75	5,2
35	6,0	91	83	80	6,0
60	6,0	94	86	84	9,9
90	6,0	96	86	83	9,9
130	6,0	100	91	86	9,9
160	25,0	105	93	91	9,9
200	15,0	112	96	90	9,9
280	20,0	104	98	93	5,5
360	25,0	104	95	91	7,0
400	40,0	112	99	96	7,0
440	70,0	112	102	100	7,0
600	150,0	122	112	107	7,0

* ... depending on the type of unit

Fig. 1: sound-level with dry plasma cutting process



**Suitable ear protection measures have to be taken in every case
(e.g. wearing of ear muffs or ear plugs)!**



The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!

Safety instructions

2.10 Endangerment by spatter

During plasma cutting and hole piercing sparks, slag and hot metal are produced. The risk of burns and fire exists!

To avoid endangerments the following has to be arranged:

- removal of all potential flammable materials from the cutting area, at least in a distance of 10 m
- cool down freshly cut material before handling or storing
- make fire extinguishers available in the cutting area

2.11 Handling of pressure reducer



For the gas supply only high- quality pressure regulators have to be used, guaranteeing a constant supply pressure. The quality of the pressure reducer influences the cutting quality and reliability of the complete unit. Furthermore the user has to follow local and national standards.



The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!



WARNING

For the plasma cutting process compressed gases are used.



To avoid endangerments following instructions have to be taken:



- please cylinders upright in secured position
- don't use damaged cylinders, pressure reducers and armatures



- only employ the pressure reducer for corresponding gas
- never lubricate pressure reducers with grease and oil
- all parts, which coming into contact with oxygen, must be absolutely free of oil and grease
- when using oxygen the pressure reducer must be furnished with an explosion protection (Protection before flame setbacks)



- perform gas pressure test acc. to chapter "Gas pressure test"



2.12 Handling of the coolant "Kjellfrost"




(only valid for units with liquid cooled torches)

For all liquid- cooled plasma torches Kjellberg Finsterwalde is using the coolant „Kjellfrost“, suitable as anti-freezer as well.


„Kjellfrost“ contains anti- corrosive inhibitors. Thereby all the components of the cooling device are protected effective against corrosion.



Please notice following items particularly:


- „Kjellfrost“ is classified as a hazardous substance in sense of the standard for hazardous substances, but not in the sense of the standard for the transportation of hazardous substances.
- Danger dominant ingredient: Ethylenglykol (Ethandiol)
- Never add water to the „Kjellfrost“ (for dilution or filling up). Only pure „Kjellfrost“ has to be used for filling up!
- The safety data sheet can be requested when required: (Tel. +49.3531.500203).
-

	<div style="background-color: yellow; text-align: center; padding: 5px;"> CAUTION</div> <p>All details given on the label of the new anti-freezer have to be followed consequently!</p> <ul style="list-style-type: none"> • „Kjellfrost“ is injurious to health • Don't drink Kjellfrost • Keep it away from food, drinks and fodder • Always clean your hands before a break and after end of work • Avoid the contact with eyes and skin • Safety goggles recommended during filling • Wear protection suit • Wear gloves from Nitril or Viton (see safety data sheet) • Immediately taking off soiled, watered clothes • Special danger of skidding by run out or spilled "Kjellfrost" • Keep away from children
	<p>First aid</p> <ul style="list-style-type: none"> • after swallowing Don't bring up, clean the mouth, drink much water, open the window for fresh air and call the doctor , present packing or label. • after eye contact Clean the eyes with much flowing water some minutes and call the doctor • after skin contact Quickly clean it with much water and soap




Safety instructions

	<p style="text-align: center;"> WARNING</p> <p>Leaked or slopped coolant "Kjellfrost" and evaporation of water portions can cause an increasing concentration of the component ethanediol.</p> <p>If there is a sufficient energy-rich ignition source, it can cause an inflammation and combustion of the ethanediol-debris.</p> <p>Absorb leaked or slopped coolant "Kjellfrost" with liquid-binding material (sand, diatomite, oil binder, acid binder, universal binder) immediately.</p> <p>Dispose the absorbed material according to official regulations.</p>
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	<p style="text-align: center;"> WARNING</p> <p>Leaking coolant "Kjellfrost" additional with influence of extreme heat causes a very fast vaporation of water portions and an increasing concentration of the component ethanediol. This can take place, for instance, if leaking coolant impacts the glowing dross at the cutting table as a result of a damaged plasma torch by collision or above the wear limits driven cathode.</p> <p>This can cause an inflammation and combustion of the ethanediol-debris.</p> <p>Absorb leaked or slopped coolant "Kjellfrost" with liquid-binding material (sand, diatomite, oil binder, acid binder, universal binder) immediately.</p> <p>Dispose the absorbed material according to official regulations.</p>
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	<p>Fire-fighting measures against ethanediol-fires</p> <p>Suitable extinguishing agents:</p> <ul style="list-style-type: none"> • water spray • alcohol resistant foam • carbon dioxide (CO₂) • extinguishing powder <p>Fight larger fires with water spray or alcohol resistant foam.</p> <p>Special hazards caused by the substance, its products of combustion or resulting gases:</p> <ul style="list-style-type: none"> • carbon monoxide (CO) • oxides of carbon, nitrogen (NO_x), sulphur • as well as not identified organic and inorganic compounds. <p>Special protective measures:</p> <p>Do not inhale explosion gases or combustion gases.</p> <p>Additional information:</p> <p>Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.</p>
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3 Maintenance

 	 WARNING
<p>Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact. Before opening (for example error search) or starting any maintenance and repair work principally the power supply source has to be switched off and visibly disconnected from the mains. Opening the plasma unit may be carried out only under responsibility of a qualified electrician!</p>	

3.1 Maintenance general

3.1.1 Intervals of maintenance

Following measures have to be taken in regular intervals:

Maintenance rate	Maintenance work	Target group	
		Operator	authorized electrical personal
weekly	<ul style="list-style-type: none"> visual inspection of the condition of the plasma power source, all system components and the plasma torches control of the filling level of the coolant (fill up on demand) inspection of the service units or fine filter for the gas supply on cleanliness (discharge resulted condensation) 	x	
monthly	<ul style="list-style-type: none"> by application of Hydrogen or Oxygen: inspection of the gas supply (see chapter gas pressure test) 	x	
all 4 to 6 month	<ul style="list-style-type: none"> Cleaning the power source and all components (control of the filter pads) 		x
	<ul style="list-style-type: none"> Cleaning small filters inside the gas connectors of the plasma gas control units 	x	
all 6 month	<ul style="list-style-type: none"> electrical revision 		x
yearly	<ul style="list-style-type: none"> for liquid cooled units: complete change of coolant „Kjellfrost“ 	x	

3.1.2 Cleaning

3.1.2.1 Cleaning of the power source

From the power source all dust and dirt which has collected inside by the fan have to be removed in intervals of 4 to 6 months. Blowing out should be done carefully with dry compressed air, more effective is to use a vacuum cleaner.

When working in shifts or under unfavourable conditions the regular cleaning should take place in shorter intervals.

For ensuring an effective cooling filter mattes, if existing, should be cleaned in water (approx. 40°C) by using standard detergents.

Manual cleaning is useful as well (beating; exhausting; with compressed air, e.g.)

In the same way all components of the system have to be cleaned.

3.1.2.2 Cleaning of the gas supply

Filter regulators and micro filters have to be cleaned weekly. Resulted condensation has to be drained; filter inserts have to be replaced in time.

The small filter screws inside the gas connectors of the plasma gas control units have to be inspected every 4 to 6 months, and cleaned if necessary. For that reason the pressure reducers of the gas cylinders have to be closed and the respective gas hose removed from the control unit. The filter screws only can be taken out by a small screw driver.

3.1.3 Electrical revision

The electrical revision of the plasma cutting system and the disposal of the noticed defects have to be carried out according to the statutory provisions via electrical specialist!

According to existing regulation an electrical revision of the plasma cutting system has to be arranged:

- after 6 months, if the installation is changing the location permanently
 - after one year, if the installation remains on the place
- a) The visual inspection should concentrate to following conditions and ensuring, that,
- the power source is in a good condition
 - the touch protection to parts functionally not activated is granted
 - main fuses or overcurrent protections are matching the line cross section
 - lines and cables are correct placed, fastened and connected (check the contact points)
 - cables and wirings are undamaged and have no burn marks
- b) By measurement has to be proofed that the protection against excessive touch potential of parts functionally not activated is granted (test of protective conductor):
The transition resistance between marked protective conductor connection of the plasma cutting system and all touchable metallic, not alive parts has to be $< 0.1 \text{ Ohm}$ if line cross section is $> 6 \text{ mm}^2$ (otherwise pay attention to EN 60204-1) $< 0.1 \text{ Ohm}$
- c) The insulating capacity of winding and line insulation has to be proofed:
- insulation value between windings and housing (protective connector terminal) $> 2.5 \text{ MOhm}$ (dry and cold condition)
 - insulation value between primary and secondary coils of the transformer T2 $> 5 \text{ MOhm}$ (dry and cold condition)

Maintenance

3.1.4 Plasma torch

The plasma torches have to be handled with care. Powerful treatment and stress load have to be avoided. All consumables have to be in clean condition and carefully changed in time (see instruction manual of the Plasma Machine Torch).

Damages of parts inside the torch, like nozzle holder and cathode tube have to be avoided.

Besides the change of consumables by using the special torch tools no other action to the torch head is allowed! Plasma torches must be transported and stored at protected places with full inserted parts on the torch head only!

Hose parcels have to be protected against damages, like sharp bending, twisting, over rolling, and thermal damages as well. The cleanness of the small filters in the gas connections has to be checked regularly at the plasma machine torch. The small filter is to be screwed in with the thread forward into the connection of the respective gas hose



CAUTION

**Coolant does not resign from the operational plasma torches at any time!
See chapter handling of the coolant "Kjellfrost".**

Defective plasma torches will be repaired exclusively by the service department or authorised repair shops of the company Kjellberg Finsterwalde!



WARNING

**All components and parts coming in touch with oxygen have to be kept free of oil and grease!
This refers specially to the torch head and the consumables.**



**You are only allowed to use ORIGINAL Kjellberg spare parts and consumables!
The use of other manufacturer consumables leads to the loss of the warranty claim.**

3.2 Maintenance special

3.2.1 Gas pressure test

When using oxygen, hydrogen or inflammable gas mixtures the check of the gas supply system is particularly important. An unnoticed gas leakage can have serious consequences.



The following gas pressure test has to be carried out separately for hydrogen, oxygen and every other inflammable gas mixture monthly:

1. Selection of the corresponding gas at the switch of the gas console (PGE) or through the data record (PGC).
2. Start the plasma unit and switch up the tumbler switch "Gas pressure test" for filling the gas hoses.
3. Close inlet valves at the pressure reducers (Tumbler switch "Gas pressure test" has to be remain switched on!).
4. Check the initial pressures of the attached gases at the respective pressure reducers. The adjusted initial pressures have to be kept constant for at least 3 min on the adjusted value.

If a pressure drop appears, the reason has to be investigated and removed immediately. After that the pressure test has to be repeated.

After a successful completion of the gas pressure test the following actions have to be carried out:

1. Turn off the tumbler switch "Gas pressure test".
2. Switch off the plasma unit.
3. Open the outlet valves at the pressure reducer.

	<div data-bbox="734 1254 941 1310"> WARNING</div> <p data-bbox="271 1321 1428 1456">Only regularly performed gas pressure tests are the guarantee for a safe operation of the gas supply system! Because of the existing risk of fire and explosion by oxygen, hydrogen and inflammable gas mixtures, the gas pressure test has to be carried out carefully and proofed by protocol.</p>
---	--

Maintenance

Year	Month	carried out gas pressure test		Date	Name	Signature
		Oxygen	Hydrogen			
	Jan					
	Feb					
	Mar					
	Apr					
	May					
	June					
	July					
	Aug					
	Sept					
	Oct					
	Nov					
	Dec					
	Jan					
	Feb					
	Mar					
	Apr					
	May					
	June					
	July					
	Aug					
	Sept					
	Oct					
	Nov					
	Dec					

Year	Month	carried out gas pressure test forming gas		Date	Name	Signature
	Jan					
	Feb					
	Mar					
	Apr					
	May					
	June					
	July					
	Aug					
	Sept					
	Oct					
	Nov					
	Dec					
	Jan					
	Feb					
	Mar					
	Apr					
	May					
	June					
	July					
	Aug					
	Sept					
	Oct					
	Nov					
	Dec					

3.2.2 Coolant system

For first filling of the cooling circuit please see item „Filling in the coolant“

Changing the coolant

Regardless of the service life of the plasma system, the coolant has to be changed completely at least every 12 months.

For this purpose, please provide an appropriate collection tank and consider the volume of the coolant tank (approx. 17 l) and the amount of coolant in the hose package.

- Unscrew the hoses of the coolant supply (M18x1.5) and the coolant return (G1/2") at the rear panel of the power source.
- Empty the coolant hoses and the plasma torch carefully with compressed air.
- Remove the left side panel of the power source.
- Unscrew the cover of the coolant tank with filler hose.
- Unscrew the upper hose connection for the coolant return at the tank (G3/8").
- Remove the connection cable of the floating switch from the terminal block.
- Untie the strap at the tank and remove the tank from the power source.
- Remove the lower hose connections for the filling level indicator (quick coupling) and the coolant supply (G1/2") via a collection tank.
- Empty and clean the coolant tank.
- Inserting the coolant tank is carried out in reversed order.
- In order to clean the pump sieve, unscrew the cap (SW 24) at the pump head. Remove and clean the sieve and re-insert it.
- Screw the left side panel back onto the power source.
- Screw the hoses for the coolant supply (M18x1.5) and the coolant return (G1/2") back onto the rear panel of the power source.
- Fill in new "Kjellfrost" according to item „Filling in the coolant“.
- Check the screw connections for tightness.
- Dispose of the coolant according to local / regional / national / international regulations.

3.2.3 Preventive periodic maintenance - component change plan

To guarantee a high availability of the unit, the strict adherence of the stated maintenance measures is necessary.

Depending on the existing individual operating conditions of the user, it can make sense to carry out a preventive periodic maintenance with component change in addition to these maintenance measures according to the following plan:

component + Article No.	Pos.	time interval					
		1 year or 1000 h	2 year or 2000 h	3 year or 3000 h	4 year or 4000 h	5 year or 5000 h	6 year or 6000 h
coolant „Kjellfrost -15 °C“ .12.62330		X	X	X	X	X	X
or coolant „Kjellfrost -25 °C“ .12.62350		X	X	X	X	X	X
pilot source contactor Q5 .10.161.719.24	04.37	X	X	X	X	X	X
ignition unit contactor Q6 .10.161.719.24	04.42	X	X	X	X	X	X
nozzle contactor Q4 .10.161.722.25	04.36	X	X	X	X	X	X
auxiliary contact Q4 .10.161.703	04.03	X	X	X	X	X	X
coolant pump, compl. .11.141.302.320	03.33				X		
torch hose package <i>by manufacturer or authorised service</i>					X		
fan M1, DM 300 mm .10.140.696	03.02					X	
fan M5, DM 250 mm .10.535.619	03.31					X	
coolant and gas cable <i>condition depending</i>							X
Relay control A1: K1, K5, K7, K8 .10.110.459 (at PCB A1) „MR-sequence control .12.LP066460“							X

Fig. 1: preventive periodic maintenance / component change plan Smart Focus

The time interval begins on the seventh year all over again (7th year as 1 year, 8 years as 2nd year, etc.).

4 Customer information on repair processing

To ensure effective processing of repair orders, please take note of the following:

▶	<p>Information</p> <p>Ship without accessories where possible</p> <ul style="list-style-type: none"> • Please send only the components suspected to be defective without any additional accessories. We do not require workpiece cables, gas hoses, operating instructions, spare parts, custom fittings etc. for the repair. • The only accessories required are those that have or could have contributed to the defect in the device, for example a plasma torch, remote control set etc.
▶	<p>Information</p> <p>Detailed description of the error</p> <p>Please provide a detailed description of the error on the repair order. Accurate information helps us to identify the error, reducing both repair times and costs.</p>
▶	<p>Information</p> <p>Plasma torches</p> <p>Please send us defective plasma torches with the consumables unchanged - exactly as the torch was loaded at the time of the error. Defective consumables provide us with important information on the sources of errors.</p>
▶	<p>Information</p> <p>Stable packaging and secure shipping</p> <ul style="list-style-type: none"> • Please package the devices and components in suitably sized containers and use non-flaking and non-shredding materials for padding. • If using styrofoam, ensure that no polystyrene chips can get into the gas or cooling water connections on the devices and components. • For previously opened devices, please always ensure that the housing and carrying handles have been firmly refastened to all mounting points on the devices. If they are not, there is a risk that the stability of the housing will be insufficient for transport and that additional damage to the device may ensue. • When sending devices weighing more than 20 kg, make sure to use a shipping company that uses pallets during transportation. This is because shipments sent as parcels are often damaged in transit.

5 Disposal

5.1 Disposal of the packing material

	packing material
plasma unit	wooden pallet or solid wooden box
plasma components and accessories	wooden pallet
consumables	plastic box (package and keeping)

If packing materials are not needed for repacking or for a possibly necessary storage of the units between intervals of normal use, the materials can properly be recycled and disposed on the basis of regional applicable regulations by a waste management company.

5.2 Disposal of the units after decommissioning

The units of the company Kjellberg Finsterwalde are products which can properly be recycled or disposed after placing out of operation on the basis of regional applicable regulations by a waste management company.



6 Power source Smart Focus 300

6.1 Technical data

Article number	.11.037.3002
primary side:	
mains voltage U_1^*:	3~ 400 V $\pm 10\%$, 50 Hz
max. connecting load:	79 kVA (100% ED)
fuse, slow:	T 125 A
mains cable:	NSSHÖU 4 x 50 mm ² Cu
power factor cos phi:	0,86 at 300 A
efficiency:	0,89
cutting side:	
open circuit voltage U_0:	400 V
cutting current I_2:	35 - 300 A
arc voltage U_2: (100 %)	200 V
cutting power P_2:	60 kW
duty cycle X:	100 % at 300 A
marking current:	10 – 50 A
workpiece cable:	conductor cross section: 35 mm ² Cu
characteristic:	drooping (CC)
ignition process:	pilot arc ignition by high voltage ignition unit; (at plasma torch connection unit PBA-300) main arc ignition by pilot arc
weight m:	488 kg
dimensions (l x b x h):	1030 x 680 x 1450 mm (with undercarriage „castors and wheels“)
protection class:	IP22
heat resistance class:	F
cooling:	Air cooled by built-in fan
torch cooling:	internal circulating cooling
coolant:	coolant mixture with integrated corrosion protection - „Kjellfrost -15 °C“ (anti freeze protection up to -15 °C) or - „Kjellfrost -25 °C“ (anti freeze protection up to -25 °C)
volume coolant box:	ca. 17 l
pressure:	5 bar bei 5 l/min
*... more voltages, see chapter "mains connection"	

Fig. 2: Technical data Smart Focus 300

6.2 Technical description



Only plasma torches of the types PerCut 2000/2000A and PerCut 4000/4000A of Kjellberg Finsterwalde are determined for use with power sources Smart Focus 130, 200 and 300 by EN 60974-1.

Exclusive these plasma torches forms a safety-related unit with the named power sources in accordance with EN 60974-7!

6.2.1 Setup

- all components of the plasma power source are mounted into a rugged housing, which is movable by hand as well as transportable with the crane
- all operation and display elements, also the level indicator for the coolant (behind the clamp) are placed at the front panel.
- the entry vents for cooling air are to find on the front panel.
- at the rear panel are:
 - the filler neck for the coolant,
 - the connectors for the workpiece cable,
 - the connectors for the cathode cable,
 - the connectors for earthing,
 - the mains cable entry,
 - the outlet vents for cooling air,
 - the connectors for the remote control,
 - the connectors for CNC-control,
 - the connectors for the plasma gas connection unit PBA-200/300 with an integrated high voltage ignition unit and
 - the connectors for the plasma gas control unit FC-300 or plasma gas adjustment unit PGE-300.
- connections for cable set PZL-200/300 and fuses, are accessible after opening the rear cover plate.
- the internal cooling system consists of the pump, the coolant tank, the heat exchanger and the flow controller for switching off the power source in case of insufficient flow rate.
- the power module contains the main transformer, the controlled 12 pulse rectifier, the cutting choke coil, the balance coil, the current relays, the shunt, the pilot resistors and the power contactors.

6.2.2 Electronic control

- optimal process sequence by micro processor control of the power source:
 - automatic monitoring
 - the individual phases of the cutting process and
 - all important processes of the plasma cutting (torch cooling, ignition time, pilot arc time, etc.)
- the electronic control made possible:
 - an optimal process control by a fast regulation of the cutting current
 - fast starting cuts through very short transition periods
 - optimal hole piercing through adjustable current rising
 - adjustable current down slope at corner-signals
- indication of process conditions and process faults by LED and display:
 - display of the preset current (nominal value) at the cutting break
 - display of the cutting voltage and current (actual value) during the cutting and marking process
- flexible adjustment of the ignition process to the necessary conditions with the help of the micro processor control

6.2.3 Special parameters of the power source

- interface for the control of the plasma unit from 2D- und 3D-CNC-guiding system, like gas cutting machines, tube cutting machines and robots:
 - analogue interface
 - serial interface (RS 485)
- serial connecting possibility of a PC for the diagnosis during service
- hose parcel extensions (PZL) (15, 25, 35, 45 or 55 m) for increasing the operational radius to max. 55 m
- special torches can be provided for special applications

6.3 Cutting technology

In the cutting data manual you will find for your plasma cutting machine the available cutting technologies and the associated parameters under point "Cutting data overview".

Contour Cut	mild steel	stainless steel	aluminium
	<ul style="list-style-type: none"> • plasma cutting technology for cutting of fine contours in best quality • cutting of small holes and inner contours in the ratio 1: 1 (diameter to thickness) with high cylindricity and contour accuracy • very high repeatability and dimensional accuracy 		
Contour Cut Speed	mild steel	stainless steel	aluminium
	<ul style="list-style-type: none"> • optimized plasma cutting technology for up to 50% faster cutting of contours • best cutting performance at highest cutting speed in quality range and low costs per cutting metre 		
HiFinox	mild steel	stainless steel	aluminium
	<ul style="list-style-type: none"> • patented plasma cutting technology with highest cutting quality for thin stainless steel and aluminium • metallic bare and dross-free cutting surfaces at the thin sheet range • very small heat affected zone 		
Ar/H2 Mix	mild steel	stainless steel	aluminium
	<ul style="list-style-type: none"> • basic technology with high cutting performance by significantly higher cutting speeds • very good contour accuracy, perpendicularity and high surface quality • dross-free plasma cutting in larger material thickness ranges • slight perpendicularity tolerance • individuelle Mischung der Gase zur optimalen Anpassung an die Schneidaufgabe 		

Cutting is possible in all positions and applicable for straight cutting (line or profile) and bevel cutting as well, on plates, sheet metal, tubes and pipes, forced and forged parts, piled plates, casted parts and scarp metal.

Because of the variable current setting the cutting power easily can be adapted to the process requirements.

6.4 Plasma marking

By application of the "Plasma FineFocus-Principle" in the plasma marking process a range of technological benefits be achieved:

- narrow marking lines
- lower heat input
- this result in a low distortion
- high marking speed
- excellent marking quality

The direct transferred plasma arc enables the marking of all electrically conductive materials with no regard to thickness and kind of material (mild steels, high alloyed steels, and special alloys).

Aluminium is less well suited for marking due to its specific material properties.

Semi-finished products such as sheet metal, tubes, profiles, blanks, forged forming parts, cast products and scrap metal can be marked.

With the continuous adjustability of marking current performance can be optimally adapted to the marking task.

Following application of plasma gases is recommended:

- Argon:
excellent marking quality for all materials
- Nitrogen:
only for higher performance at notching and punching

6.5 Putting into operation

6.5.1 Check, placement and transport

- Please check the delivery directly on the basis of the order and delivery documents on completeness and correctness. In the case of incompleteness or deviations please inform the supplier and the carrier immediately.
- Please check the delivery immediately on damages. Damages have to be announced immediately to the carrier and supplier.
A damage report has to be generated.

The Unit is designed for a service in explosion-proofed rooms or in the free air by using a roofing under following conditions:

ambient temperature:	-10 °C to +40 °C	
transport- and storage temperature:	-15 °C to +55 °C	when first filling with coolant „Kjellfrost -15 °C“ standard filling
	-25 °C to +55 °C	when first filling with coolant „Kjellfrost -25 °C“
relative moisture:	max. 90 % at 20 °C	
	max. 50 % at 40 °C	

Fig. 3: operational conditions

Place the power source so that the air flow is not blocked. The unit is to be set up in such a way that the cooling air can enter and escape unhindered by the ventilation openings. A free distance of at least 250 mm should be kept around all 4 sides of the unit.

Avoid that dust (especially metallic particles), acid damp, corrosive substances and gases can enter the unit. The life time and the function of the plasma cutting will be influenced.

The plasma cutting system is designed acc. to the requirements of the protection class IP 22 (DIN EN 60529), that means:

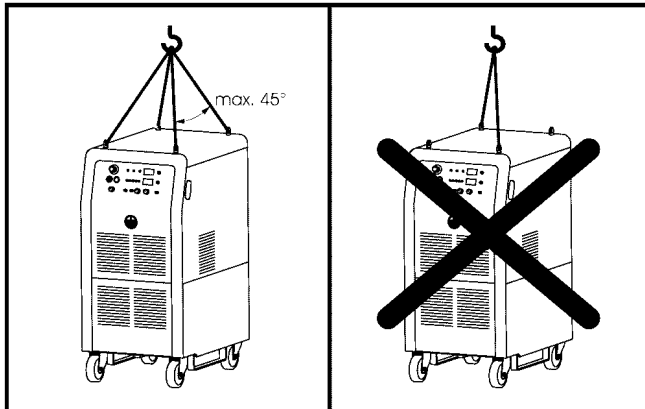
- protection against penetration of solid parts above 12 mm size
- straight dropping water does not have any damaging effect on an up to 15° inclined

The unit has to be installed horizontally.

At maintenance work a distance of approx. 1000 mm should be kept around all 4 sides of the unit.

It is possible to load the unit by forklift.

	WARNING
<p>Danger of tilting at the loading by the fork truck! Further personal and material damages can result, please note the rules of conduct when dealing with a forklift. The power source has to be taken from the side, pay attention to the load centre.</p>	



For crane transportation lifting eyes are provided.

Fig. 4: crane transport

	WARNING
<p>Endangerment at the crane transportation by falling down of the unit. Further personal and material damages can result. For crane transportation all four lifting eyes have to be used! The angle between the ropes or chains should not exceed 45°! Pay attention for the weight of the unit!</p>	

 	CAUTION
<p>Endangerment through free standing wheels by manual moving of the unit. Foot injuries are possible. Caution by the manual moving of the unit - wear foot guards!</p>	

Power source Smart Focus 300**6.5.2 Installation****6.5.2.1 Mains connection**

The plasma power source is delivered by default for the connection to the mains voltage with mains cable (5 m long). The mains cable has to be connected in compliance with the applicable regulations to a circuit breaker.

Mains fuses shall be connected in series up to the power switch according to the following chart:

Mains voltage U1 (+ 10% / - 10%)	I _{1max}	Fuse, slow	Mains cable conductor cross section Cu	Article number of power source
3~ 400 V, 50 Hz	114 A	125 A	NSSHÖU 4 x 50 mm ²	.11.037.3002
3~ 380 V, 50 Hz	120 A	125 A	NSSHÖU 4 x 50 mm ²	.11.037.3007

6.5.2.2 Workpiece connection / current return linePower source side:

For the connection of the workpiece cable a socket is provided in the rear wall of the power source.

Workpiece side:

- At plasma units, which are equipped with a workpiece cable with workpiece clamp, the connection occurs directly and firmly to the workpiece, at the component or at the device at which the cutting current is carried out (for example cutting table).
- At plasma units, which are equipped with a workpiece cable with cable lug, the connection occurs directly and firmly to a M12- thread bolt of the device, at which the cutting is carried out (for example cutting table).

You have to pay attention in each case to a good metallic contact!

**WARNING**

It is not allowed to use conductive parts of building, like steel construction, pipes, track ways or similar devices for conducting the power back to the plasma cutting system, as far cutting is not performed at those parts!

General information



The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!



Between workpiece and cutting table must be a good electrical contact!

The potential equalisation of the entire system is the responsibility of the operator and has to be carried out by an electrician *).

When integrating components of other manufacturers into the plant complex (e.g. cutting table, guiding system), it is necessary to follow the specific information given by those other manufacturers.

Protective potential equalisation

The protective potential equalisation for all relevant components of the complex is used as basic provision in case of a failure. It protects persons against electric shock in case of indirect contact *).

Functional potential equalisation

The functional potential equalisation is used in order to reduce the effects that an insulation fault as well as electric and electromagnetic disturbances might have on the operation of the plant.

Normally, the functional potential equalisation is realised by a connection with the protective conductor system. If, however, the electric interference level on the protective conductor system is too high so that the proper operation of the complex is no longer guaranteed, there is the option to install a separate earthing conductor which serves as additional functional earthing (see picture below. ²⁾).

Potential equalisation and protective conductor guidance

The potential equalisation has to be done in star shape by the shortest possible wires (preferably copper wires) with the largest possible cross section. We recommend a conductor cross section Cu of at least 25 mm² *). The wires have to be marked with the two-colour combination GREEN-YELLOW *).

The potential equalisation between plasma cutting unit, gas console, PBA and cutting table or guiding system is the responsibility of the operator. For this purpose, the plasma cutting unit, the gas console and the PBA are each equipped with a thread bolt size M8. The wires are not part of the delivery content.

The following picture shows an example of potential equalisation and protective conductor guidance. Depending on the configuration of the plant, there may be deviations from this example.

*) Cf. also EN 60204-1 (IEC 60204-1)

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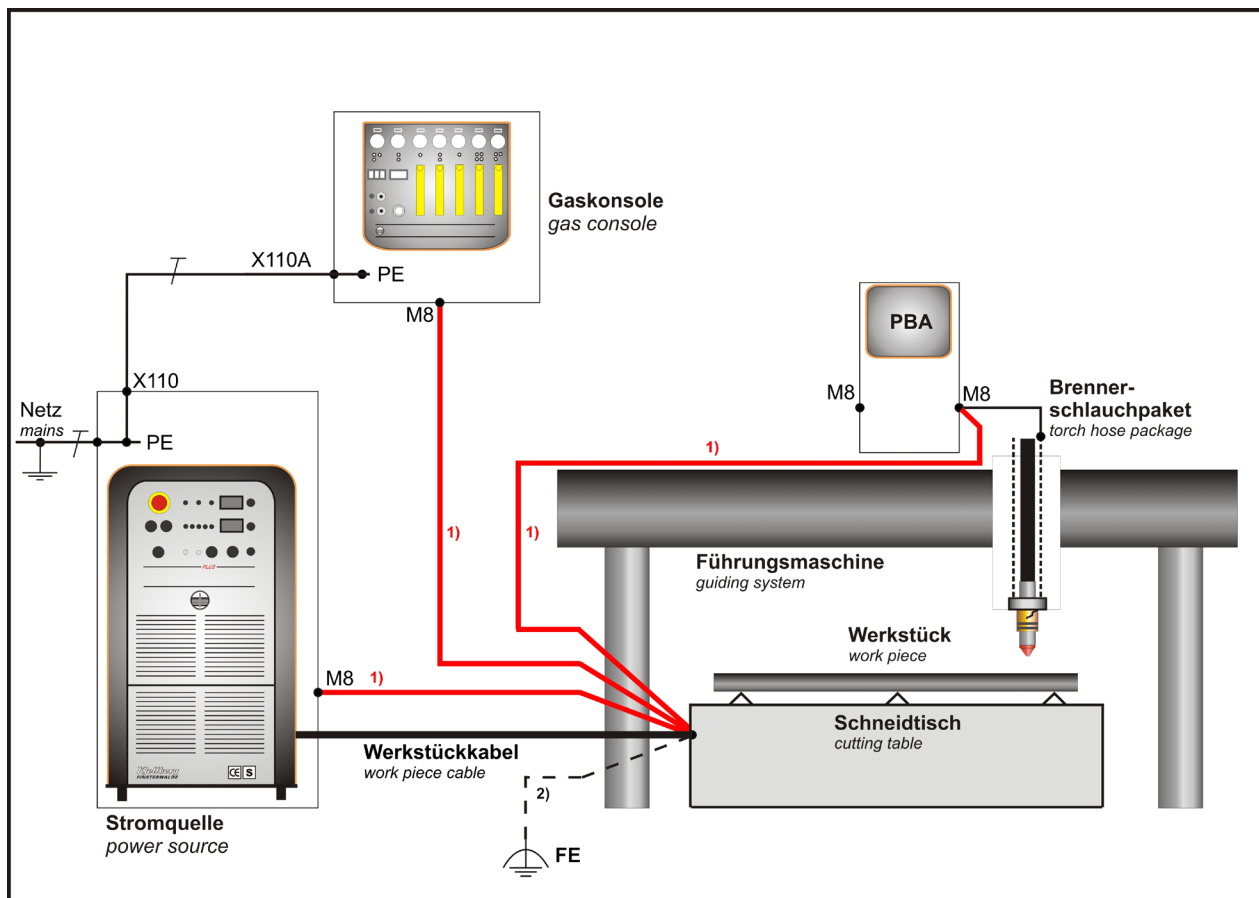




Fig. 5: Potential equalisation and protective conductor guidance, example

Footnote/Term	Explanation	Note
	Symbol for protective earth PE	
	Symbol for functional earth (FE)	
¹⁾	Installation by operator	Wires are not part of the delivery content
²⁾	External wire for additional functional earthing	Optional
Torch hose package		The earthing wire is not part of the torch hose package
PBA	Plasma torch connecting unit	With integrated ignition unit

6.5.2.3 Connections at the rear panel of the power source

All connecting and control cables will be placed to the rear panel of the power source. Voltage-carrying parts and the fuses are accessible only after opening the cover plate, which is protected by a safety contact.

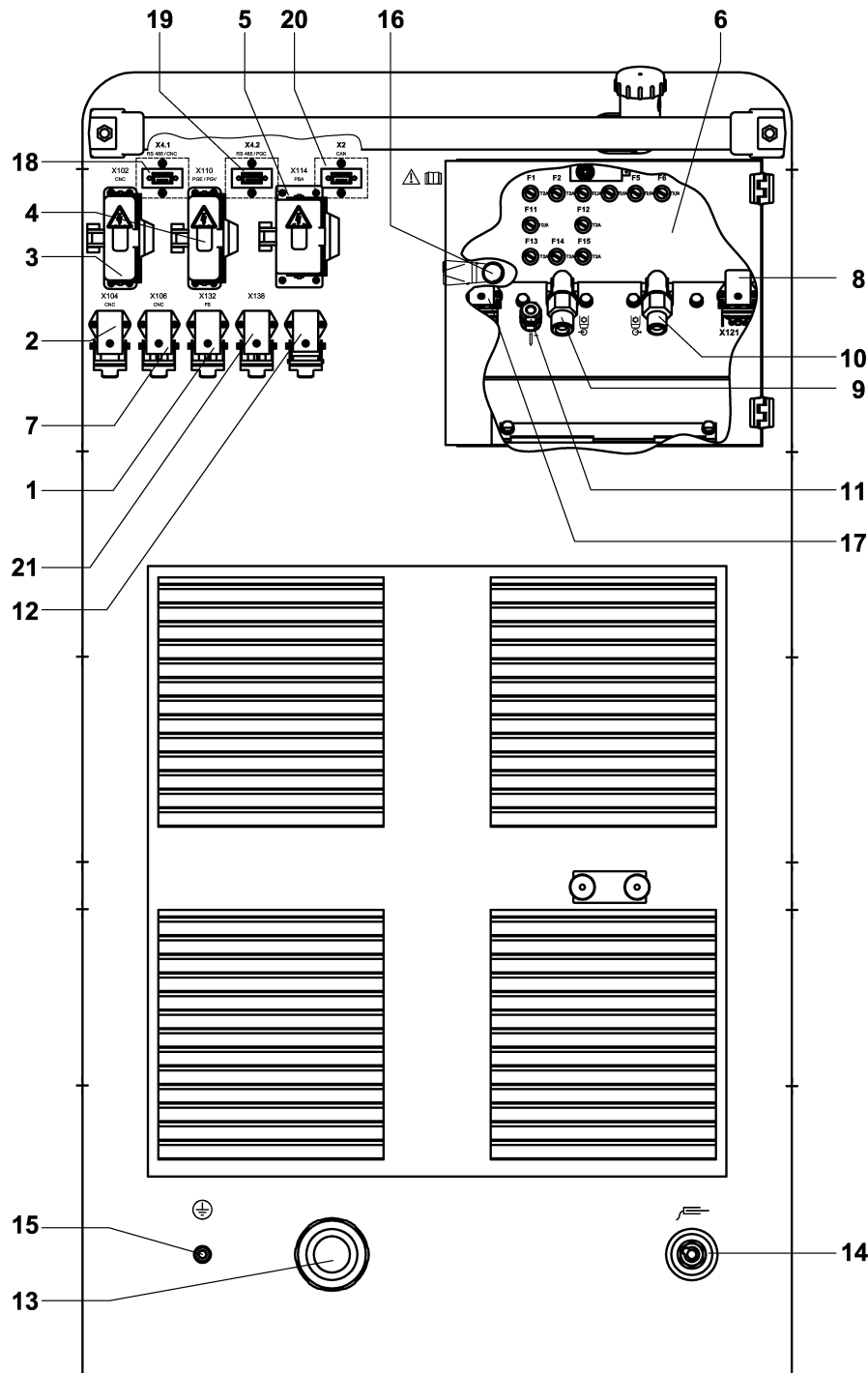


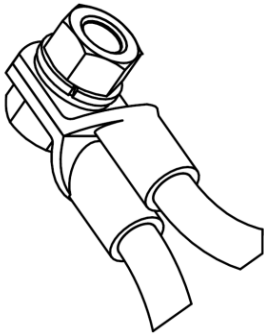
Fig. 6: rear panel connectors

Power source Smart Focus 300

1	Connector remote control (FB)	X132	8-pol. socket
2	Connector CNC	X104	4+1-pol. socket
3	Connector guiding system or height control	X102	25-pol. socket
4	Connector gas console	X110	25-pol. socket
5	Connector control cable PZL	X114	10-pol. socket
6	Fuses		F1 - F15
7	Connector remote control	X106	7+1-pol. socket
8	Connector control cable PZL	X121	7+1-pol. socket
9	Connector "coolant return"		G1/2"
10	Connector "coolant supply"		M18x1,5
11	Connector external cathode cable		terminal-M10
12	Reserve		
13	Mains cable entry		M63
14	Workpiece connection		welding cable socket
15	Terminal earthing		terminal-M8
16	Cover flap		
17	Connector control cable PZL	X122	8-pol. socket
18	Connector serial interface RS 485 (CNC)	X4.1	9-pol. plug
19	Connector serial interface RS 485 (PGC)	X4.2	9-pol. socket
20	Connector CAN-Bus	X2	9-pol. plug
21	Connector ocs (ohmic contact sensor)/ elec. initial positioning	X138	8-pol. socket

Following components are suitable for the connection to the power source:

- the plasma torch connection unit PBA-300 with the PZL
- a gas console for the adjustment and the dosage of the process gases
- the remote control FB for the operation of the process



**Fig. 7: Connector external cathode cables 2x50 mm²:
cable lugs placed against each other (11)**

6.6 Remote control FB (optional)

With the remote control FB the cutting process with the plasma machine torch can be started and stopped. It is provided with an ON-(green) and OFF-(red) button. The 10 m control cable becomes connected to the connector X132, placed on the back wall of the power source.



Information

If the Remote Control FB is connected no ignition of the plasma torch from the CNC control is possible.

6.7 Filling up the coolant

The coolant circuit is to be filled with "Kjellfrost -15 °C" (frost-resistant up to -15 °C) or "Kjellfrost -25 °C" (frost-resistant up to -25 °C). In addition to frost protection, these coolants with specially developed corrosion protection are also used for increasing the lifetime of the pump and seals as well as for increasing the service life of the coolant channels of the plasma torch. Therefore, please use exclusively the coolant „Kjellfrost“! The use of simple, standard antifreeze may cause the failure of the plasma system within a very short time.

The volume of the coolant tank amounts to approx. 17 l. The filler neck (2) is at the rear panel of the power source.

Please connect the plasma torch and fill in the coolant until it reaches the upper mark (max) of the filling level indicator (1) before switching on the plasma system.

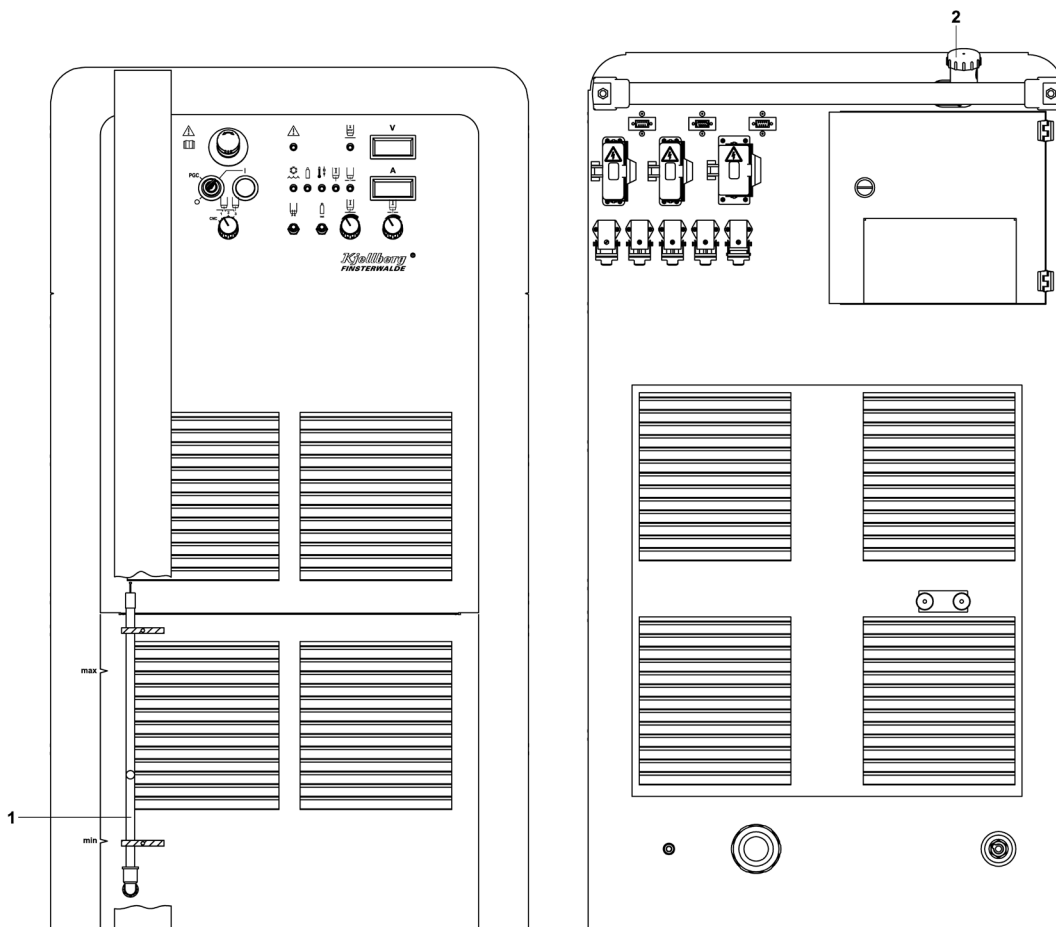
Warning: If the maximum filling quantity is exceeded, the coolant will exit the tank through the overflow and run on the floor.

Switch on the plasma system and watch the filling level indicator.

After the pump has vented the coolant hoses and the plasma torch and the coolant level does not go down any further, please refill „Kjellfrost“ up to the upper mark.

Changing the consumables and the plasma torch causes losses of the coolant. Therefore it is necessary to control the coolant level regularly and to refill the coolant before it reaches the lower mark (min) of the filling level indicator.

Regardless of the service life of the plasma system, the coolant has to be changed completely at least every 12 months.



6.8 Operating and display elements

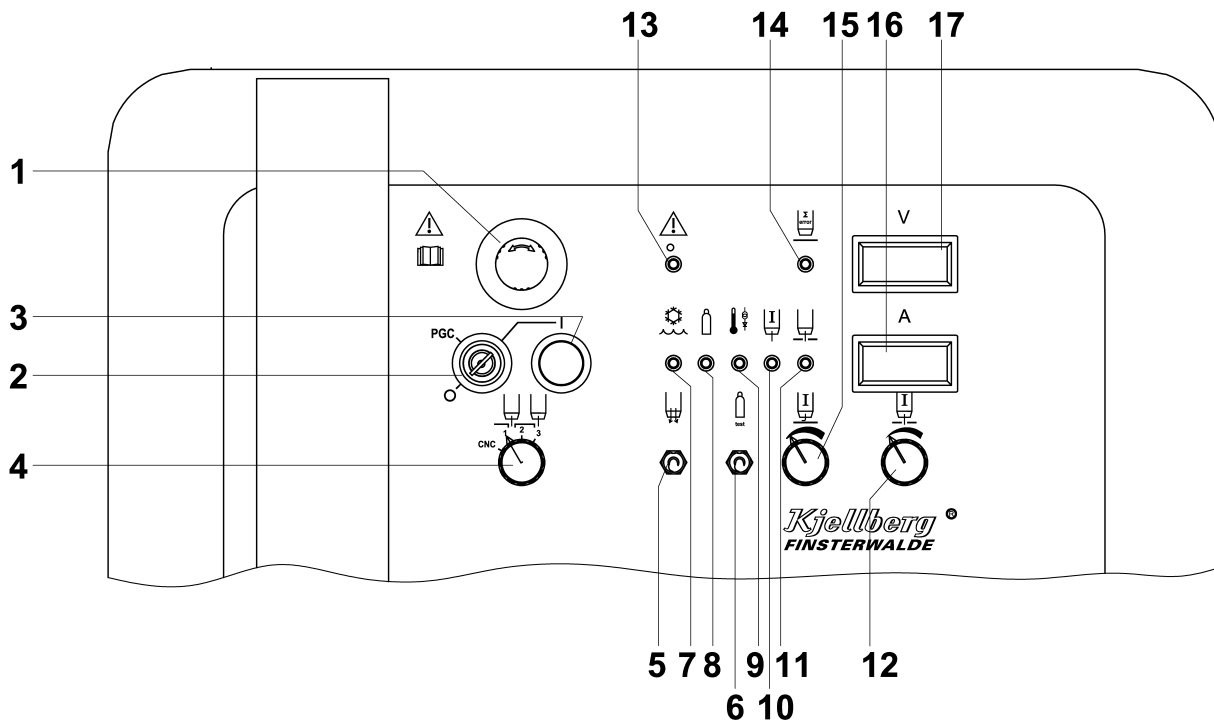


Fig. 8: Control and display elements

1. **Red emergency stop device S3 "Emergency stop", (reset button)**
 - activated: Plasma cutting unit OFF
 - unlocked: Plasma cutting unit can be switched ON
2. **Key switch S1 "Mains ON"**
 - Position 0: Voltage for control transformer and fan of controlling is OFF
 - Position PGC: Voltage for control transformer, fan of controlling and PGC is ON
 - Position I: Voltage for control transformer, fan of controlling and PGC is ON, unit can be switched ON by S2
3. **Green illuminated button S2 "PA ON"**
 - Activation: power ON for main transformer, cooling unit, fan and control system
 - signal lamp H1 ON: power source ON
4. **Selector switch S7 "Technology"**

Adjustment : see cutting charts

 - Position CNC: - CNC- controller (all areas)
 - Position 1: - range 1
 - Position 2: - range 2 (starting gas)
 - Position 3: - range 3 (starting gas and flying cutting of steel)

5. Tumbler switch "Gas test"

upper position: gas test ON

- for adjusting the gas pressure
- for blowing out of the remaining drops of coolant after change of consumables
- LED signal lamp yellow H31 "cumulative error" (13) ON
- plasma cutting system not ready for ~~operation~~ cutting

6. Tumbler switch "Gas pressure test"

Upper switch position: Gas pressure test ON

- LED signal lamp yellow "cumulative error" **(13)** and "Process error" (14) are ON
- solenoid valves are closed
- plasma cutting machine is not ready for cutting

Carry out the gas pressure test corresponding to the chapter "Maintenance special".

7. LED-signal lamp green H29 "Coolant OK"

- LED ON: cooling circuit operates (flow rate is o. k.)

8. LED-signal lamp green H28 "Gas OK"

- LED ON: pressure of plasma and swirl gases and also for control gas, see corresponding instruction manual of the gas console

9. LED-signal lamp green H30 „Temperature OK"

- LED ON: - Rectifier within the permissible thermal area
- main fan ON

10. LED signal lamp white H11 "Pilot arc"

- LED ON: pilot arc is ON

11. LED signal lamp white H10 "Main arc"

- LED ON: main arc is ON

12. potentiometer "cutting current "

adjustment of the cutting current (35 - 300 A) 5 A-steps

13. LED signal lamp yellow H31 "cumulative error gas, coolant, temperature"

- LED ON: - plasma cutting system not ready for operation
- indicates error through error codes at the current display **(16)**

14. LED signal lamp yellow H32 "process error"

- LED ON: - plasma cutting system not ready for operation cutting
- indicates error through error codes at the current display **(16)**

15. potentiometer "marking current"

adjustment of marking current (10 - 50 A)

16. current display

- indicates cutting current (actual value)
- indicates cutting current (nominal value)
- indicates "error codes", see error chart / error codes

17. voltage display

- indicates the cutting voltage
- indicates "gas test" (GAS)

Power source Smart Focus 300



information at the display	Meaning	Remark
<div>voltage</div> <div>current</div>		
<div>U-1</div> <div>100</div>	<div>device number (U-1 till U-4, U ... Unit)</div> <div>software version number (example: 1.00)</div>	will be displayed one after another for short time after the start.
<div>SF- U SF</div> <div>130 200 300</div>	<div>device type (Smart Focus) device type (Smart Focus UWP)</div> <div>Smart Focus 130, 200, 300</div>	
<div>ERS UER5</div> <div>PGE</div>	<div>gas t display U ... in case of power sources that operate in the mode UWP</div> <div>PGE connected</div>	
<div>cnc Ucnc</div> <div></div>	<div>serial connections between plasma unit and guiding system activated</div>	<div>display only during cutting breaks display U ... in case of power sources that operate in the mode UWP</div>

Fb- UFb-	remote control (FB) is connected	display only during cutting breaks display U ... in case of power sources that operate in the mode UWP
GAS	gas test active	gas flows
GCL	Gas Change Long	gas change long – between different cutting programs
0000	progression scale	
GCS	Gas Change Short	gas change short – between cutting and marking
0000	progression scale	
112	cutting voltage- actual value (example: 150 V)	display during cutting or marking
25	current- actual value (example: 130 A)	

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CNC	plasma unit waits for OF -signal from guiding system (CNC)	
OFF	disturbance end	
Fb-	plasma unit waits for OF -signal from remote control	
OFF	disturbance end	
Er1	error codes/ last error	Example for possible error messages see error chart / error codes
GRS	gas pre-flow	
PrE1	gas pre-flow phase1	gas flows before start cutting
400	open-circuit voltage at gas pre-flow (e. g.: 400V)	
PrE2	gas pre-flow phase2	gas flows before start cutting
GRS ERRS	no gas error at inlet gas error at inlet	gas pressure test is carried out
Prob	Gas pressure test	
Pos	gas post-flow	gas flows after the end of cutting

6.9 Cutting operation

	<div style="background-color: orange; text-align: center; padding: 5px;"> WARNING</div> <p>It is not allowed to operate the unit with any of the housing cover plates not in place! It is hazardous to the operator and other people in the area, and prevents the equipment from properly cooling the components!</p>
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Before cutting can start the following steps have to be taken:

Inspection of the plasma torches:





- the torch must be in a correct and undamaged condition
- the inserted consumables must match the intended cutting technology and have to be in a good shape

Inspection of the plasma power source:

- the mains fuse are of the required size (see chapter "Technical data of plasma machine")
- the workpiece cable is correct connected (see chapter "connection / current return line")

Inspection of the installed plasma gas unit:

The gas supply system is correct installed, connections are safe and tight (see chapter „connection of gas supply” – instruction manual of plasma gas unit).

  	<div style="background-color: orange; text-align: center; padding: 5px;"> WARNING</div> <p>Do not level the plasma torch towards the eyes or other parts of the body! Do not touch the nozzle, because there is an electrical hazard by the high voltage ignition and a risk of burns from the pilot arc!</p> <p>Avoid “flash burn” of the eyes by wearing safety glasses!</p>
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Operation sequences

Check before starting the gas supply, corresponding to the point "connection of the gas supply" of gas console.

1.	Red emergency stop device S3 "emergency stop" (1)	Unlock the button by turning it in one direction.
2.	Key switch S1 "Mains ON" (2)	Turn the key switch to the position „I“. switch to "PGC" when change consumables. <ul style="list-style-type: none"> • Mains voltage is applied to the control transformer. • Display of consumables at operation screen "data set parameter" of the PGC (only for FlowControl).
3.	Illuminated button green S2 „PA ON" (3)	<p>Activate the plasma unit with the illuminated push button. Main transformer, fan, pump and control are switched on.</p> <p>Inspection:</p> <ul style="list-style-type: none"> • The display screens appear for a short moment after starting the unit following messages: • <ul style="list-style-type: none"> at the voltage display (17): <i>U-I</i> = device-no. example: device 1 <i>5F</i> = device typ example: Smart Focus <i>0</i> = voltage actual value example: 0 V at the current display (16): <i>100</i> = software-version example: V 1.00 <i>300</i> = max. current power source example: 300 A <i>130</i> = current nominal value example: 130 A • green illuminated push button S2 "PA ON" (3): lights • LED signal lamp green H30 "Temperature OK" (9): lights • LED signal lamp green H29 "Coolant OK" (7): lights • An automated gas purging is started. • LED signal lamp green H28 "Gas OK" (8): lights • LED signal lamp yellow H31 "Cumulative error" (13): does not light <p>Unit is ready for operation!</p>
4.	Selector switch S7 "technology" (4)	Dial the technology range according cutting chart.
5.	Operation gas console	See instruction manual of corresponding gas console. <ul style="list-style-type: none"> • Select the necessary plasma regime. • Adjust plasma - and swirl gases according to the cutting charts.
6.	potentiometer P5 "cutting current" (12)	<ul style="list-style-type: none"> • Adjust the cutting current with the potentiometer. • Look at the value shown at the current display (16).

7.	potentiometer P7 "marking current" (15)	<ul style="list-style-type: none"> Adjust the marking current with the potentiometer. Look at the value shown at the current display (16).
8.	tumbler switch S2 "gas test" (5)	<p>Adjust the tumbler switch "Gas test":</p> <ul style="list-style-type: none"> press the tumbler switch "gas test" (5) at the power source or the switch/button "gas test" at the gas console <p>The gas test starts automatically:</p> <ul style="list-style-type: none"> when unit becomes switched ON when changing gases of PGV <p>inspection:</p> <ul style="list-style-type: none"> blowing out of the plasma torch for example blowing out of the coolant residue after consumable change LED signal lamp yellow H31 "cumulative error" (13): <p>lights</p> <ul style="list-style-type: none"> The voltage display (17) shows "GAS" (6RS)
9.	position the plasma torch	<ul style="list-style-type: none"> Bring the plasma torch in the start position. Adjust the ignition height according to the cutting chart. <p>Hole piercing occurs over the work piece.</p> <p>Flying cutting is only possible with switch position 3 of the tumbler switch S7 "technology" (4).</p>
10.	plasma torch ON	<p>Plasma torch can be switched on through:</p> <ul style="list-style-type: none"> the "torch ON"-signal of the CNC-control from the guiding system or pressing the ON-button at the remote control (FB) <p>Pilot arc ignition:</p> <ul style="list-style-type: none"> LED signal lamp white H11 "current flows" (10) : <p>lights</p> <ul style="list-style-type: none"> after pilot arc contacts work piece, main arc ignites automatically LED signal lamp white H10 "main arc" (11) : <p>lights</p>
11.	plasma cutting	Plasma cutting according to the cutting chart.
12.	plasma torch OFF	<p>Plasma torch can be switched off through:</p> <ul style="list-style-type: none"> discontinuation of the "torch ON"-signal of the CNC-control from the guiding system or pressing the OFF-button at the remote control (FB) <p>Plasma arc extinguishes</p>
13.	plasma unit OFF	<p>Turn key switch S1 „Mains ON" (2) to</p> <ul style="list-style-type: none"> Position „0 “ or Position „PGC“ (for consumable change) <p>The unit is switched off..</p>
14.	Red emergency stop device S3 "emergency stop" (1)	<p>Press the red emergency stop device S3 "emergency stop" (1).</p> <p>All integrated components of the emergency stop circle are switched OFF, after pressing the button.</p>

Fig. 1: Operation sequences

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Switch ON and OFF of the plasma torch

The pilot arc will be established by the "torch ON"-signal from the guiding system (X102:B2-B3) or when pressing the ON-button of the remote control FB after the gas preflow. The successful ignition of the pilot arc is potential free released through the signal "current flows" (X102: A3-A4). This signal is from ignition until down slope.

The arc time is limited to approx. 10 s. After contacting the workpiece the main arc automatically becomes ignited and the cutting process starts. The signal "main arc ON" (X102: A1 A2) transmitted potential free the achieved cutting power according to the current nominal value

The plasma arc extinguishes if there is no "torch ON"- signal from the CNC control of the guiding system or the "OFF"-button on remote control is activated or when overrunning the workpiece.

Flying cutting start

Flying cutting is only possible with switch position 3 of the tumbler switch S7 "technology" (4):

- switch ON torch (ignite pilot arc) 10 to 20 mm before the edge of the workpiece
- move plasma torch toward the workpiece
- as far as the pilot arc contacts the workpiece the main arc establishes
- at thin sheet metal the starting speed should be reduced
- the height between swirl gas cap and workpiece should be in a range of 1.0 to 4.0 mm. The respective torch distances are given in the cutting starts.

Hole piercing



WARNING

Upcoming hot material can lead to endangerments (risk of burns and fire)!

- when hole piercing above the workpiece the height for ignition has to be adjusted, depending on the plate thickness (values are given in the cutting chart)
- after the ignition of the pilot arc the main arc establishes immediately
- the torch should start movement simultaneously with the ignition to reduce the danger of damaging torch parts. Upcoming material can effect nozzle, swirl gas nozzle or nozzle gas
- for thicker materials the following procedure is recommended:
 - adjust ignition height acc. cutting chart (1.2 - 2 x cutting height)
 - pierce delay acc. cutting chart
 - lift torch during main arc slightly to avoid that spatter can damage the torch head
 - after the material is pierced through the torch returns to the optimum cutting height

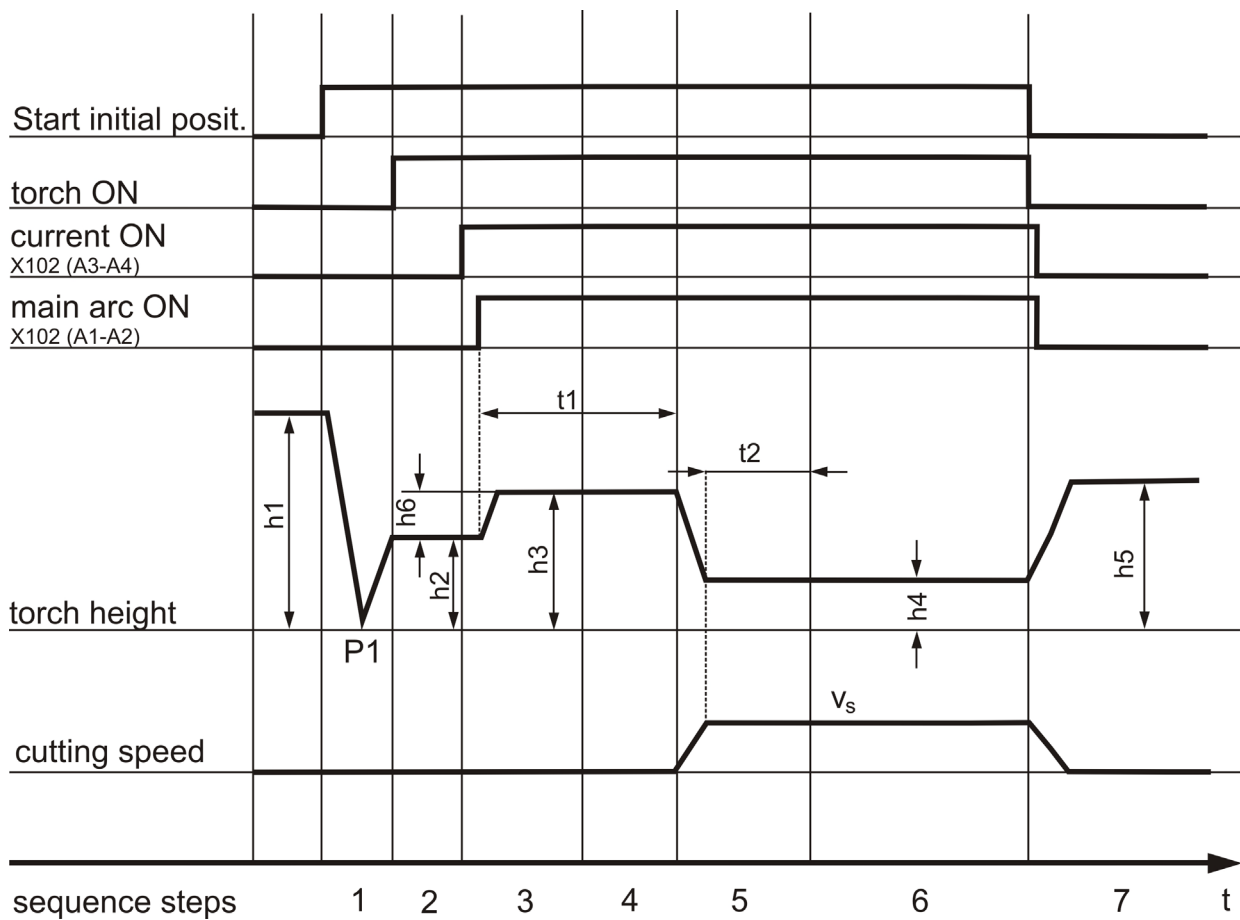


Fig. 9: schematic diagram of a cutting process with height control system

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Sequence steps of height control

- 1 Start initial positioning ON /after the initial positioning of the workpiece, the plasma torch is increased to the ignition height
- 2 torch ON / gas pre-flow / waiting for pilot arc ON
- 3 keep torch to ignition height / waiting for current flows, main arc ON
- 4 start of hole piercing, lifting up to pierce height temporary (at larger material thickness)
- 5 the lowering of the plasma torch on the cutting height occurs after the pierce time, beginning of the XY movement, start control delay for height control (control delay)
- 6 cutting with voltage-dependent height control
- 7 complete cutting process, torch lifting to transitional position

Adjustment parameters

- h1 reference position
- h2 ignition height of plasma torch
- h3 pierce height = elevated torch height at hole piercing (at larger material thickness)
- h4 cutting height
- h5 transitional height (torch height between several cuts)
- h6 additional height = pierce height - ignition height ($h6 = h3 - h2$)
- t1 pierce time
- t2 control delay for the height control:
The dynamic processes at the hole piercing has to be completed before the actual value is taken for the height control.
- P1 electric initial positioning
- v_s cutting speed

Switching OFF the plasma cutting system

The power source will be switched OFF by turning the key switch S1 "main ON" (2) to position „0“. By that all active components of the HiFocus are switched off. When activating the red emergency stop device S3 (1) "emergency-stop" all components become deenergised, with exception of the control transformer and the fan of the control.



Information

The red Emergency stop S3 "Emergency OFF" is a reset switch for starting the power source by the green push button S2 the emergency stop has to be reset by a rotation.
If the plasma cutting machine is not used for a longer period it should be disconnected visibly from the mains.

6.10 Combination of the HiFocus with CNC-controls of the guiding systems and robots

See also wiring diagram "CNC interface ..." (... SP2)

The control cable for the combination of the power source with CNC-controls of guiding systems or robots has to be connected to the 25 pole socket (X102), placed in the back wall of the power source. The respective cable the user has to prepare by himself. The necessary plug (system Wieland) can be supplied on request from Kjellberg Finsterwalde.

The potential-free contacts are dimensioned for a current load of max. 500 mA DC at a control voltage of 24 V. Relay contacts have to be furnished with a protective diode.

	Information Before connecting the control cable remove the link X102 (C3-C4). It is not possible to operate the power source without the link or without emergency stop signal from the guiding system!
--	--

X102	signal	remark
input		
B2-B3	torch ON	potential free closing contact
B4-B5	corner ON	potential free closing contact
C3-C8	data set 0/1	potential free closing contact
A7	Cutting: 0 - 10 V DC (\triangleq 35 A - 300 A) Marking: 10 – 50 A	analogue input for active control (potential free outlet from CNC required)
B6	GND DC	
C6	+15 V DC	
C5	I_soll extern ON	potential free closing contact
C4	emergency stop from CNC	potential-free break contact remove wire link from 102
output		
A1-A2	main arc ON	potential free closing contact
A3-A4	current flows	potential free closing contact
C1-C2	emergency stop from PA	potential-free break contact
C7-A8	Ready for cutting	potential free closing contact
B7-A8	Ready for operation	potential free closing contact
A9	cathode potential (0 up to -200 V DC)	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> </div> <div>cutting voltage</div> </div>
B8	nozzle potential (0 up to -100 V DC)	
C9	workpiece potential (0 V DC)	

Fig. 10: X102, signals between power source and CNC interface

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	<p>Information</p> <p>If the Remote Control FB is connected no ignition of the plasma torch from the CNC control is possible.</p>
--	--

X104	signal	remark
output		
1	GND/CNC	reference point
2	current 0 -10 V/CNC	1V \triangleq 50 A
3	voltage 0 -10 V/CNC	1V \triangleq 25 V
	PE	earthing

Fig. 11: X104, signals of current actual value and voltage actual value

X4.1	Serial interface RS-485
<p>By means of the serial interface RS-485 on the back side of the machine additional to the interface X102 records can be read or transferred. The interface connectors have the following function:</p> <p>X 4.1 Connection to CNC and</p> <p>X 4.2 Connection to PGC.</p> <p>Further information regarding received or transmitted parameters and their limits for communication between CNC/PC and power source are shown in the description. (Serial Interface - kPSP a-c)</p> <p>The descriptions (Serial Interface - kPSP a-c) can be ordered separately.</p>	

Fig. 12: X4.1, Serial interface RS-485

Switching ON via X106

The cable connector X106 offers the possibility to start and stop the plasma cutting machine HiFocus 161i directly from the guiding system.

By an internal switch, placed on the rear of the PCB-box the plasma cutting machine can be switched over to the function switching ON from guiding system.

▶	<p>Information</p> <p>According to existing safety standards it must not be possible to start the unit external (through CNC) and from the power source as well.</p> <p>The On/Off- function should be practicable only from one place! Kjellberg Finsterwalde clearly points out that in case the switching On is carried out from the CNC the user has to realize the safety function (e.g. avoiding self- acting restart after input power break).</p> <p>Furthermore by safety reasons the actuation of the key- switch during the change of consumables as stipulated in the instruction manual is obligatory.</p> <p>The green illuminated push button S2 “Stand- by” (3) which is installed in the front wall of the power source in this case is Off by safety reasons</p>
---	---

X106	signal	remark
input		
1 - 2	PA ON of CNC	potential free closing contact
3 - 4	Emergency stop of CNC	potential-free break contact remove wire link from X106
output		
5 - 6	Emergency stop of PA	potential-free break contact

Fig. 13: X106, signals distance control of CNC

▶	<p>Information</p> <p>Before connecting the control cable remove the link X102 (C3-C4). It is not possible to operate the power source without the link or without emergency stop signal from the guiding system!</p>
---	--

6.11 Multiple machine operation

For a multiple machine operation each plasma unit has to be provided with a separate machine number. Therefore the PCB Sequence control is furnished with the Jumpers J7 and J8 (see following chart). The jumper block is placed in the centre of the PCB close to the connector X30 (see fig.). Ex works the unit is adjusted to 1. The actual machine number will be shown for a short moment on the voltage display (20) just after the plasma machine is switched on.

U-1, U-2, U-3 or U-4 (Unit 1-4)

Device	1	2	3	4
J7	open	connected	open	connected
J8	open	open	connected	connected

Fig. 14: Allocation of machine numbers

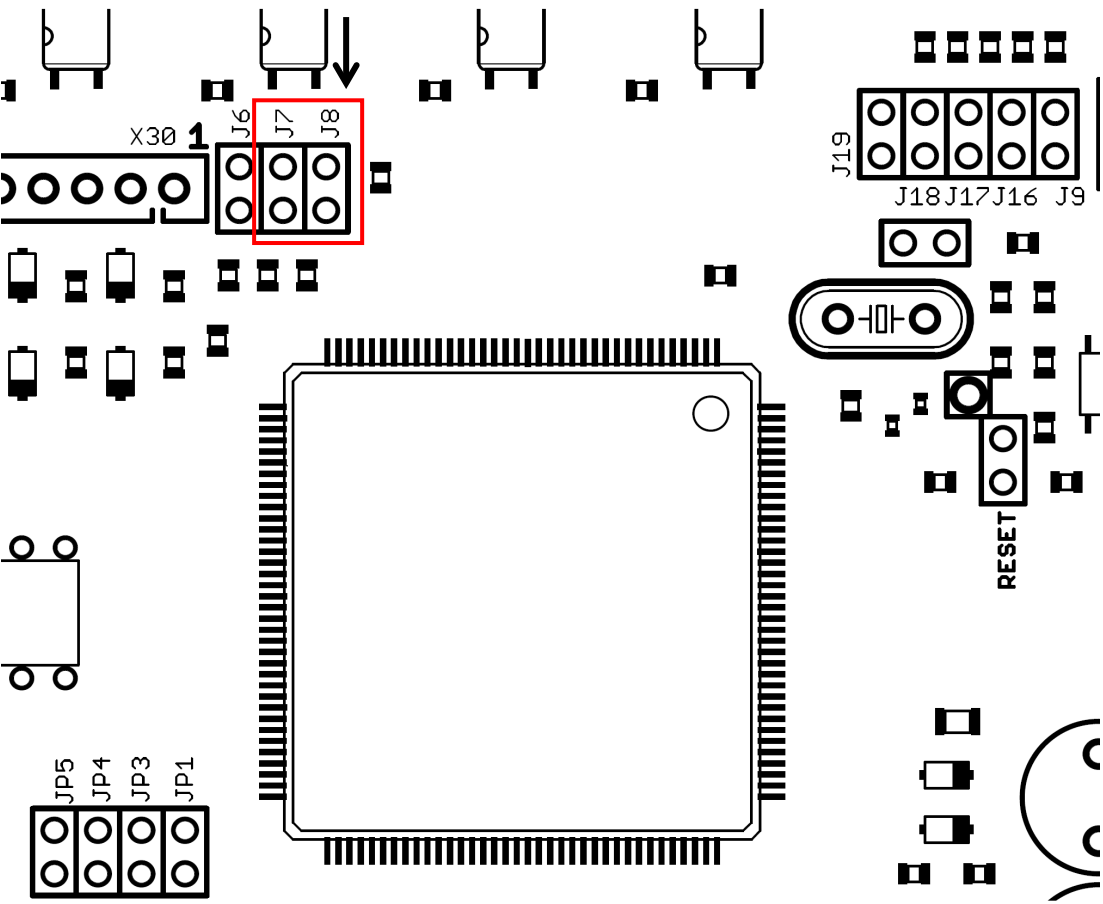
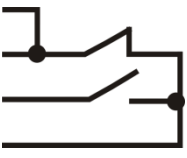


Fig. 15: Detail of LP A1

6.12 Switching regime of the power source

6.12.1 Start by remote control FB (at commissioning)

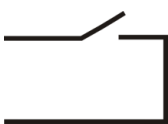
Connection to socket X132

X132	Function	Contact
4	FB operation	
1	+ 24 V	
2	FB ON	
3	FB OFF	

- The bridge 1 – 4 switches in the operating mode with remote control (FB)
- FB “ON” = - press ON-push-button shortly, switches plasma machine “ON”
- FB “OFF” = press OFF-push-button, switches plasma machine “OFF”

6.12.2 Start by CNC

Connection to socket X102


X102	Function	Contact
B2	Torch ON	
B3	Torch ON	

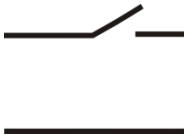
- Closed potential free contact switches plasma machine “ON”
- Opened potential free contact switches plasma machine “OFF”

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6.12.3 Start from CNC with special function "separate ignition signal"

Connection to socket X102 (process start signal) and X132 (ignition signal)

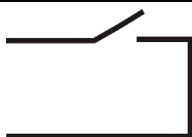
X132	Function	Contact	
1	+ 24 V		ignition signal
2	FB ON		
3	FB OFF		

X102	Function	Contact	
B2	Torch ON		process start signal (gas flow)
B3	Torch ON		

- operation mode chosen by link X132 (1-3)
- process start signal (gas flow) activated by Torch ON ((X102 (B2-B3))
- gas pre-flow is running (e.g. when lowering Z-axle)
- arc ignition by closing contact X132 (1-2)
- main arc is switched off by opening contact X132 (1-2)
- down slope is running
- gas post-flow is terminated by opening the contact X102 (B2-B3)

6.12.4 Start from CNC with special function "pre-impulse"

Connection to socket X102 (process start signal)

X102	Function	Contact	
B2	torch ON		process start signal (gas flow)
B3	torch ON		

- ON is made through a short ON impulse from CNC (X120:B2-B3); pulse duration 100 ms up to max. 180 ms
- gas pre-flow activated (e.g. when lowering Z-axle)
- arc ignition occurs after closing of the contacts X102 (B2-B3)
- re-closing of the contacts have to occur not later than 20 s after first impulse, otherwise the plasma unit goes automatically into the condition OFF
- OFF by opening contact X102 (B2-B3) during the cutting process or automatically due to the timeout after first start impulse.

6.13 Protective facilities

The plasma cutting machine is ready for operation, when after actuating the key switch S1 "mains on" **(2)** and the green illuminated push button S2 "PA ON" **(3)** and the

- LED signal lamp green H30 "Temperature OK" **(9)**,
- LED signal lamp green H28 "Gas OK" **(8)** and the
- LED signal lamp green H29 "coolant OK" **(7)** are ON,
- LED signal lamp yellow H31 "cumulative error" **(13)** is OFF and
- the nominal value of the cutting current is shown at the current display **(16)**.

The protection circuits are acting as described in the following and switching OFF the power source:

- Emergency stop of PA, locking switch, emergency stop of CNC, locking switch of PBA, filling level of the coolant




After using the key switch S1 "Mains ON" **(2)** the power source will not start when pressing the green illuminated push button S2 "PA ON" **(3)**. (Pump M6, fan M5 and main fan M1 do not start to run, control transformer T1 and fans M2-M4 are ON.)

By the following errors the LED signal lamp yellow H31 "cumulative error" **(13)** is ON the green illuminated push button S2 "PA ON" **(3)** is ON:

- coolant flow control
 - switches OFF at a flow rate < 3,0 l/min
 - (Shows error at current display **(16)**, see also error list/ error codes of power source)
 - LED signal lamp green H29 "coolant OK" **(7)** is OFF (Information: if long extensions are in the circuit it can take 1 min before the cooling circuit is activated)
- gas pressure control
 - switches OFF if gas is missing, gas pressure is < 0,4 MPa (4 bar) or when swirl gas cap is missing
 - LED signal lamp green H28 "Gas OK" **(8)** OFF
- temperature control
 - switches OFF in case of thermal overload of the inverter module
 - LED signal lamp green H30 "Temperature OK" **(9)** OFF

The readiness for cutting of the unit is signalled, when the gas test has finished in addition to the readiness of operation.

6.14 Information for trouble shooting

	 WARNING
	<p>Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact. Before opening (for example error search) or starting any maintenance and repair work principally the power supply source has to be switched off and visibly disconnected from the mains. Opening the plasma unit may be carried out only under responsibility of a qualified electrician!</p>

If during the operation malfunctions are registered the cutting has to be stopped and the reason to be found out.

error	reason / solution
1. After activating the key switch S1 "mains ON" (2) to position „I“ and switching on the green illuminated push button S2 "PA ON" (3), Pa does not switch ON	<ul style="list-style-type: none"> • emergency-stop device S3 "emergency stop" (1) is activated (reset switch) • „emergency stop“ of CNC is activated • link X102 (C3-C4) and X106 (1-2) for operation without CNC • cover plate on back wall of PA or door of PBA open • control cable plasma torch not connected to X121/X122 • filling level in the coolant tank too low
2. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H28 "Gas OK" (8) is OFF	<ul style="list-style-type: none"> • low pressure of selected gases (see cutting chart)
3. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H29 "Coolant OK" (7) is OFF	<ul style="list-style-type: none"> • coolant flow < 3.0 l/min • no or less coolant filled up
4. LED signal lamp yellow H31 "cumulative error" (13) is ON and LED signal lamp green H30 "Temperature OK" (9) is OFF	<ul style="list-style-type: none"> • thermal overload on rectifier → cool down by running fan
5. LED signal lamp white H11 "Pilot arc" (10) OFF:	<ul style="list-style-type: none"> • no ignition • check the pilot current
6. LED signal lamp white H10 "Main arc" (11) OFF: plasma cutting machine switches OFF after ca. 10 s	<ul style="list-style-type: none"> • no cutting power, main power source OFF • pilot arc time > 10 s; • pilot arc without contact to workpiece • no current flow to workpiece <ul style="list-style-type: none"> - workpiece cable not connected - ignition height not correct

The plasma sequence control of the plasma cutting system is displaying certain error codes, if during service or operation errors are noticed. The current display indicates the corresponding error messages and additionally the respective LED light.

The description of these errors and the rectification is given in the following chart:

current-display	relevance	LED-display	cause	end or fault clearance	
Er 2	Error power source	LED-signal lamp yellow H31 “Cumulative error“ (13) lights and LED-signal lamp yellow H32 “Process error“ (14) flashes	current relay K1.x “main source” or K2 “current flows” or K3 “current pilot source flows“ is pulled or voltage at the torch without “torch ON”-signal	remote control: press “FB OFF” stop “torch ON”	inform the service!
Er21	Transfer arc		current relay K3		
Er22	Main arc		current relay K1		
Er24	Pilot arc		current relay K2		
Er27	Fuse PBA defect		check measuring cable cathode voltage and fuse F1 in PBA		
Er28	Torch solenoid valve		Voltage of torch solenoid valves not OK		
Er29	Actual current detected		Current flow without ON signal		
Er 3	Error torch	LED-signal lamp yellow H31 “cumulative error“ (13) ON	current flow during gas preflow →short circuit at the torch	switch OFF unit, check torch and consumables	
Er31	Transfer arc		Current relay K3		
Er32	Main arc K1		Current relay K1		
Er34	Pilot arc		Current relay K2		
Er39	Actual current detected		Current flow with ON signal		
Er 4	Pilot arc time	LED-signal lamp yellow H32 “Process error“ (14)	pilot arc time exceeded	remote control: press FB OFF CNC: stop ON	
Er 5	Ignition time	LED-signal lamp yellow H32 “Process error“ (14)	HV ignition time exceeded or no ignition	remote control: press FB OFF CNC: stop ON	
Er 6	Main arc interruption	LED-signal lamp yellow H32 “Process error“ (14)	arc interruption during cutting (main source)	end after ca. 1 s	

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current-display	relevance	LED-display	cause	end or fault clearance
Er 8	Gas test period	LED-signal lamp yellow H32 "Process error" (14)	max. time exceeded, stop gas test and start again if required	tumbler switch "gas test" OFF
Er 9	Pilot arc interruption	LED-signal lamp yellow H32 "Process error" (14)	plasma arc interruption during ignition (pilot source) main arc is not formed	end after ca. 1 s
Er10	Communication error	LED-signal lamp yellow H32 "Process error" (14)	X110 (B2) interrupted CAN communication between PGC ↔ PGV interrupted	Control connection X102 (B2) and PGC - PGV
Er43	Coolant error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H29 "coolant OK" (7) OFF	coolant missing	settle disturbances
Er51	Temperature error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H30 "temperature OK" (9) OFF	high temperature	settle disturbances
Er60	Sequence error	LED-signal lamp yellow H32 "Process error" (14)	Error in the cutting sequence	external release missed
Er70	Gas error	LED-signal lamp yellow H31 "Cumulative error" (13) ON and green H28 "gas OK" (8) OFF	gas missing	check gas bottle if necessary replace
Er71			gas missing at start of power source	open gas bottle
Er72			gas pressure too low	check gas, start the power source again



7 Plasma gas control unit FlowControl-300

FC 300, Art.-No.:	.11.825.1250 (PGV-300)		.11.420.008 (PGC-300)			
Operating voltage						
Solenoid valves:	24 V AC, 50 / 60 Hz					
Control	230 V AC, 50 / 60 Hz		24 V DC			
Dimensions (lxbxh):	517 x 551 x 445 mm		350 x 116 x 338 mm			
Weight:	ca. 29 kg		2,6 kg			
Connectable gases:	Air	Argon	Hydrogen			
Purity:	1)	99,996 %	99,95 %			
Information:	dirt, oil and water free					
Filter / fine filter:	2)					
Flow rate, max.:	1100 l/h 5300 l/h 4)	3100 l/h	2300 l/h			
Maximum pressure:	12 bar	12 bar	12 bar			
Inlet pressure:	10 bar	10 bar	11 bar			
Connection:	G1/4"	G1/4"	G3/8"LH			
Usage as:	PG1, PG2, KG	PG1, PG2, KG	PG3			
Connectable gases:	Air	Oxygen	Nitrogen	Forming gas N ₂ /H ₂ (95/5) %		
Purity:	1)	99,5 %	99,999 %			
Information:	dirt, oil and water free					
Filter / fine filter:	2)	3)				
Flow rate, max.:	5300 l/h	3500 l/h	1800 l/h	1900 l/h		
Maximum pressure:	12 bar	12 bar	12 bar	12 bar		
Inlet pressure:	10 bar	10 bar	10 bar	10 bar		
Connection:	G1/4"	G1/4"	G1/4"	G3/8"LH		
Usage as:	WG2	PG2, WG1	PG1, PG2, KG, WG1	WG2		
	1)	Requirements to air quality ISO 8573-1:2010 [1:4:1]				
		max. size of particles:	0.1 – 0.5 µm	0.5 – 1 µm	1 - 5 µm	(category 1)
			≤ 20.000	≤ 400	≤ 10	
		max. pressure dew point:	+3 °C			(category 4)
		max. rest oil content:	0.01 mg/m ³			(category 1)
	2)	Air: 5/0.01µm, 16 bar				
	3)	O ₂ : 5/0.01 µm, 10 bar				
	4)	Air: WG 5µm, 16 bar				

Fig. 16: Technical data

7.2 Technical description

The plasma FlowControl is needed when adjusting and dosing the plasma and swirl gases (process gases) according to operation.

The FlowControl consists of two partial devices:

1. the plasma gas controller (PGC)

It contains the necessary cutting data for the cutting process and controls the volume flow and the timing of the single process gases.

2. the plasma valve unit (PGV)

It contains all switching and control elements for the gas flow of the process gases: gas connections, push switches, solenoid valves, also the flow measurements and adjustment equipments.

Gas test can be selected by using the button "gas test" at the PGC.

The process gases, which are pre-selected with the cutting program, flow.

The adjustment of the required gas parameters occurs through the selection of the suitable record at the PGC for the cutting task:

- at manual operation: for adjustment of the parameters with hand wheel or
- at automatic operation: by transfer of these parameters from the CNC control to the PGC over the serial connection RS485.

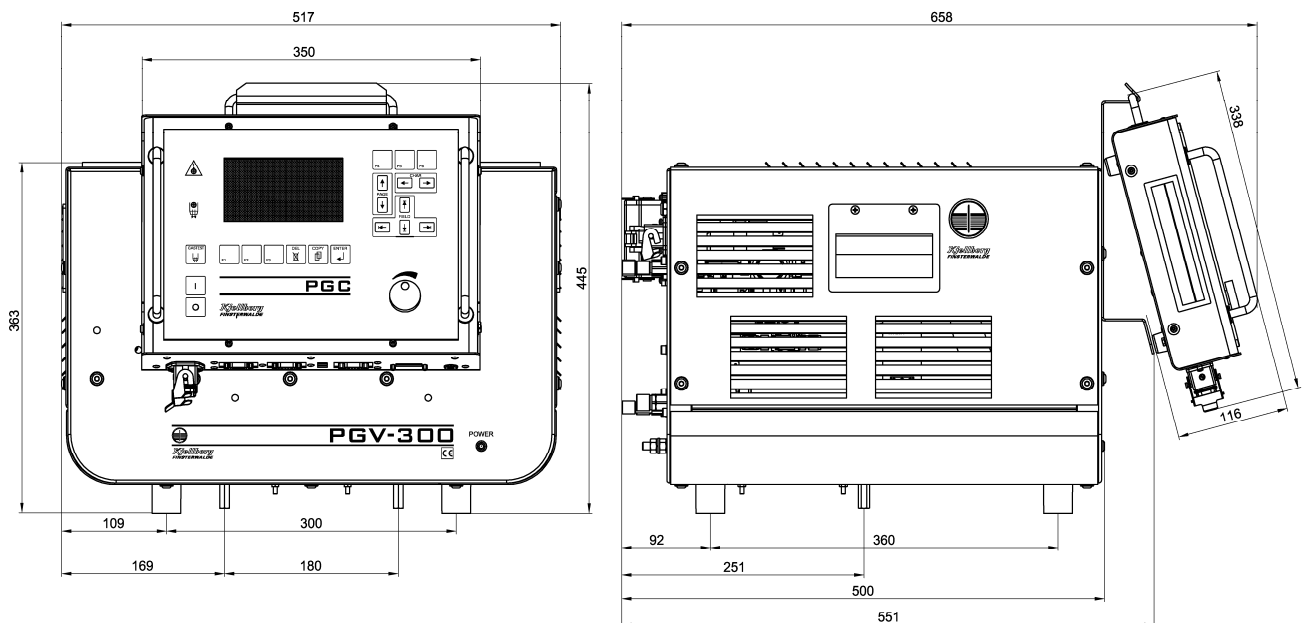


Fig. 17: Dimension diagram

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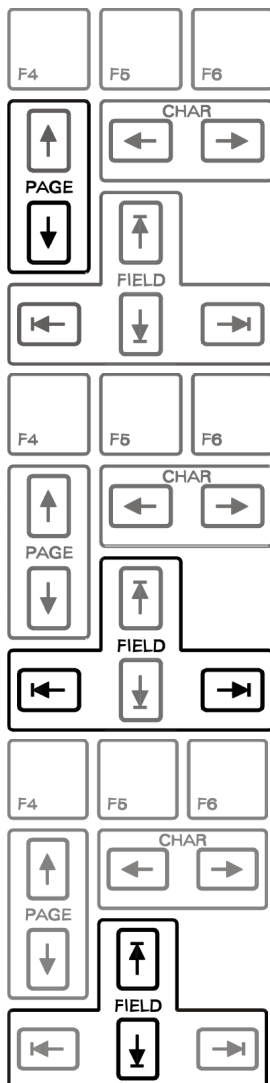
7.2.1 Operation

When switching ON the power source the gas control is furnished with the supply voltage. The micro processor of the PGC becomes initialised and performs the connection to the other components of the system. On the display panel the start screen appears.

The PGC administrated 16 internal data bases with up to 13.986 different cutting data sets, which includes all the necessary parameters for the cutting process. The data bases are characterised through the type of the power source, the gas console and the torch.

In a data base, there can be put down up to 1499 cutting data bases, divided into two ranges:

1. default data 001 – 999
pre-set, proved cutting data
2. user data 1000 - 1499
for the storing of the modified cutting data through the user
(for example due to changed material qualities)



This change takes place:

- automatically after a preset time
(under the provision that the components connected to the CAN bus will be recognised from the PGC) or
- by pressing the page-down button
the components required for the CAN bus must not be available for that purpose)).

The field Language allows the selection for the service of the unit in the desired language (German / English / French ...). The selection of the language is done with the buttons FIELD right/left.

In the field Torch the desired range of data can be selected. The selection of the data field range is carried out with the buttons FIELD right/left.

Change between language and data field range by key FIELD up/down.

Fig. 18: Sections of the using front panel of the PGC

7.2.2 Operation screen "start screen"

The start screen will be displayed immediately after applying the current supply. After a fixed time it automatically changes to the operation screen.

Software version number of PGV will be displayed after succesful connection between PGC and PGV.

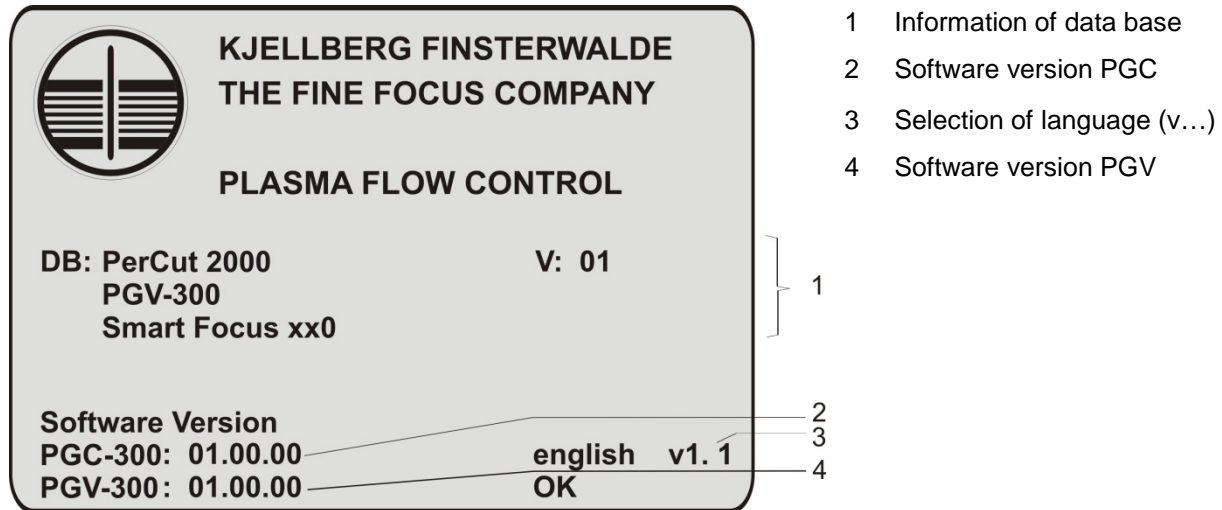


Fig. 19: Example of start screen

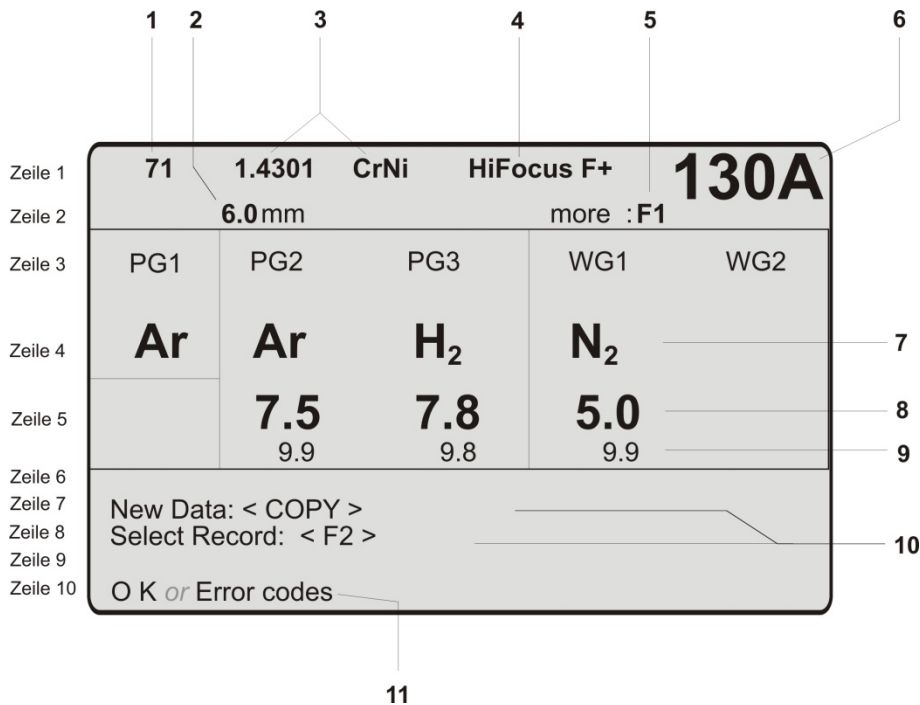
Switching possibilities

execution	action
data base selecection	FIELD right / left
language selection	FIELD right / left
For operation screen "cutting	PAGE down
For operation screen "support"	PAGE up

Fig. 20: Switching possibilities operation screen "start screen"

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7.2.3 Operation screen "Cutting"



- 1 record number
- 2 thickness
- 3 material
- 4 technology / comment
- 5 button for further information on the data record
- 6 cutting current
- 7 dedicated gas per kind of gas
- 8 pressure per gas (cutting gas reference value)
- 9 cutting gas actual value
- 10 order display
- 11 report

Fig. 21: Display operation screen "cutting"

line 1	1	set number: only set numbers covered with data will be displayed
	3	kind of material description
	4	description of the comment
	6	necessary cutting current (only in manual operation and PGC is master)
line 2	2	thickness
	5	after using the key F1 - display of the record parameter opens itself (notice about employed consumables and further cutting parameters)
lines 3 - 6		<p>In these lines the ignition gas, cutting gas and swirl gases will be displayed. Cutting gases PG 2-3 and swirl gases WG 1-2 are possible.</p> <p>If one data set is selected the respective windows indicates the valid gases (line 4) for this set, as well as cutting gas-reference pressure in Bar (line 5) and their cutting gas-actual pressure in Bar (line 6). For gases that are not used the fields of the respective gas path are blank.</p> <p>In this case the pilot arc becomes ignited with the gas of the path PG1.</p>
lines 7 - 8		<p>Command line</p> <p>Indications are given for possible commands, like: copying of the data set, repeated transmission of parameters, gas test and process runs etc.</p>
line 9		<p>Information</p> <p>„no data set on I/O“ or „no free memory capacity available“</p>

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line 10 Error display

Group 1: communication error	
Error display	Cause
CAN-PGV	<ul style="list-style-type: none"> • connection to PGV is interrupted
Current	<ul style="list-style-type: none"> • PGC is Master and does not have a RS 485 connection to the power source.

Gruppe 2: gas error	
Error display	Cause
cap	<ul style="list-style-type: none"> • torch is not correctly installed
error: pressure]-> PG2, PG3, WG1, WG2	<ul style="list-style-type: none"> • outlet pressure of used gases too high +20 % cutting gas-reference pressure
error: pressure]-> pg2, pg3, wg1, wg2	<ul style="list-style-type: none"> • outlet pressure of used gases too low -20 % cutting gas-reference pressure
set. ch.	<ul style="list-style-type: none"> • there is no data set selected
invalid set	<ul style="list-style-type: none"> • CNC has sent wrong gas combination

Group 3: Warning	
display	Cause
Warning: pressure pg2, pg3, wg1, wg2	<ul style="list-style-type: none"> • outlet pressure of used gases too low -10 % cutting gas-reference pressure
Warning: pressure PG2, PG3, WG1, WG2	<ul style="list-style-type: none"> • outlet pressure of used gases too high +10 % cutting gas-reference pressure

Switching possibilities

execution	action
data set selection	hand wheel (available data sets)
data set confirmation	ENTER
cutting pressure selection	hand wheel (2,5 – 10,0 bar)
cutting current selection	hand wheel (current in A)
For operation screen “start screen”	PAGE up
For operation screen “data set overview”	PAGE down
create a new data set	COPY
view technology data	F1
confirm new data set	ENTER
delete user data set	DEL
change data set	
field to field	FIELD right/left
sign to sign	CHAR right/left
sign selection	hand wheel
to field set number	F2
gas test	GAS TEST
choose stored set	button 0/I
show stored data set at 0	button 0
show stored data set at I	button I
activate the data set choice of button 0 / I	F3
finish the data set choice of button 0 / I	F2

Fig. 22: switching position operation screen “cutting”

7.2.4 Operation screen "record parameters"

By operating the button F1 it is possible to switch from the screen „Cutting“ into the screen „Record parameter“. Information regarding torch consumables have to be used and recommended technological parameters for the cutting process are shown. This screen can not be modified. Return to the screen „Cutting“ is possible by second operation of the F1 button.

After pressing the COPY button during screen „Cutting“ is shown, it switches into screen „Record parameter“, too. Now overwriting of arrays is possible.

At first the PGC shows the next free user record (1000 - 1499). With the rotating knob a record number can be chosen. Select the changeable arrays with the FIELD keys and go with the CHAR keys within this arrays from sign to sign. With the rotating knob values and signs can be chosen or changed.

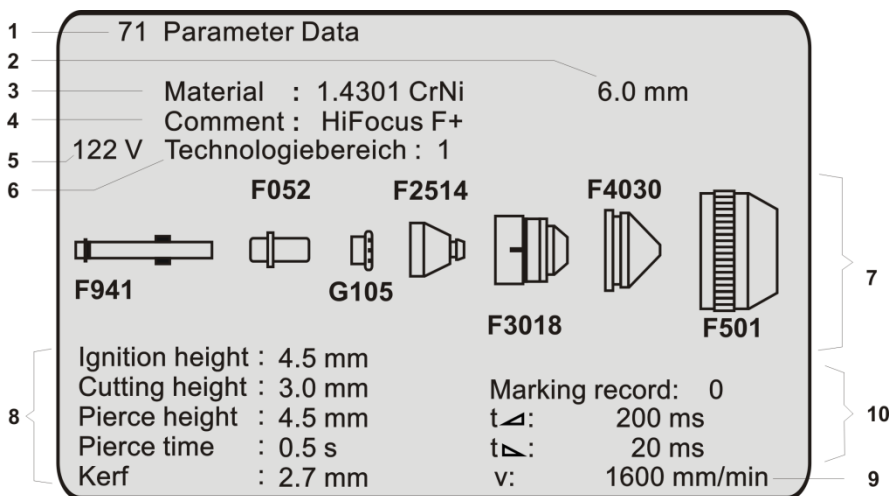


Fig. 23: Display example "parameter data"

1	record display	display of record number
2	thickness	thickness of the cutting material
3	material	kind of material
4	comment	display of the according technology or comment
5	cutting current	value of the cutting voltage, that has to be expected at the cutting process
6	technology range	position of the technology range switch (e.g. 1)
7	torch consumables	display of the necessary consumables
8	technology parameter	display of the recommended cutting parameters for the guiding machine
9	cutting speed	recommended speed of the torch in the stable cutting process
10	marking record	information of the according marking record

Switching position

execution	action
1. possibility: with F1-button to parameter data	
to the operation screen	F1
2. possibility: with COPY-button to parameter data	
select a new data set	hand wheel
cursor field by field	FIELD up / down
cursor field by field	FIELD right / left
save data set	ENTER
(only possible in range 1000 - 1499)	
cursor sign by sign	CHAR right / left
change the sign and/or value	hand wheel
For operation screen "cutting"	PAGE up

Fig. 24: Switching position operations screen "parameter data"

7.2.5 Operation screen "data survey"

Technology data servy					
#:	Material	:	mm:	A:Comment	
1:	1.0037 S235	:	1.0:	35: CCS	1 set number
2:	1.0037 S235	:	1.5:	35: CC	2 kind of material or gas combination
3:	1.0037 S235	:	2.0:	35: CC	3 thickness
4:	1.0037 S235	:	3.0:	35: CC	4 cutting current
5:	1.0037 S235	:	4.0:	35: CC	5 comment
6:	1.0037 S235	:	5.0:	35: CC	
7:	1.0037 S235	:	6.0:	35: CC	
8:	1.0037 S235	:	4.0:	60: CCS	
9:	1.0037 S235	:	5.0:	60: CCS	
10:	1.0037 S235	:	6.0:	60: CCS	
11:	1.0037 S235	:	8.0:	60: CCS	
12:	1.0037 S235	:	10.0:	60: CCS	
13:	1.0037 S235	:	4.0:	90: CCS	
14:	1.0037 S235	:	5.0:	90: CCS	

Fig. 25: Display "data survey"

Changing into this operation screen from the operation screen "cutting" is possible pressing the button "PAGE down".

A list of all in the PGC installed data records is available (for the respective torch) in the operation screen "data survey". It will be displayed ascending to the respective record number.

A overview of all in the PGC unlocked gas combinations is in the data survey of the torch range "CNC data record". Only these combinations are released in CNC-operation by the PGC.

Switching possibilities

execution	action
data set selection	ENTER
cursor data set wise scroll	FIELD up / down
scroll page by page	FIELD right / left
delete data set (only possible for set range 1000 - 1499)	DEL
For operation screen "cutting"	PAGE up
For operation screen "configuration data"	PAGE down

Fig. 26: Switching position operation screen "data survey"

7.2.6 Operation screen "Configuration data"

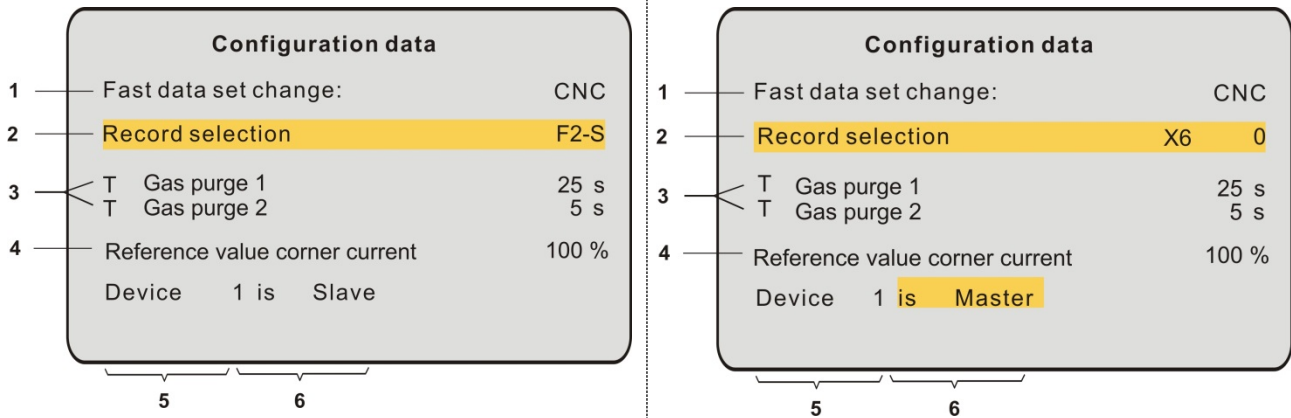


Fig. 27: Display example configuration data

1	Fast data set switchover	<u>Fast data set switchover</u> between two stored data sets (at manual mode of PGC) <ul style="list-style-type: none"> • by pressing button F3 or • by CNC (via interface X102) Default setting: CNC
2	Data set selection	<u>data set selection</u> (at manual mode of PGC) <ul style="list-style-type: none"> • by pressing button F2 F2-S → short protocol/ F2-L → long protocol or <ul style="list-style-type: none"> • by CNC (via interface X6) The selected set number of CNC is shown at the right side of this line. No set number selected: 0
3	T gas purge 1	This time determines the duration of the gas purge after each change of the gas between two different cutting processes. Standard setting gas purge time1 = 25 s
	T gas purge 2	This time determines the duration of the gas purge between a cutting process and a marking process. If cutting gas and marking gas are identical (e.g. argon), is not blown through. Standard setting = 5 s

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4	reference value corner current for long protocol	At signal „corner“ the cutting current will be set down to the cutting current-reference value (1 = 1 % of the cutting current-reference value) global adjustable at the range 60 – 100 %
5	device	<u>Device number</u> If several PGCs are operated with one Bus RS485 a distinction is possible by the device number of the equipment. Possible settings are devices 1 - 4 . Default setting: device 1.
6	device is ...	<u>Master</u> (for manual mode of PGC) The PGC sends the value of the cutting current stored in the internal database to the power source. A change of that value has to be carried out at the PGC always. For the data set selection of CNC via interface X6 (see section 2 of this table) is the PGC always master. <u>Slave</u> (for CNC or manual mode of PGC) The PGC receives instruction of a superordinated control (CNC). Default setting: Slave

Switching possibilities

execution	action
cursor to next value	FIELD up / down FIELD right / left
change value	hand wheel
For operation screen “data survey”	PAGE up
For operation screen “support”	PAGE down

Fig. 28: Switching possibilities for operation screen “configuration data”

7.2.7 Operation screen "Support"

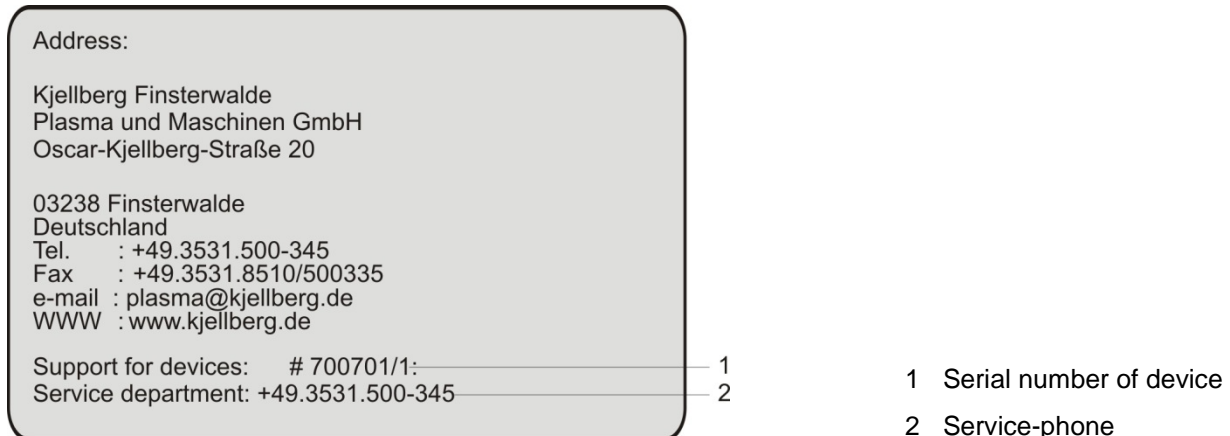


Fig. 29: Display "Support"

The screen contains information for contacting the Kjellberg Finsterwalde Company.

7.2.8 Selection of data sets for the cutting and marking process

Data sets can be manually chosen at the PGC (see chapter "Manual selection of cutting data at the PGC") or generated over the serial interface from the data bank integrated in the guiding machine (s. norm of serial communication) and transmitted to the PGC (see chapter "Preselection of gas parameters from the external control").

7.2.8.1 Manual selection of cutting data at the PGC 3

With the manual selection of cutting data sets at the PGC a cutting data set suitable for the respective cutting operation will be chosen from the data bank integrated in the PGC. This cutting data set contains the cutting data necessary for the cutting process. The required gas parameter will be transferred to the PGV just after the data set was selected.

The technology selector switch of the power source has to be switched manually to the position shown in the technological data sheet. If no serial interface connection between PGC and power source is existing, then the current value indicated at the display has to be adjusted with the potentiometer "cutting current" or potentiometer "marking current". An automatic takeover of the cutting current from the data set under the below stated conditions takes place, if the PGC and the power source are connected by a serial 9-pole sub-D cable (RS485).

After the confirmation of a data set at the PGC simultaneously with the adjustment of the gas parameters at the PGV the cutting current will be transferred to the power source. The cutting current appears at the power display of the machine and the information i_{cut} appears at the cutting break on the voltage display. Necessary adjustments of the cutting current occur at the operation screen on the PGC.

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Necessary conditions for the automatic current set point passing are:

- Serial connection between PGC and the power source through the 9 pole interface cable
- PGC and power source are working as the same device (default setting : device 1)
Power source: Jumper 7 and 8 of the sequence control not placed (delivery condition).
PGC: Adjustment at configuration side "device"
- The power source supplies the current for the data bus.
- The PGC has to be the master. PGC adjustment at the configuration side "Device is ..."
- A serial connection to the guiding machine doesn't exist or the communication to the guiding machine is switched off.

7.2.8.2 Selection of a data set of the PGC

The PGC possesses an own internal data base with the optimised data for the respective cutting process. These data are included in data sets in the internal data base, listed at torch types.

In the start screen the selection of torches is carried out, with limitation of the valid data set for the respective torch.

In the operation screen the data sets can be selected by using the hand wheel. Record numbers are opened by key F2. After confirming the requested data set by the Enter button, the data set is activated and information will be transferred from the PGC to the PGV. The respective gas valves of the PGV will open and are starting the automatic gas purge process.

After the purge action the gas control is ready for the cutting process.

The selection of a data set can be performed in the working screen Data Survey too.

When switching off the plasma power source (for changing consumables, or at shift end) the gas control simultaneously becomes switched off. Has the power source a 2-step start mode for changing spare parts of the plasma torch at first the power source has to be switched into position "PGC ON". Now the power source is switched off, but the power supply of the PGC keeps on and the parameters of the file are still readable.

After the restart of the power source the PGC (in both variants) at first is activating the Start Screen, is testing then the connection to the components at the CAN BUS and is initiating after that the operation screen, when it is o.k.

In the working screen the PGC recognizes the last used data set and activates it automatically.

Changes on the parameters displayed in the operation screen are possible by the hand wheel. The changes become operative after performing with the Enter button. If no performing is done after a short delay the previous value will be displayed

7.2.8.3 Fast data set selection by using the keys "0" and "I"

The fast data set selection is possible only during the manual operation, controlled by the button F3 or through the serial interface X102 (C3 - C8). At first the source for the data set switching is selected at the configuration side. Set selection is done with button F3 or from CNC through interface X102 of the power source.

Possibilities of selecting a data set and its storage

1. Press button "F2", select set and press "ENTER" -
purge procedure starts. → to data set selection

Press button "0" or "I" shortly,
after then press "ENTER" shortly → set will be stored in "0" or "I".
2. With button "Page" into technology data summary
select set and press "ENTER" - → into operations picture parameter
purge procedure runs.

Press button "0" or "I",
after then press "ENTER" → stores set in storage "0" or "I".

If under condition "plasma stop" the key "0" or "I" is pressed longer, then the data set, stored under this position will be displayed. The display is available as long as the button is pressed.

Possibilities of switching between two data sets

The fast data set selection will be activated by button "F3", and deactivated by button "F2".

Set selection by button "F3"

In the configuration screen the set selection "F3" is active.

The storages "0" and "I" have been covered with the respective data sets.

(preferably "0" with the cutting record, and "I" with the marking record)

When pressing first time button "F3", then the fast data set selection will be activated. Always the set of the storage "I" will be loaded at first. The purge process takes place. After pressing "F3" again the set of storage "0" will be loaded and purging starts. Further activating of key "F3" causes changes between the sets "0" and "I". No data set change takes place, if "F3" is activated under the conditions "Cutting, Purge or Purge error". Alterations of the stored data sets "0" and "I" are not possible. For that the mode fast data set selection has to be stopped with "F2".

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The display fast data set selection, activated by "F3", will be shown under the field PG1.

Set change with "F3" / Set "0" active (cutting set)

1	1.0037	S235	CCS	35A	
6.0 mm			more :F1		
PG1	PG2	PG3	WG1	WG2	
Air	O ₂		O ₂	Air	
PGC 0	6.0 6.0		2.0 2.0	3.5 3.5	
New Data: < COPY > Select Record: < F2 >					
O K or Error codes					

Set change with "F3" / Set "1" active (marking set)

1	1.0037	S235	CCS	35A	
6.0mm			more :F1		
PG1	PG2	PG3	WG1	WG2	
Air	O ₂		O ₂	Air	
PGC 1	6.0 6.0		2.0 2.0	3.5 3.5	
New Data: < COPY > Select Record: < F2 >					
O K or Error codes					

Fig. 30: Display "set change F3"

3. Set selection through control cable of the CNC

In the operation screen "configuration data" at first the "fast data set selection over CNC" has to be active. The stores "0" and "1" have been covered with the respective data sets (preferably "0" with the cutting record, and "1" with the marking record).

With the first pressure of the button "F3" the fast data set selection will be active. From the guiding machine a potential-free contact is required. At the interface X102 of the Smart Focus.

C3/C8 = connected, set of storage "1" loaded and

C3/C8 = interrupted, set of storage "0" loaded.

Purging takes place. If the assignment of the entry X102 (C3 - C8) will be changed, then the respective data set will be loaded and purging takes place. Changes during the condition "Cutting, Purging and Purge error" do not effect a data set change. The data set change takes place only at the condition "plasma stop".

Alterations of the stored data sets are not possible. For that the mode fast data set selection has to be stopped with "F2".

The display fast data set selection, activated by "F3", will be shown under the field PG1.

Set change with CNC/ Entry power source
X102 (C3 - C8) disconnected

1	1.0037	S235	CCS	35A	
6.0 mm		more :F1			
PG1	PG2	PG3	WG1	WG2	
Air	O ₂		O ₂	Air	
CNC 0	6.0 6.0		2.0 2.0	3.5 3.5	
New Data: < COPY > Select Record: < F2 >					
O K or Error codes					

Set change with CNC/ Entry power source
X102 (C3 - C8) connected

1	1.0037	S235	CCS	35A	
6.0 mm		more :F1			
PG1	PG2	PG3	WG1	WG2	
Air	O ₂		O ₂	Air	
CNC 1	6.0 6.0		2.0 2.0	3.5 3.5	
New Data: < COPY > Select Record: < F2 >					
O K or Error codes					

Fig. 31: Display "set change CNC"

7.2.8.4 Safe of user data set

If preset records was changed for the cutting process, it is possible to safe them as user records at the user data range.

At first press the COPY-button under the operational display. The existent gas combination with its values is safed now and the display changes into the operational display "record parameter".

This display is adjustable.. With the FIELD-buttons a field can be selected and with the CHAR-buttons changed from character to character. Changes of values or characters can be made with the rotating knob. If ready, the record is safed by pressing ENTER. By operating the DEL-button all changes can be deleted.

Existing data sets are not changeable later. Moreover only existing gas combinations can be changed.

If all free storage spaces are engaged, the operations picture shows the notice "no storage space available".

7.2.8.5 Delete of data sets

Deleting of records can be performed in display „data survey“.

You can only delete user records.

At first the cursor will be placed to the record to be deleted by the FIELD- buttons. Then the DEL- button should be pressed. After the deleting the cursor jumps back to the 1.record (This procedure can take some time at large data amounts. During this procedure the equipment must not switched off). The deleted record is no more available.

7.2.8.6 Preselection of gas parameters from the external control

If the PGC should be controlled from an external data bank, then this is performed by the serial interface (RS485) connector X4.

The internal data bank of the PGC for the cutting parameters in this case is not active.

The cutting data will be taken from the data bank, included in the guiding machine and transferred to the PGC through the serial connection.

Following system configurations are possible:

- The guiding machine determines the gas parameters for the cutting process through the serial connection. Then the current parameters will be adjusted manually at the cutting power source.
- The guiding machine determines the gas parameters for the cutting process through the serial connection. The current parameters will be determined from the guiding machine through the conventional interface X102.
- The guiding machine determines the gas parameters and the current parameters for the cutting process through the serial connection.

In this case the guiding machine is the master, controlling the two slaves connected to the serial bus. Nevertheless the connection of the guiding machine with the power source through the interface X102 is besides the serial connection necessary.


The signals, like "Torch ON", or "Emergency Stop" will be transferred by safety reasons furthermore through the connection X102.

Following conditions for the function of the serial connection are necessary:

- Serial connection between guiding machine, power source and PGC by a 9-pole connecting cable

The guiding machine transmits the data to the as the same devices defined PGC and power source (Standard: Device 1).

- Power source: Jumper 7 and 8 of the sequence control are not placed (condition at delivery)
- PGC: Adjustment at configuration side "Device"
- The current supply for the data bus is carried out from the guiding machine or the power source
- 24V DC are at the clamp 2 and 6 from the bus interconnection link X4.1
- The PGC must be the slave.
- PGC adjustment at configuration side "Device is" slave

	<p>Information</p> <p>After switching ON the PGC select the operation "set points of CNC" at the display under the point "torch". The cursor is in the operation screen on the most recently used gas combination.</p>
---	---

The PGC is waiting for data from the serial interface. The mode of the data transfer is defined in the document "serial Interface" - part 1-3.

If a data set was transferred from an external source the PGC is checking the content. When it is found OK the data set becomes activated. The parameters will be displayed in the operation screen and the required values transferred from the PGC to the PGV. This transfer is performed like the operation with internal data sets.

When switching off the plasma unit the PGC is storing the last transferred data set from the external source. After the restart the gas control automatically is activating this set. The gas control is ready for operation again without transmission of a data set.

The external control has no direct access to the data sets of the internal data base of the PGC.

7.3 Operating and display elements

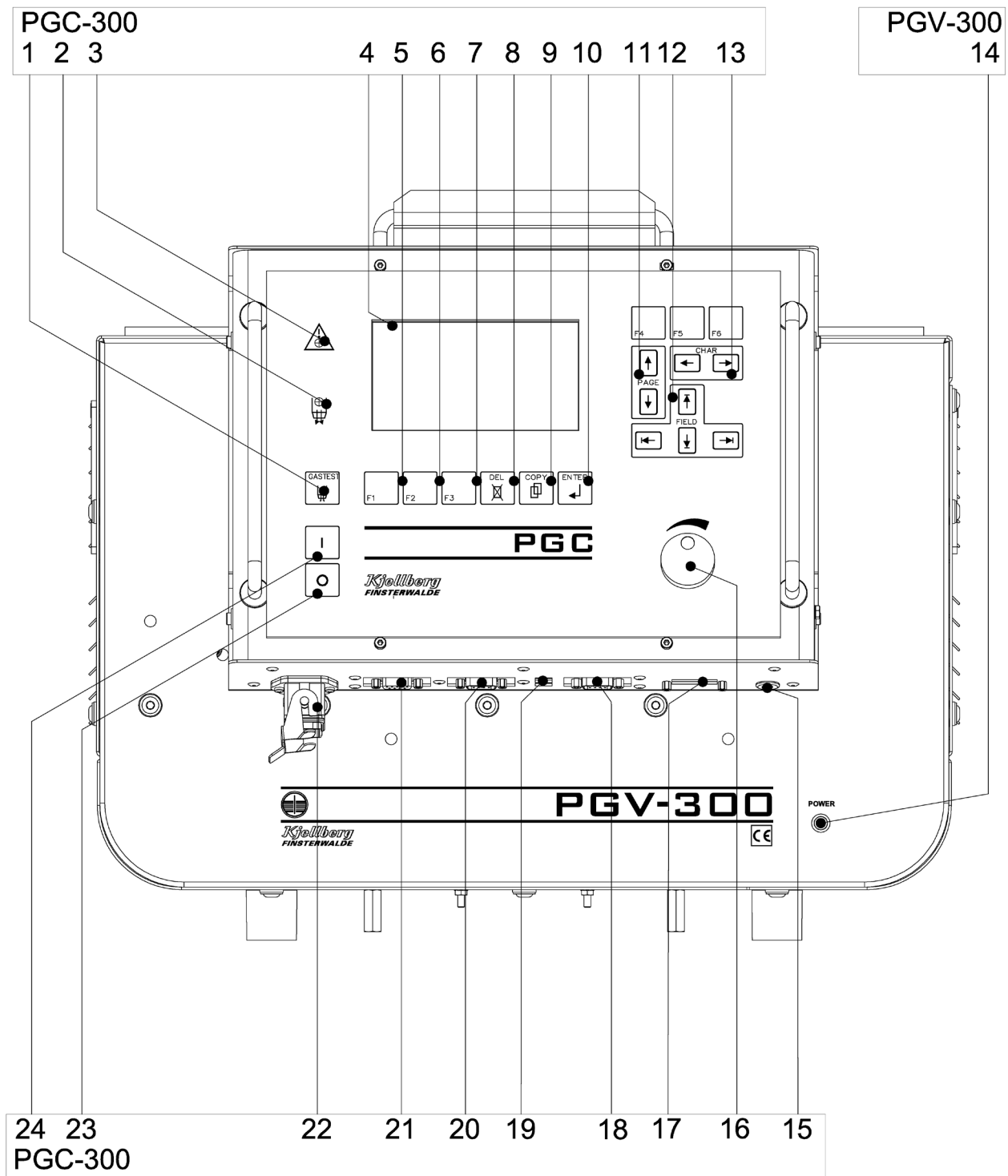


Fig. 32: Control and display elements PFC 300

1	button „GASTEST“
2	display for gas control signal
3	display error
4	LCD Display
5	F1 button "technology data"
6	F2 button "to set selection"
7	F3 button "set change"
8	DEL button "delete button"
9	COPY button "new data set"
10	ENTER button "input confirmation"
11	PAGE button "changes display pages"
12	FIELD button "position change field"
13	CHAR-buttons "position change sign modification"
14	LED-Power - power supply ON
15	contrast adjustment display
16	hand wheel for parameter selection
17	option: binary data transmission to guiding system (X6)
18	serial interface RS-232 (X5)
19	switch of interfaces RS-485 – RS-232
20	connection to power source RS-485 (X4)
21	CAN1 signal connection to PGV (X2)
22	socket current supply PGC (X1)
23	store key of data set 0
24	store key of data set I

7.4 Connection of the plasma gas valve unit PGV

Connect the PGV through a 25-pole control cable with the plasma unit by interface X110 (9). The gas supply hoses for the plasma gas and swirl gas have to be fitted to connectors (1) to (7). The connectors (13) to (17) are provided for the supply hoses to the plasma torch connection unit PBA.

The connection between PGV and PGC occurs over the connectors X1 (12) und X2.1 (10).

Screw the PGV at the top of the plasma machine or set the gas console to another suitable place.

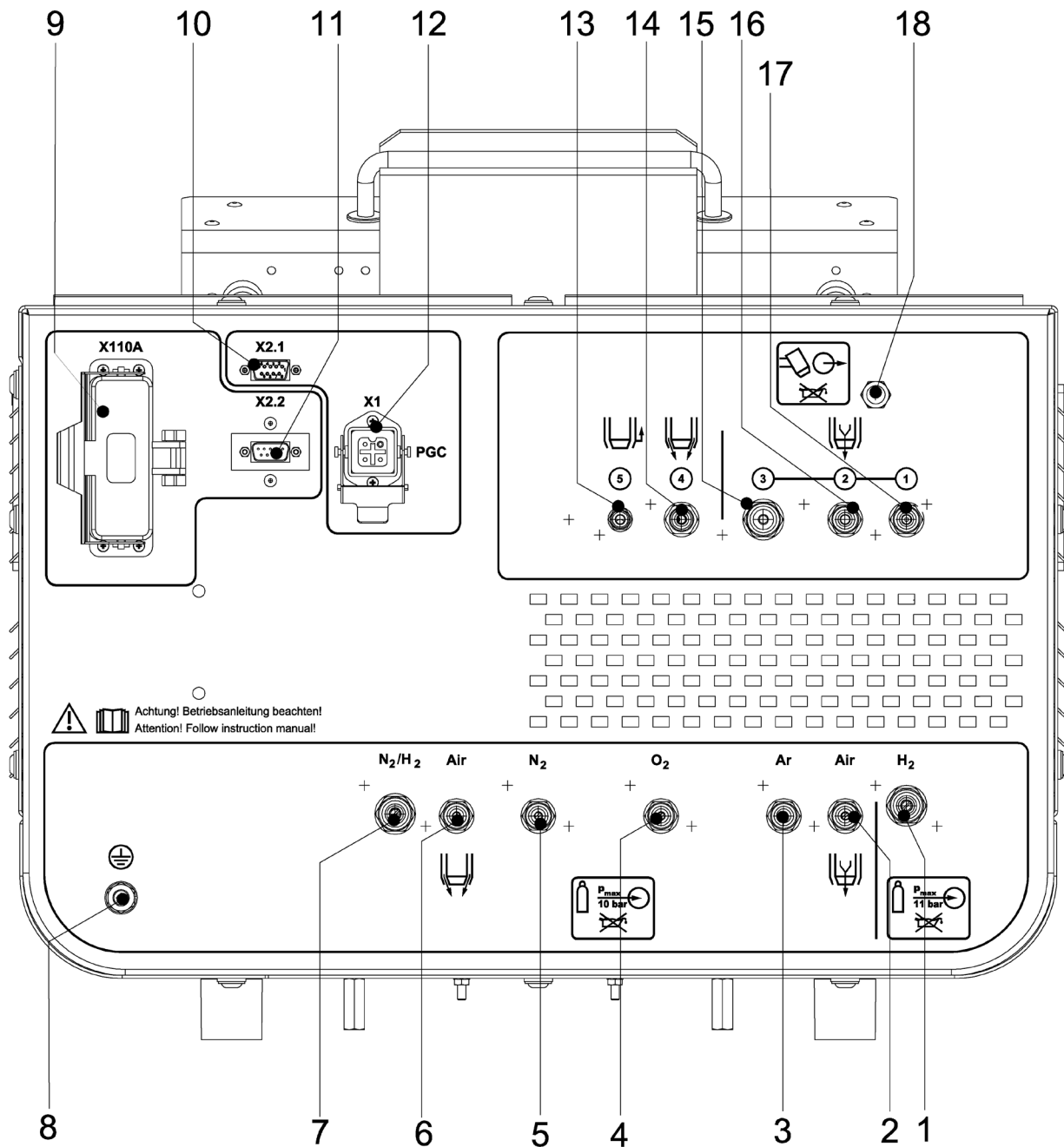


Fig. 33: rear connections of PGV

1	Inlet plasma gas	PG3	H ₂	G3/8"LH
2	Inlet plasma gas	PG1, PG2	Air	G1/4"
3	Inlet plasma gas	PG1, PG2	Ar	G1/4"
4	Inlet plasma gas / swirl gas	PG2, WG1	O ₂	G1/4"
5	Inlet plasma gas / swirl gas	PG1, PG2, WG1	N ₂	G1/4"
6	Inlet swirl gas	WG2	Air	G1/4"
7	Inlet swirl gas	WG2	N ₂ /H ₂ (forming gas)	G3/8"LH
8	Terminal earthing			terminal M8
9	Connection X110A - connection plasma power source			25-pol. plug
10	Connection CAN1 signal connection to PGC (X2.1)			D-Sub 9-pol.-plug
11	not used (X2.2)			D-Sub 9-pol.-socket
12	Connection socket current supply PGC (X1)			4-pol. socket
13	Torch connection control gas	KG	5	G1/8"
14	Torch connection swirl gas	WG	4	M12x1
15	Torch connection cutting gas	PG3	3	G3/8"LH
16	Torch connection cutting gas	PG2	2	G1/4"LH
17	Torch connection ignition gas	PG1	1	G1/4"
18	silencer			G1/8"

7.5 Connection of the gas hoses between plasma gas console and PBA

The length of the gas hoses for the connection of the components of the plasma cutting complex have to be arranged according to the system configuration. The following hoses are used:

		Air	Ar	H ₂	N ₂	N ₂ /H ₂	O ₂	Autogenous hose 4 x 3,5	Connectors
1 Plasma gas	PG1	x	x		x			blue	G1/4" - G1/8"
2 Plasma gas	PG2	x	x		x		x	blue	G1/4"LH - G1/8"
3 Plasma gas	PG3			x				red	G3/8"LH - G1/8"
4 Swirl gas	WG	x			x	x	x	blue	M12x1- G1/8"
5 Control gas	KG	x	x		x			blue	G1/8" - G1/8"

The designations "1" up to "5" are located on the back wall of the plasma gas console and at the end of the respective hoses.

7.6 Connection of the gas supply



For the gas supply only high- quality pressure regulators have to be used, guaranteeing a constant supply pressure. The quality of the pressure reducer influences the cutting quality and reliability of the complete unit. Furthermore the user has to follow local and national standards.



Concerning the necessary plasma and swirl gases and the regulated pressures are considered at the cutting charts.



The quality of the plasma gases must be maintained (see chapter "Technical data"). Using unclean gases can lead to dual arcs, increased deterioration of the nozzles and cathodes and damage to the torch and at the plasma gas console.

In order to protect against coarse dirt, all the plasma gas console and plasma torches are fitted with fine filters. These filters can be removed using a small screwdriver and cleaned when necessary.



WARNING

The maximum input pressure must not exceed 1.2 MPa (12 bar) , however it must be at least 0.1 MPa (1 bar) more than the designated operating pressure in the cutting chart!
Follow the conditions for using gas cylinders and the manufacturer's instructions of pressure reducers.

The connections for the plasma gas supply hoses can be found at the rear of the plasma gas console (see upper Fig.).

7.6.1 Plasma gases

For the gas supply the following hoses have to be used:

Plasma gas		Colour of the gas hose	Marking	Connectors
Air	Air	black	grey	G1/4"
Oxygen	O ₂	blue		G1/4"
Argon	Ar	black		G1/4"
Hydrogen	H ₂	red		G3/8"-LH
Nitrogen	N ₂	black	green	G1/4"
Forming gas	N ₂ /H ₂	red	green	G3/8" LH

Fig. 34: Overview of the gas hoses

Air

Requirements to air quality ISO 8573-1:2010 [1:4:1]

max. size of particles:	0.1 – 0.5 µm ≤ 20.000	0.5 – 1 µm ≤ 400	1 - 5 µm ≤ 10	(category 1)
max. pressure dew point:	+3 °C			(category 4)
max. rest oil content:	0.01 mg/m ³			(category 1)

Gas supply using compressed air bottle:



- Check cylinder valve to see if clean (free from oil and grease) and clean if necessary
- Open the cylinder valve for a short time to blow out dust
- Connect air pressure-reducer to cylinder
- Using the black coloured and grey marked gas hoses G1/4"-G1/4", connect the pressure-reducer to the filter / fine-filter and the filter / fine-filter to the plasma gas console "Air" gas connector
- Open the cylinder valve and adjust the pressure between min. 10 bar and max. 12 bar, displayed on the manometer

Gas supply using ring mains or compressor:

- The use of an oil and water separator and a cold drier is recommended
- This is to be connected between the ring mains or compressor and the plasma gas console
- If an oil-free compressor is used, the oil separator can be omitted
- Using the black coloured and grey marked gas hoses G1/4"-G1/4", connect the pressure-reducer to the filter / fine-filter and the filter / fine-filter to the plasma gas console "Air" gas connector
- Adjust the gas pressure on the compressor so that a pressure between min. 10 bar and max. 12 bar is fitted

Plasma gas control unit FlowControl-300

Oxygen

	<div data-bbox="735 293 938 338"> WARNING</div> <p data-bbox="272 353 1423 450">All parts that come into contact with oxygen must be kept oil and grease free! When using oxygen, the explosion protection for oxygen must be connected to the pressure-reducer (protects against backfiring)!</p>
---	---

Install the fine-filter between the gas supply and the plasma gas console!

- Check cylinder valve to see if clean (free from oil and grease) and clean if necessary
- Open the cylinder valve for a short time to blow out dust
- Connect oxygen pressure-reducer with explosion protection to the gas supply (cylinder, ring mains)
- Using the blue coloured gas hose G1/4"-G1/4", connect the pressure-reducer to the filter / fine-filter and the filter / fine-filter to the plasma gas console "O₂" gas connector.
- Open the cylinder valve and adjust the pressure between min. 10 bar and max 12 bar, displayed on the manometer

Argon, Hydrogen, Nitrogen

- Check the cylinder valve on cleanliness (must be free of oil and grease) and if necessary clean it.
- Open the cylinder valve shortly for blowing out the dust.
- Connect the pressure-reducer for the appropriate gases to the gas cylinder.
- Using the black coloured gas hose G1/4", connect the argon pressure-reducer to the plasma gas console "Ar" gas connector
- Using the black / green coloured gas hose G1/4", connect the nitrogen pressure-reducer to the plasma gas console "N₂" gas connector
- Using red gas hose G3/8"LH connect the hydrogen pressure-reducer to the plasma gas console "H₂" gas connector
- Using red / green coloured gas hose G1/4" connect the hydrogen pressure-reducer to the plasma gas console "N₂/H₂" gas connector
- Open the valve and adjust the gas pressure on the pressure-reducer so that the pressure for argon, nitrogen and hydrogen shown on the plasma gas console manometer is the same as shown on the cutting chart for flowing gas

7.7 Assembly of clamping ring connections

7.7.1 Initial assembly

1. Choose a hose (1) of appropriate length and put the support bushing (2) into the hose end.
2. Push the hose end with support bushing through the nut (3) and the two-piece clamping ring (4). Please make sure that the clamping ring is adjusted correctly.
3. Put the hose with support bushing and clamping ring into the connection body (5) until stop and tighten the nut (3) by hand.
4. Now tighten the nut (3) with 1-1/4 turn of the spanner. Fix the glued-in connection body (5) with a second spanner while tightening the nut (3). Never turn the connection body!

► It is helpful to mark the nut (3) at 9 o'clock. After 1-1/4 turn the marking is at 12 o'clock.

The assembly of pipes is done in the same way, however without support bushing.

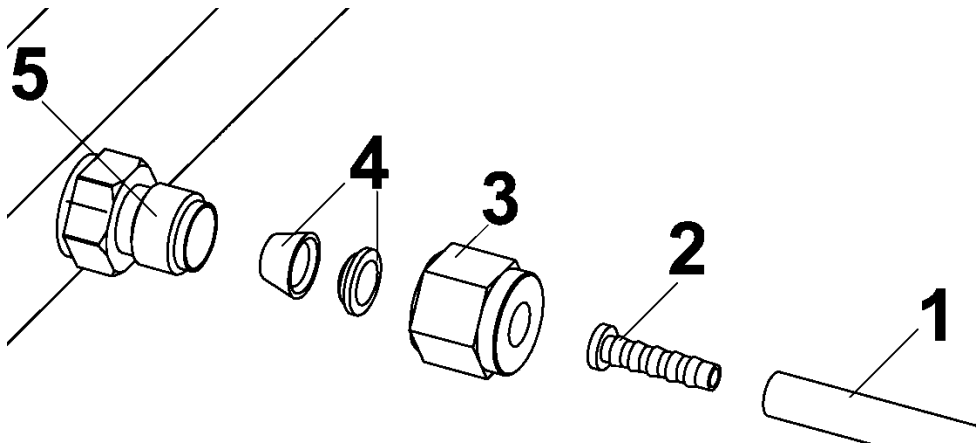


Fig. 35: Initial assembly of clamping ring connection

7.7.2 Dismantling

Fix the glued-in connection body (5) with a second spanner while loosening the nut (3). Never turn the connection body!

7.7.3 Reassembly

1. Put the hose (1) with support bushing (2) and pressed clamping ring (4) into the connection body (5) until stop.
2. Tighten the nut (3) by hand.
3. Now tighten the nut (3) with approx. 1/4 turn of the spanner until you notice that the strength needed increases considerably. Fix the glued-in connection body (5) with a second spanner while tightening the nut (3). Never turn the connection body!

► Due to the narrow production tolerances, the marking on the nut will be almost exactly at the same position as after the initial assembly.

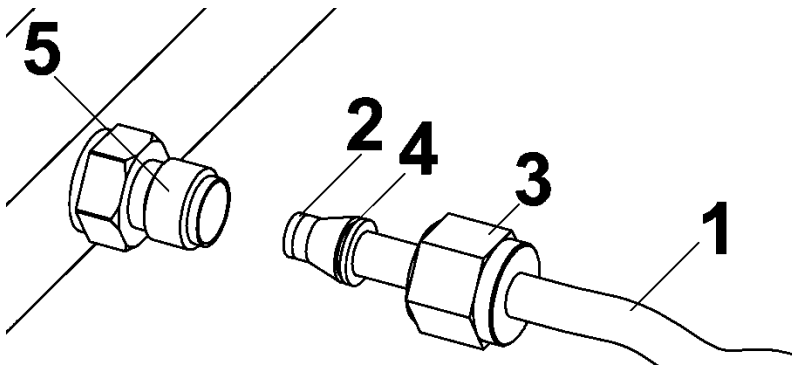


Fig. 36: Reassembly of clamping ring connection



8 Plasma machine torch PerCut 2000/2000A / PerCut 4000/4000A

8.1 Technical data

	PerCut 2000(.11.856.401)		PerCut 2000A(.11.856.201)	
	Plasma torch with quick change head (Version with threaded coupling)		Plasma torch with quick change head (Version with bayonet coupling)	
Current carrying capacity, max.				
Cutting current, I _S :	200 A			
Pilot arc current, I _{Pb} :	40 A			
Duty cycle	100 %			
Ignition	high voltage ignition (max. 17 kV) by pilot arc			
Clamping diameter	50.8 mm			
Torch cooling	Coolant mixture			
	<ul style="list-style-type: none">• „Kjellfrost -15 °C“ (freezing protection up to -15 °C) or• „Kjellfrost -25 °C“ (freezing protection up to -25 °C) with integrated corrosion protection			
Flow rate coolant	min. 3.0 l/min			
Plasma gases	Air, O ₂ and Ar, N ₂ , H ₂ and mixtures of this gases (for quality, pressure and flow rate see particular plasma gas regulate unit or plasma gas control unit)			
Swirl gases	Air, O ₂ and N ₂ and mixtures of this gases (for quality, pressure and flow rate see particular plasma gas regulate unit or plasma gas control unit)			
Length of the hose set:	1.5 m			
Terminals				
Coolant return with cathode cable	WR	G3/8“		
Coolant supply	WV	G1/4“		
Pilot cable	PI	pilot plug 4 mm		
Control gas	KG	PU-hose NW4 ws		
Plasma gases	PG			
Ignition gas		PU-hose NW3 sw		
Cutting gas		PU-hose NW3 bl		
Swirl gas	WG	PU-hose NW4 gn		
Initial positioning contact	eEF	blade receptacle 6.3x0.8 mm		
Weight	1.0 kg (change head)		1.1 kg (change head)	
	0.8 kg (Shaft without hose set)		0.9 kg (Shaft without hose set)	
	2.4 kg (Shaft + 1.5 m hose set)		2.5 kg (Shaft + 1.5 m hose set)	

Fig 37: Technical data

	PerCut 4000(.11.855.401)	PerCut 4000A(.11.855.201)
	Plasma torch with quick change head (Version with threaded coupling)	Plasma torch with quick change head (Version with bayonet coupling)
Current carrying capacity, max.		
Cutting current, I_S:	400 A	
Pilot arc current, I_{Pb}:	40 A	
Duty cycle	100 %	
Ignition	high voltage ignition (max. 17 kV) by pilot arc	
Clamping diameter	50.8 mm	
Torch cooling	Coolant mixture	
	<ul style="list-style-type: none"> • „Kjellfrost -15 °C“ (freezing protection up to -15 °C) or • „Kjellfrost -25 °C“ (up to -25 °C) with integrated corrosion protection 	
Flow rate coolant	min. 4,0 l/min	
Plasma gases	Air, O ₂ and Ar, N ₂ , H ₂ and mixtures of this gases (for quality, pressure and flow rate see particular plasma gas regulate unit or plasma gas control unit)	
Swirl gases	Air, O ₂ and N ₂ and mixtures of this gases (for quality, pressure and flow rate see particular plasma gas regulate unit or plasma gas control unit)	
Length of the hose set:	1,5 m	
Terminals		
Coolant return with cathode cable	WR	G1/2"
Coolant supply	WV	M18x1,5
Pilot cable	PI	pilot plug 4 mm
Control gas	KG	PU-hose NW4 ws
Control cable	SL	7-pol.plug
Plasma gases	PG	
Ignition gas	ZG	PU-hose NW4 sw
Cutting gas	SG	PU-hose NW4 bl
Exhaust	EXH	PU-hose NW3 ge
Swirl gas	WG	PU-hose NW4 gn
Initial positioning contact	eEF	blade receptacle 6.3x0.8 mm
Weight	1,0 kg (change head)	1,1 kg (change head)
	1,3 kg (Shaft without hose set)	1,2 kg (Shaft without hose set)
	3,9 kg (Shaft + 1.5 m hose set)	3,8 kg (Shaft + 1.5 m hose set)

Fig 38: Technical data

8.2 Technical description



The plasma torches PerCut 2000/2000A of Kjellberg Finsterwalde are determined for use with power sources Smart Focus 130 and Smart Focus 200 by EN 60974-1.

These plasma torches and power sources are safety-related units in accordance with EN 60974-7!



The plasma torches PerCut 4000/4000A of Kjellberg Finsterwalde are determined for use with power sources Smart Focus 130, Smart Focus 200 and Smart Focus 300 by EN 60974-1.

These plasma torches and power sources are safety-related units in accordance with EN 60974-7!

The plasma machine torch consists of the torch head, the torch shaft, the hose set and the consumables.

The torch PerCut 2000 consists of change head PerCut 4000 and shaft PerCut 2000.

The torch PerCut 4000 consists of change head PerCut 4000 and shaft PerCut 4000.

The torch contains two plasma gas hoses and one swirl gas hose for the gas supply.

The plasma torches are suitable for cutting with the plasma gases air (air), oxygen (O₂), argon (Ar), nitrogen (N₂), hydrogen (H₂) and their mixtures.

Swirl gases can be air (air), oxygen (O₂) and nitrogen (N₂) or their mixtures.

The cutting current is transferred to the cathode by a flexible copper cable, which is inserted in the insulating coolant return hose. The pilot current is transferred to the nozzle via a pilot cable.

The nozzle is fixed in the nozzle holder by a detachable nozzle cap. The coolant circulates between nozzle and nozzle cap, a special cooling tube ensures an effective cooling of the cathode. This system ensures an efficient cooling of all thermally stressed torch parts.



Before using a plasma torch it is necessary to ensure that the torch is equipped with the suitable parts for the selected plasma gases and cutting procedure! After each consumable change, a gas purge (approx. 20 s) is required to blow out all residual coolant which can damage the torch during the high-voltage ignition!



You are only allowed to use ORIGINAL Kjellberg spare parts and consumables! The use of other manufacturer consumables leads to the loss of the warranty claim.

8.3 Connection of the plasma torch to the plasma torch connection unit PBA

	 WARNING
	Before opening the plasma torch connection unit, the plasma cutting system has to be switched OFF always and disconnected visibly from the mains!

The plasma torch has to be fastened to the support of the guiding system by using an adequate insulation. A special torch holder is available from Kjellberg Finsterwalde.

The plasma torches are connected to the connectors on and in the PBA. The following connections shall be established:

PerCut 2000/2000A

- Screw connections
 - coolant return (WR) G3/8"
 - coolant supply (WV) G1/4"
- electr. plug connections
 - pilot cable (PI) pilot plug 4 mm
 - initial positioning contact (eEF) Flachsteckhülse 6,3x0,8 mm
- Plug connector with sleeve nut for fluids
 - control gas (KG) PU-hose NW4 ws

Lead the plasma gas hoses and the swirl gas hoses through the corresponding openings of side wall on the outside and connect them to the marked quick couplings

- Plug connector with sleeve nut for fluids
 - plasma gas 1 (PG1) PU-hose NW3 sw
 - ignition gas (ZG)
 - plasma gas 2 (PG2) PU-hose NW3 bl
 - cutting gas (SG)
 - swirl gas (WG) PU-hose NW4 gn

Unscrew the sleeve nut to this, clip the hose to the plug nipple and fasten the nut on tightly.

Relieve the hose assembly with flange and hose band.

PerCut 4000/4000A

- Screw connections
 - coolant return (WR) G1/2"
 - coolant supply (WV) M18x1.5
- electr. plug connections
 - pilot cable (PI) pilot plug 4 mm
 - control cable (SL) 7-pol. plug
 - initial positioning contact (eEF) blade receptable 6.3x0.8 mm
- Plug connector with sleeve nut for fluids
 - control gas (KG) PU-hose NW4 ws




Lead the plasma gas hoses and the swirl gas hoses through the corresponding openings of side wall on the outside and connect them to the marked quick couplings

- Plug connector with sleeve nut for fluids
 - plasma gas 1 (PG1) PU-hose NW3 sw
 - ignition gas (ZG)
 - plasma gas 2 (PG2) PU-hose NW3 bl
 - cutting gas (SG)
 - swirl gas (WG) PU-hose NW4 gn
 - Exhaust (E) PU-hose NW3 ge

Unscrew the sleeve nut to this, clip the hose to the plug nipple and fasten the nut on tightly.

Relieve the hose assembly with flange and hose band.

8.4 Consumables and their exchange

 	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>In order to change consumables, the plasma cutting system shall be switched OFF and secured against any accidental start. An unauthorised start-up is prevented by e.g. pulling out the key of the key-operated switch after switching off the plasma cutting system!</p>
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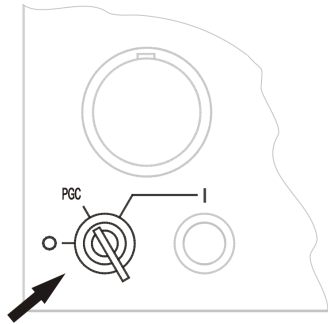




Fig. 39: key switch at the operating and display front of the plasma unit

	<div style="background-color: orange; text-align: center; padding: 5px;">  WARNING </div> <p>All components and parts coming in touch with oxygen have to be kept free of oil and grease! This refers specially to the torch head and the consumables.</p>
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	<p>The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!</p>
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Used or damaged consumables shall be replaced in due time (Reference: visible change of the cutting quality).

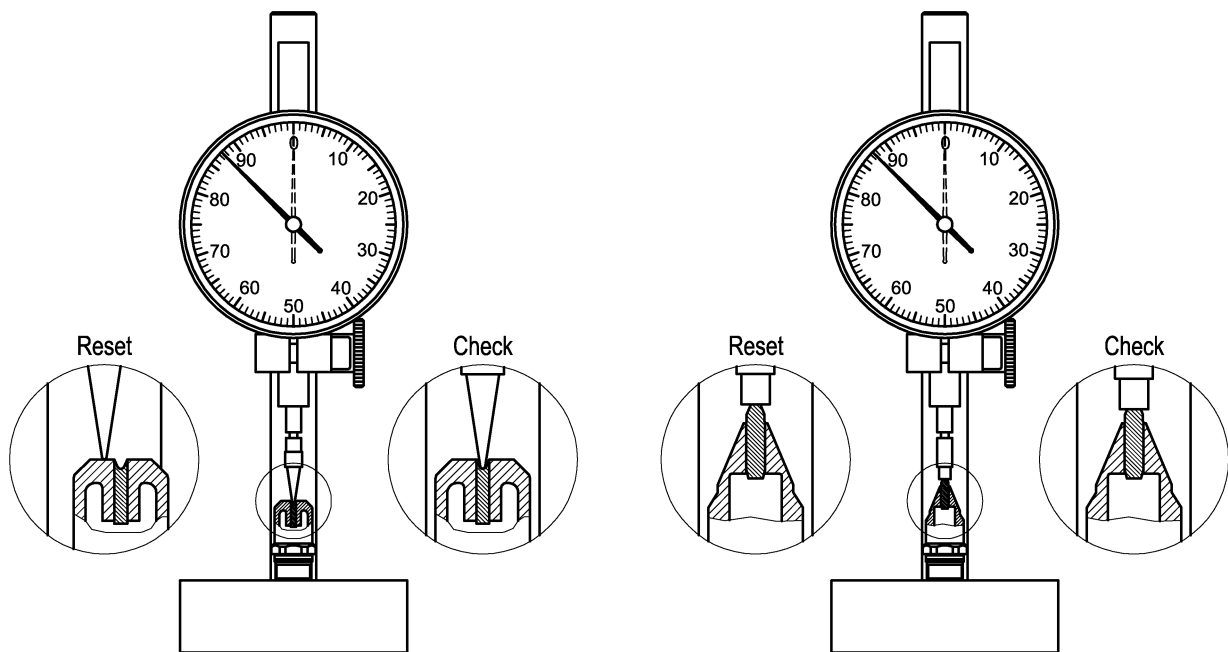
The life time of the cathode depends on the cutting time, the number of ignitions und the cutting current.

	 WARNING	
	<p>If an above the wear limits driven cathode produce a damage of the plasma torch, leaking coolant can impact glowing dross.</p>	
	<p>Leaking coolant "Kjellfrost" additional with influence of extreme heat causes a very fast vaporisation of water portions and an increasing concentration of the component ethanediol.</p>	
	<p>This can cause an inflammation and combustion of the ethanediol-debris.</p>	
	<p>Absorb leaked or slopped coolant "Kjellfrost" with liquid-binding material (sand, diatomite, oil binder, acid binder, universal binder) immediately. Dispose the absorbed material according to official regulations.</p>	

cathode	article no.	cutting range	plasma gas	position no.	plasma unit	max. cathode burn-back [mm]	
						for quality cut	max.*)
F005	.11.855.401.350	≤ 200 A	O ₂	xx.02	Smart Focus 130 Smart Focus 200 Smart Focus 300	1,30	1,80
F006	.11.855.401.360					1,30	1,80
F012	.11.855.411.320					1,50	1,80
F022	.11.855.421.320	300 A				1,30	1,80
F042	.11.855.441.520	≤ 200 A	Ar/H ₂			<0,50	0,50
F052	.11.855.451.520					<0,50	0,50
F065	.11.855.461.550	300 A				<1,50	1,50

*) ... Attention: A higher cathode burn-back can lead to the destruction of the torch.

Fig. 40: max. cathode burn-back



Control with sharp meter feeler .16.004.810.2

Control with flat meter feeler .16.004.810.8
Reset only with unused cathode

Fig. 41: Ascertaining of the cathode wear with the cathode dial indicator Art.-Nr. .36.000.015

The life time of the nozzle mainly depends on the cutting time, the number of ignitions and the handling of the torch (performance of hole piercing, upcoming spatter, etc.).

Be sure that the consumables are suitable for the intended cutting procedure.

The consumables shall be replaced with great care and only with the mounting aids which are part of the delivery.



Under no circumstances pliers or other unsuitable tools have to be used for consumable change, they entail inevitably the damage of the consumables, for example burr formation and thereby malfunctions of the plasma torch.



After screwing off the protective cap to replace the swirl gas cap without any further replacement of consumables, the tightness of the nozzle cap must absolutely be checked and, if required, tightened again before mounting the protective cap!

apply to plasma torch:

**PerCut 2000/2000A
PerCut 4000/4000A**



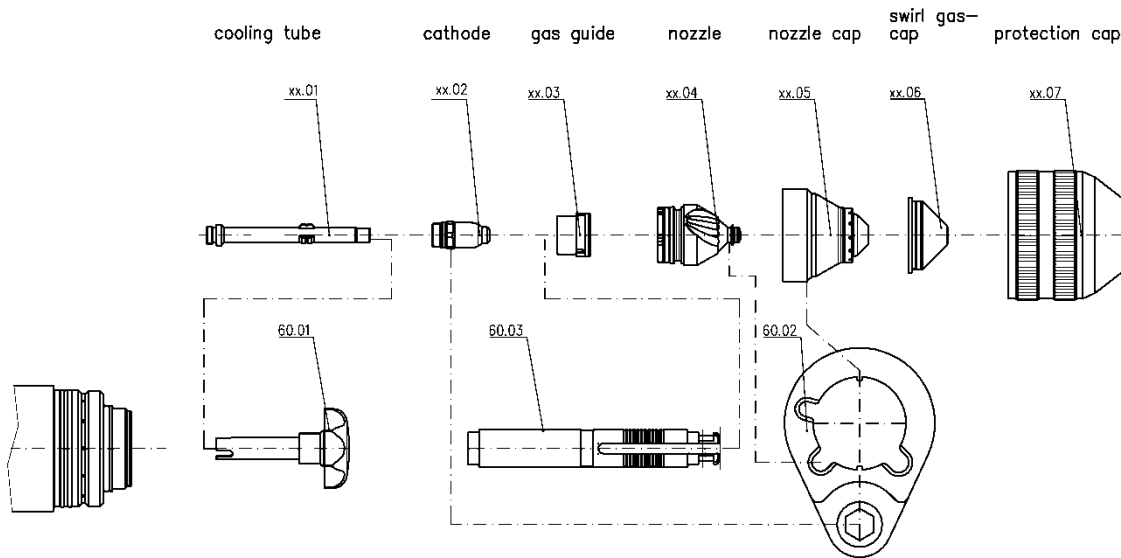
Make sure that all wearing parts are complete and correct installed!

Especially the cooling tube has to be inserted. Other wise the cooling is ineffective and the torch gets damaged.

No other parts as mentioned before have to be changed unauthorised on the plasma machine torch.

A further opening of the torch from the front side is not possible.

8.4.1 Plasma machine torch PerCut 2000/2000A / PerCut 4000/4000A



Dismounting of used consumables

Before dismounting the consumables of the PerCut please insert the change head in the "Station for the change heads" (see chapter "Dismantling of the change head") and remove with the aid of compressed air the coolant from the change head.

1. Manually unscrew the protective cap (xx.07) together with the swirl gas cap (xx.06).
(Press out swirl gas cap from protective cap.)
2. Unscrew nozzle cap (xx.05) by aid of a torch tool - PerCut 440-450* (60.02).
3. Take out the nozzle (xx.04) together with the gas guide (xx.03) by aid of a torch tool - PerCut 440-450* (60.02).
4. Pull out the gas guide (xx.03) from the nozzle (xx.04) by aid of the specific wrench (60.03).
5. Unscrew the cathode (xx.02) by aid of a torch tool - PerCut 440-450* (60.02).
6. Remove the cooling tube (xx.01) using the socket wrench (60.01) when changing technology or changing data set in accordance with the cutting data.

Mounting of new consumables

1. Screw in the cooling tube (xx.01) by aid of a socket wrench (60.01).
2. Tightly screw in the cathode (xx.02) by aid of a torch tool - PerCut 440-450* (60.02).
3. Insert the gas guide (xx.03)
4. Insert the nozzle (**xx.04**) into the torch head (see picture on next page). Turn the nozzle such that the nozzle's wide groove is positioned exactly above the oval opening in the torch head. Then insert the nozzle until stop. Now the nozzle is locked and cannot be turned anymore.
5. Position the nozzle cap (xx.05) by aid of a torch tool - PerCut 440-450* (60.02) and fasten hand tight
6. Position the swirl gas nozzle (xx.06) and manually fasten with the protective cap (xx.07).

O-rings only need replacement in case of deformation or damage.

* The torch tool - PerCut 440-450 (60.02) is a multifunctional tool to:

- screw and unscrew the cathode by means of hexagon 11 mm,
- pull out the nozzle by means of the engraved notches 6 mm, 7 mm and 8 mm and
- screw and unscrew the nozzle cap by means of opening Ø 37 mm.

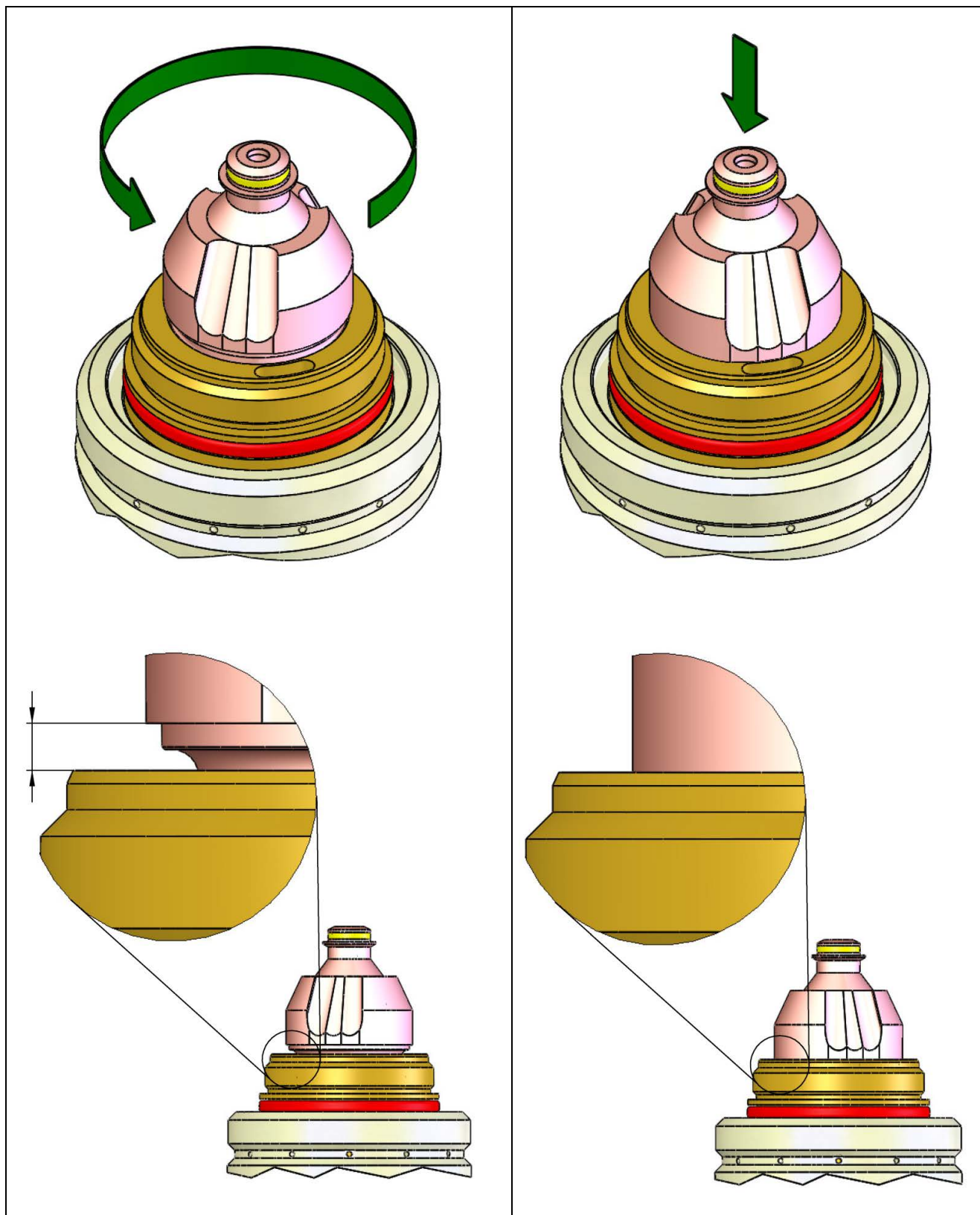


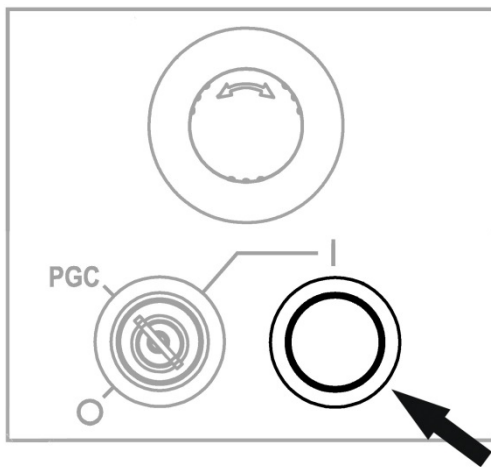
Fig. 42: Insert the nozzle into the torch head

8.4.2 Replacement of the current socket and current plug in the torch shaft**CAUTION**

Maintenance and repair work at the current socket and current plug of the plasma torches may be carried out only by the service department or authorised repair shops of the company Kjellberg Finsterwalde!

8.4.3 Operation of the torch after consumable change

When re-starting the plasma unit after the consumable change, proceed as follows:



1. After pressing the green button S2:
 - automatic gas purge activated
 - no coolant shall leak from the plasma torch (bide until the disappearance of the air bubbles in coolant hoses)
2. Switch over the tumbler switch S5 to gas test for at least 20 sec or choose the automatic time of gas test on the PGC:
 - drain residual coolant from the plasma torch
 - coolant drops can damage the torch during ignition

Fig. 43: green illuminated button S2 on front panel of power source

8.5 Information for using of the change heads

Change head PerCut 4000 and PerCut 4000A

8.5.1 Dismantling of the change head



WARNING

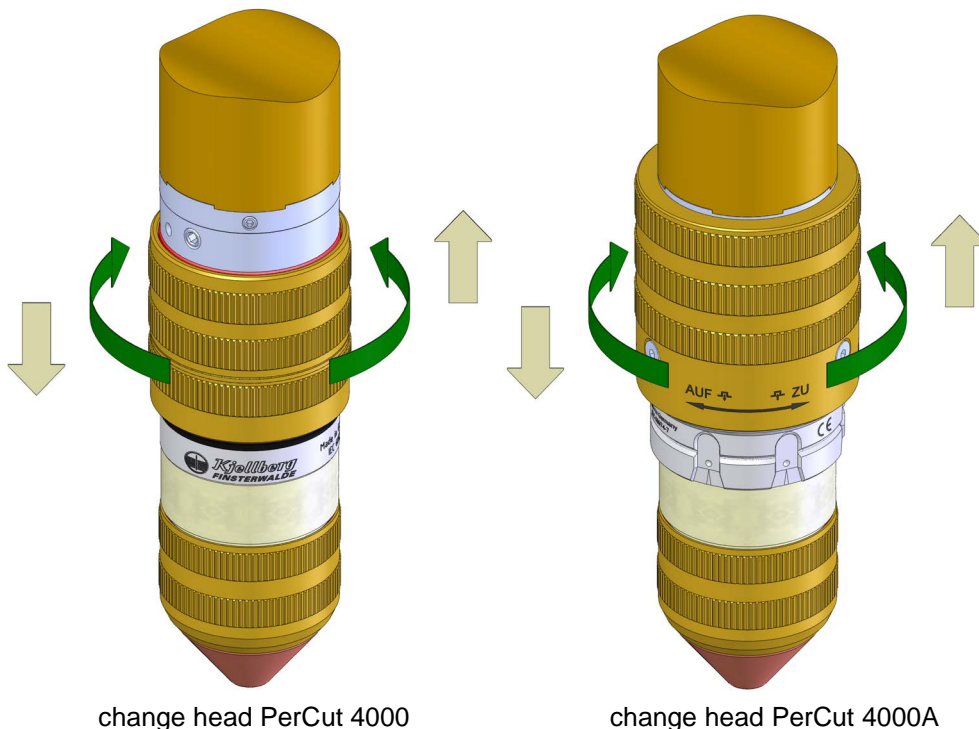
Before starting any installation or maintenance work the power source has to be switched off and visibly disconnected from the mains(unplug mains cable)!



Do not drop the change head, it could be damaged!

The change head is a high-quality precision part and must therefore be handled with care. To prevent damages, it is recommended to store the change head not being used in the optionally available "Parking station for the change heads".

1. Safeguard against dropping down of the change head (e.g. with left hand).
2. Remove the change head according to the following figure.



change head PerCut 4000

change head PerCut 4000A

3. Torch head should be placed on a smooth pad and secured against rolling away.
It is recommended to use the "Station for change head".

Please use for storage of the change head the "Station for the change heads".

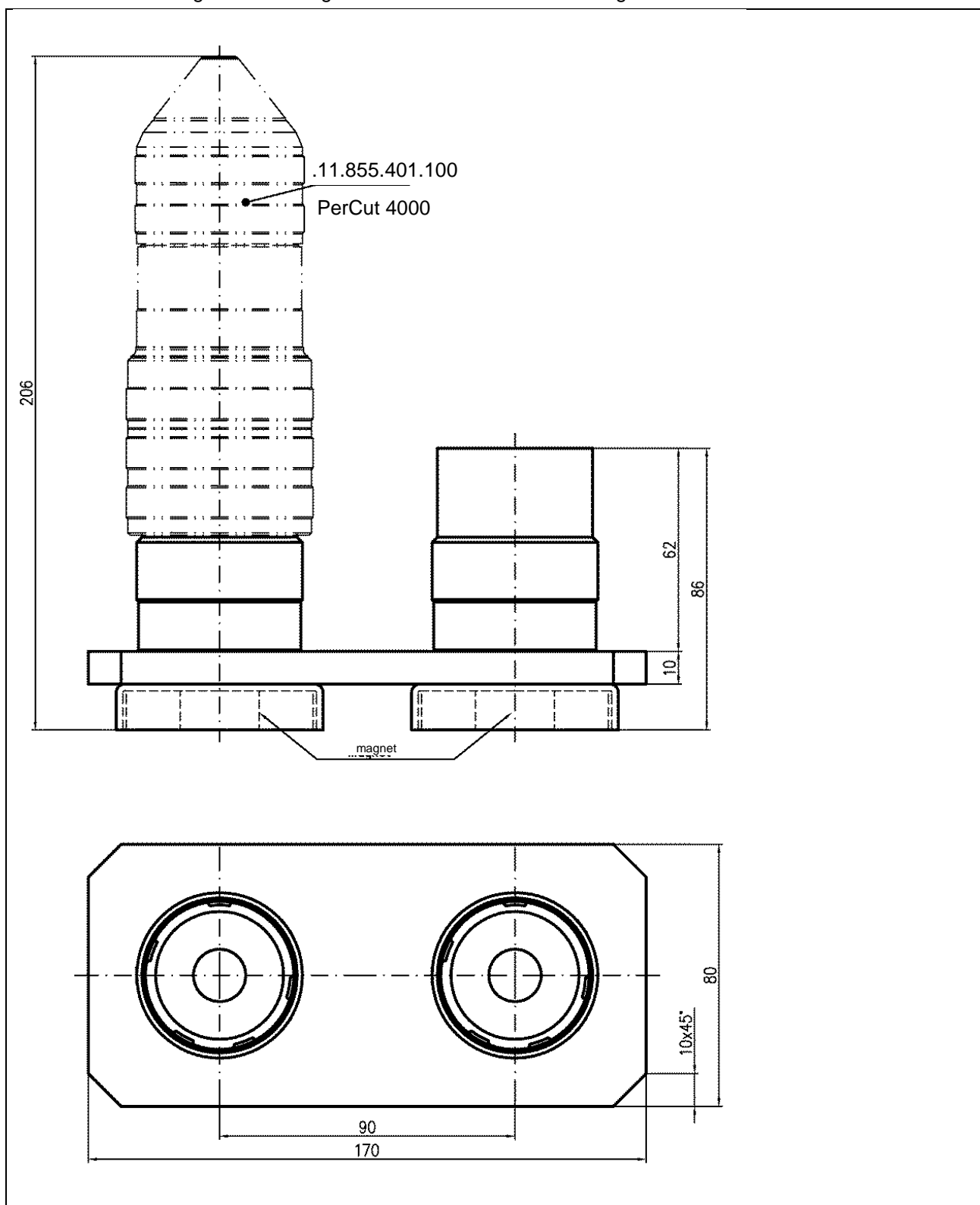


Fig. 44: Parking station .11.855.401.830 suitable for change head PerCut 4000

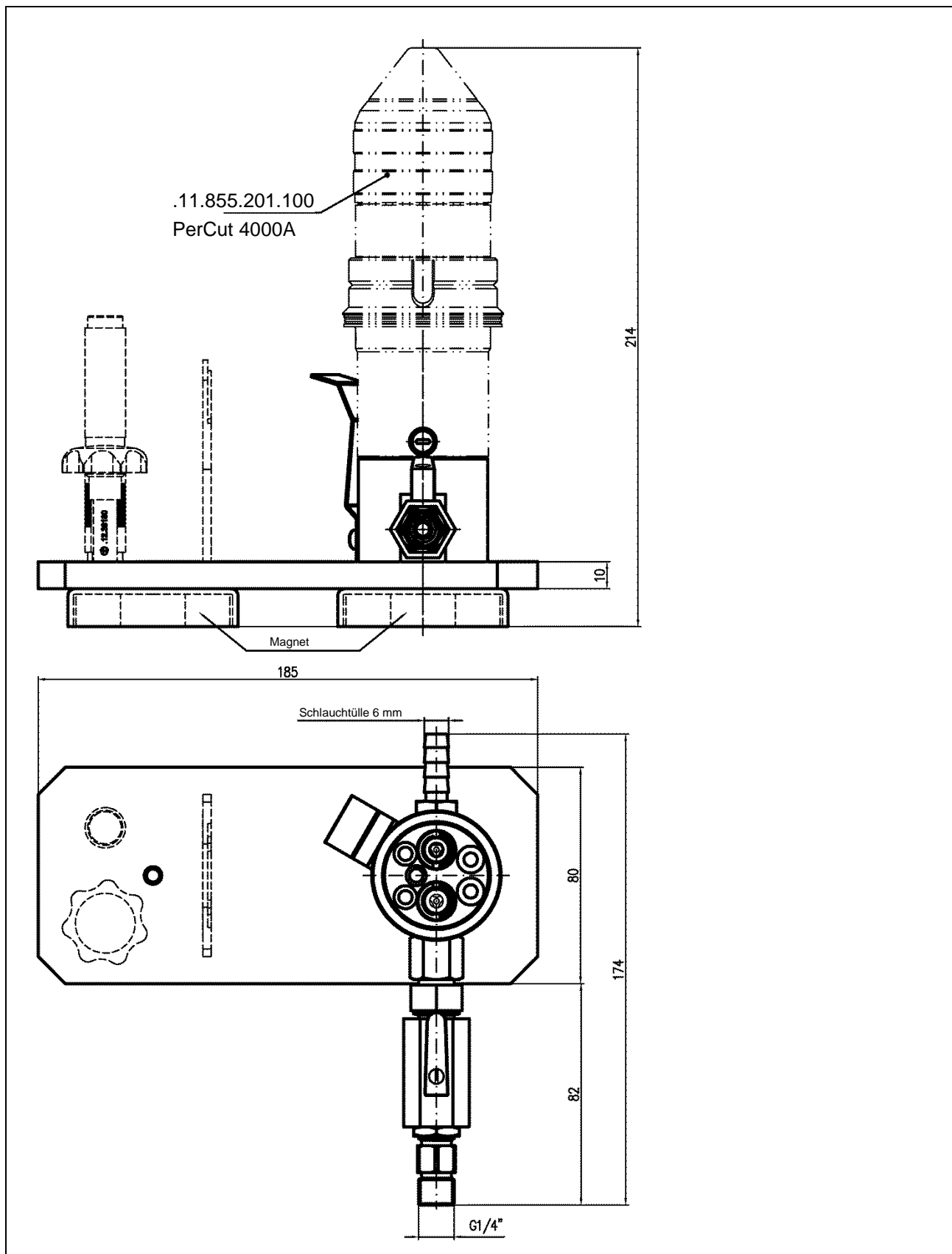
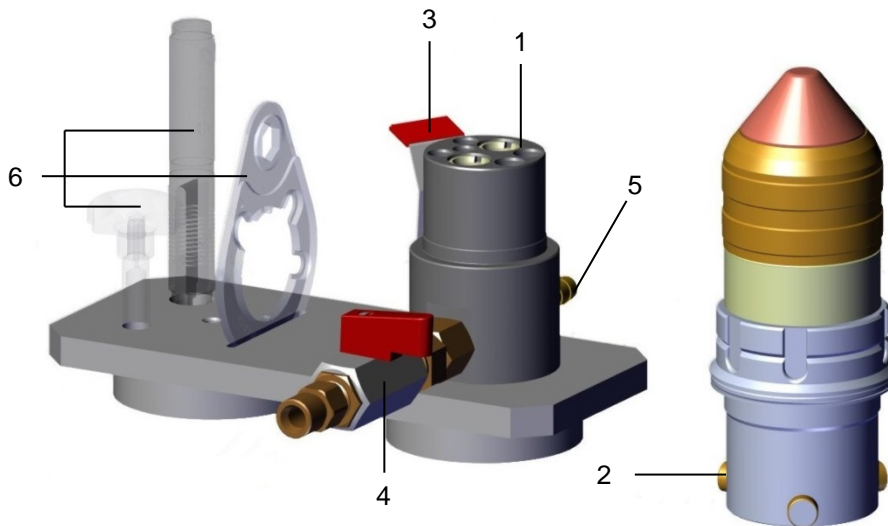


Fig. 45: Parking station .11.852.201.840
suitable for change head PerCut 4000A

Plasma machine torch PerCut 2000/2000A / PerCut 4000/4000A *FINSTERWALDE*

Use the parking station .11.852.201.840 for consumable change of change head PerCut 4000A, this station is equipped with a mechanism for blowing out of the coolant.



1. Unscrew the change head from the torch shaft for change of consumables.
2. Place change head to the parking station (1). Pay attention to the correct position! The radial pin (2) of the change head must engage in the retaining bracket (3).
3. Connect at the terminal piece of the ball valve (4) a hose for compressed air.
4. Connect a hose to the drain pipe (5) for discharging the coolant-air mixture and bring this to a collection.
5. Open the ball valve (4) complete, for blowing out the coolant with the aid of compressed air.
6. Close the ball valve (4) again.
7. Perform the change of consumables with the supplied standard tools (6) according to the instruction manual (see chapter "Consumables and their exchange").
8. After completion of consumable change removing the replaceable head by pressing down the retaining bracket (3) of the parking station and pull out the change head straight up.
9. Connect the change head to the torch shaft.

8.5.2 Maintenance of the change head

Plasma torch:	PerCut 2000	PerCut 2000A
Drawing of the spare parts lists:	.11.856. <u>4</u> 01.E0	.11.856. <u>2</u> 01.E0

Plasma torch:	PerCut 4000	PerCut 4000A
Drawing of the spare parts lists:	.11.855. <u>4</u> 01.E0	.11.855. <u>2</u> 01.E0

The position numbers indicated in the sections below, e.g. (01.08), refer to the spare parts drawings above. You will find these spare parts drawings in the appendix „Spare parts lists“.

In order to increase the lifetime of the o-rings we recommend the occasional use of an exclusively oxygen-suitable lubricant:

- Please apply the lubricant only to the o-rings marked with # in the following picture!
- Please wet the o-rings only slightly with the lubricant!
- Please make sure that no lubricant enters the nipples and borings!
- An oxygen-suitable lubricant (e.g. lubricant for O₂ LC 40 Fluid, article no. .10.616.104) can be obtained from Kjellberg Finsterwalde.

**The use of lubricant for o-rings:**

- Please wet the o-rings with oxygen-suitable lubricant only!
- The use of other oils and fats may eventually destroy the quick-change head / plasma torch!
- Please apply lubricant only to those o-rings marked or mentioned accordingly!
- Under no circumstances shall lubricant be applied to the o-rings of the consumables which are subject to high thermal load!

8.5.2.1 Control of the O-rings

Check of the outer o-rings

- 1 x o-ring 28 x 2.0 (01.08)
- 1 x o-ring 40 x 2.0 (01.09)
- 1 x o-ring 42 x 2.0 (01.10)

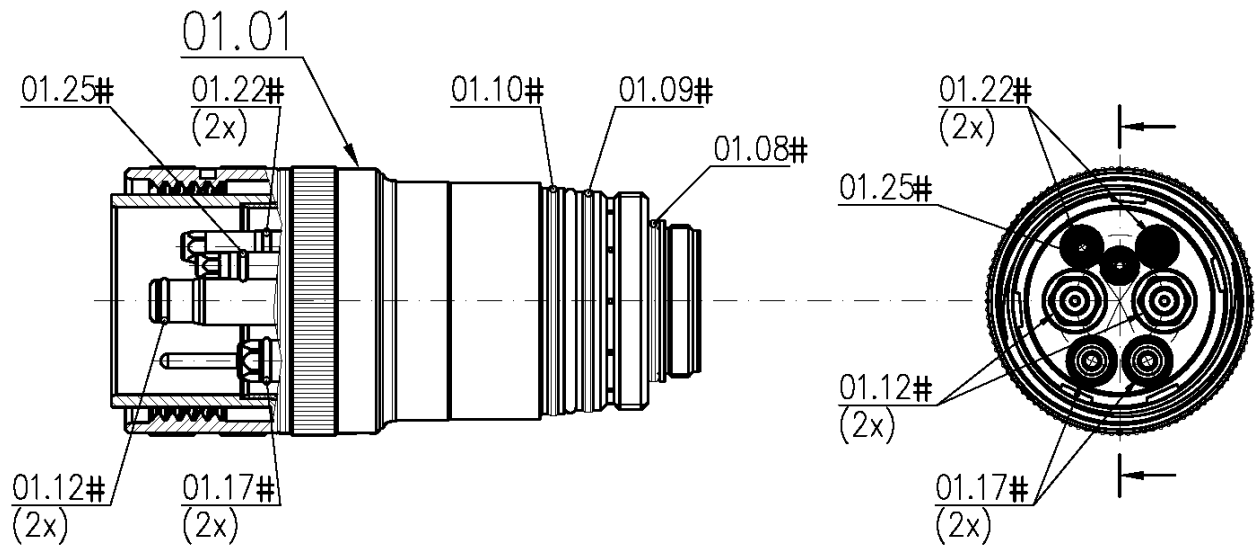
Please replace the o-rings in case of damage or wear.

Check of the inner o-rings

This list includes only those o-rings that are subject to wear during mounting and demounting of the quick-change head:

- 2 x o-ring 6 x 1.5 (01.12) at WV-plug WV (**01.13**) and current-plug WR (**01.14**), if necessary dismantling of the plug, use socket wrench (**60.20**) for current- /WV-plug for the mounting / dismantling.
- 2 x o-ring 4.5 x 1.5 (01.22) at nipple WG and PG (**01.24**) required dismantling of the nipple, use torque screwdriver (**60.10**) with hexagonal insert SW6 (**60.14**) at montage with changed o-ring and tighten with 30cNm.
- 1 x o-ring 3.5 x 1.5 (01.25) at nipple KG (**01.27**), required dismantling of the nipple, use torque screwdriver (**60.10**) with hexagonal insert SW5 (**60.12**) at montage with changed o-ring and tighten with 20cNm.
- 2 x o-ring 6 x 1.5 (01.17) at insulating bush PI and insulating bush EF (**01.19**), required dismantling of the socket, use torque screwdriver (**60.10**) with hexagonal insert SW8 (**60.13**) at montage with changed O-ring and tighten with 60cNm.

PerCut 4000



PerCut 4000A

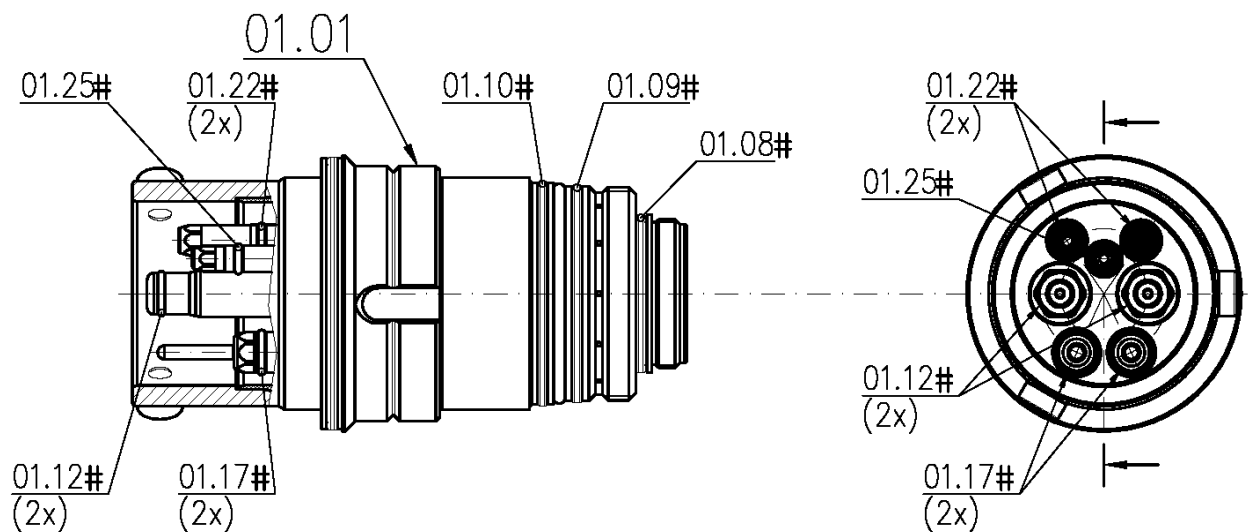


Fig. 46: Inner and outer o-rings of the change head

8.5.2.2 Control of the location pin

Control or change of location pin (01.20):

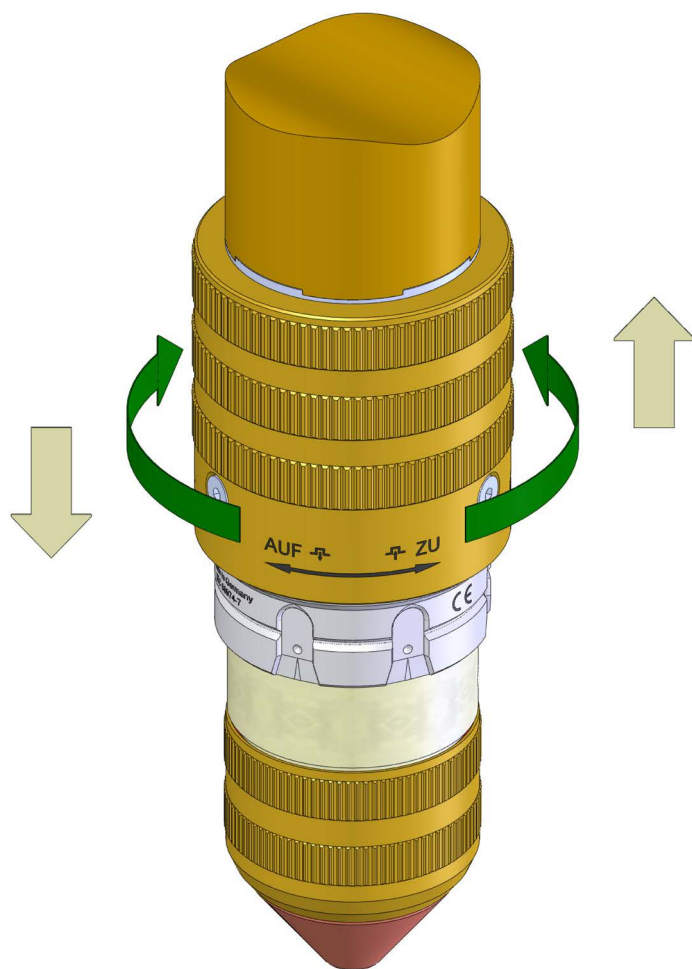
- required dismantling of PI insulating bush (01.19), use torque screwdriver (60.10) with hexagonal insert SW9 **(60.13)**
- unscrew the location pin (01.20) use torque screwdriver (60.10) with hexagonal insert SW6 **(60.14)**
- screw , if necessary, a new location pin and tighten with a torque screwdriver (60.10) and hexagonal insert SW6 (60.14) with 20 cNm, for this change the adjustment at the screwdriver!
- insert PI insulating socket (01.19), use torque screwdriver (60.10) with hexagonal insert SW8 **(60.13)** and tighten with 60 cNm (change the adjustment at the screwdriver!)

8.5.3 Add on of the change heads

Remove the residual coolant from the torch interface (head and shaft) before assembly the change head, for example through the blowing out with compressed air!

8.5.3.1 PerCut 4000A

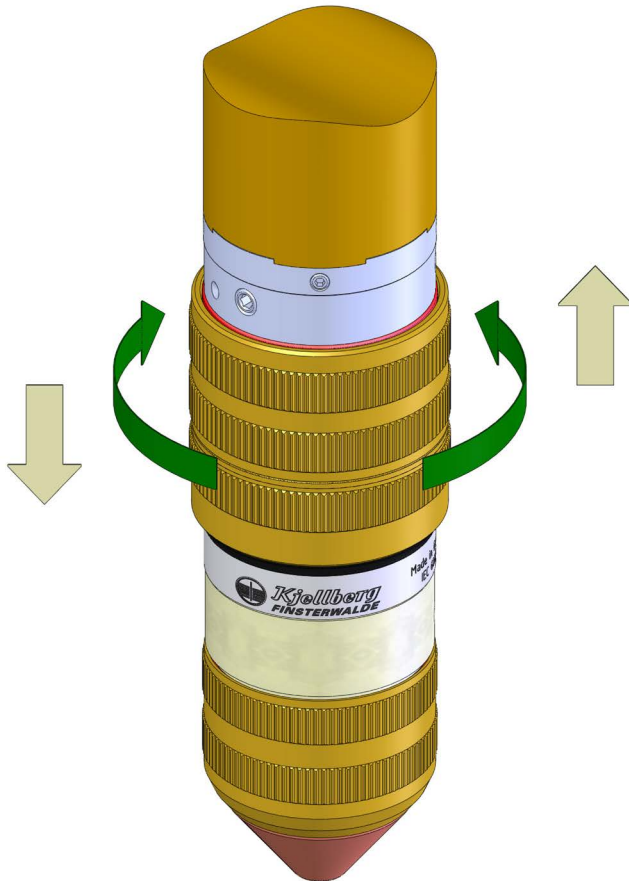
1. Thread the change head into torch shaft, adjust each of the three locking screws on the long groove of the locking sleeve.
2. Turn the locking sleeve to the shaft according to the following figure, until it stops in interlock position, supportingly push the torch head against torch shaft in the same time.



In case the sealing sleeve cannot be locked, the change tip is not plugged onto the shaft far enough. It must then be checked whether the correct position of the head to the shaft, all inner components are free of foreign matter and whether all rings are okay. In case of doubt, the contact positions of the torch must be cleansed with compressed air, and a further attempt is to be made **WITHOUT USING FORCE!**

8.5.3.2 PerCut 4000

1. Threading the change head through the torch shaft by means of 5- groove system.
2. Turn the lock on the head approx. 4 turns, according to the following figure, until the noticeable mechanical stop.



If the torch head cannot be screwed completely on the torch shank (noticeable mechanical stop) it must be controlled whether all inside components are free of impurity and all O-rings are okay. In the case of doubt the contact of the torch has to be cleaned with compressed air. Afterwards connect the change head without using FORCE with the shank!



9 Plasma torch connection unit PBA-300

9.1 Technical data

Art. no.:	.11.820.254
Operating voltage (magnet solenoids):	230 V AC, 50 / 60 Hz (see chapter „connection of gas supply“ in the instruction manual of the plasma gas control unit)
Dimensions (lxbxh):	397 x 265 x 252 mm
Weight:	6 kg
used gases:	see "Connection of the gas supply" at the plasma gas console
Connection to:	PGE-300, PGV-300 with line set PZL-300

Fig. 47: Technical data

9.2 Technical description

The plasma torch connection unit PBA-x00 is the intersection between the plasma torch and the power source. The plasma ignition unit is located in the PBA-x00. After opening the safety-contact protected angle flap the connectors for coolant supply, nozzle, coolant return, cathode and control gas are accessible. The connectors for the plasma gases and the swirl gases are placed sideward on the PBA-x00.

Fig. 48: Dimension diagram

9.3 Connection of the plasma torch connection unit

The plasma torch connection unit has to be fixed to the guiding system or to a robot, the customer is using. For the correct fastening the bottom plate of the PBA is furnished with four distance pieces (with threads M6 inside/outside).

Two attachment variants result:

1. with distance pieces at the supplied condition
2. with turned distance pieces

Afterwards cables of the hose parcel PZL will be inserted into the PBA and fastened there.

The numbered connecting hoses for the gas supply have to be installed gas proof to the respective connectors 1 and 4. The control hose is attached to connector 5 at the supply side of PBA. The plug of control lines will be plugged in X114A, X121A and X122B and surely locked.

Connect the plasma torch with the output side of the PBA; exactly how the connection of hose parcel PZL with the input side. The plasma gas and swirl gas hoses are screwed according to the outer designations as well as the inner designations of control gas (G1/8") at the connecting plate. The connections for plasma gas, swirl gas, igniting gas and exhaust are indicated in colour to the distinction.

After finishing the installation work close the cover, otherwise the door switch avoids starting of plasma power source!

Plasma torch connection unit PBA-300

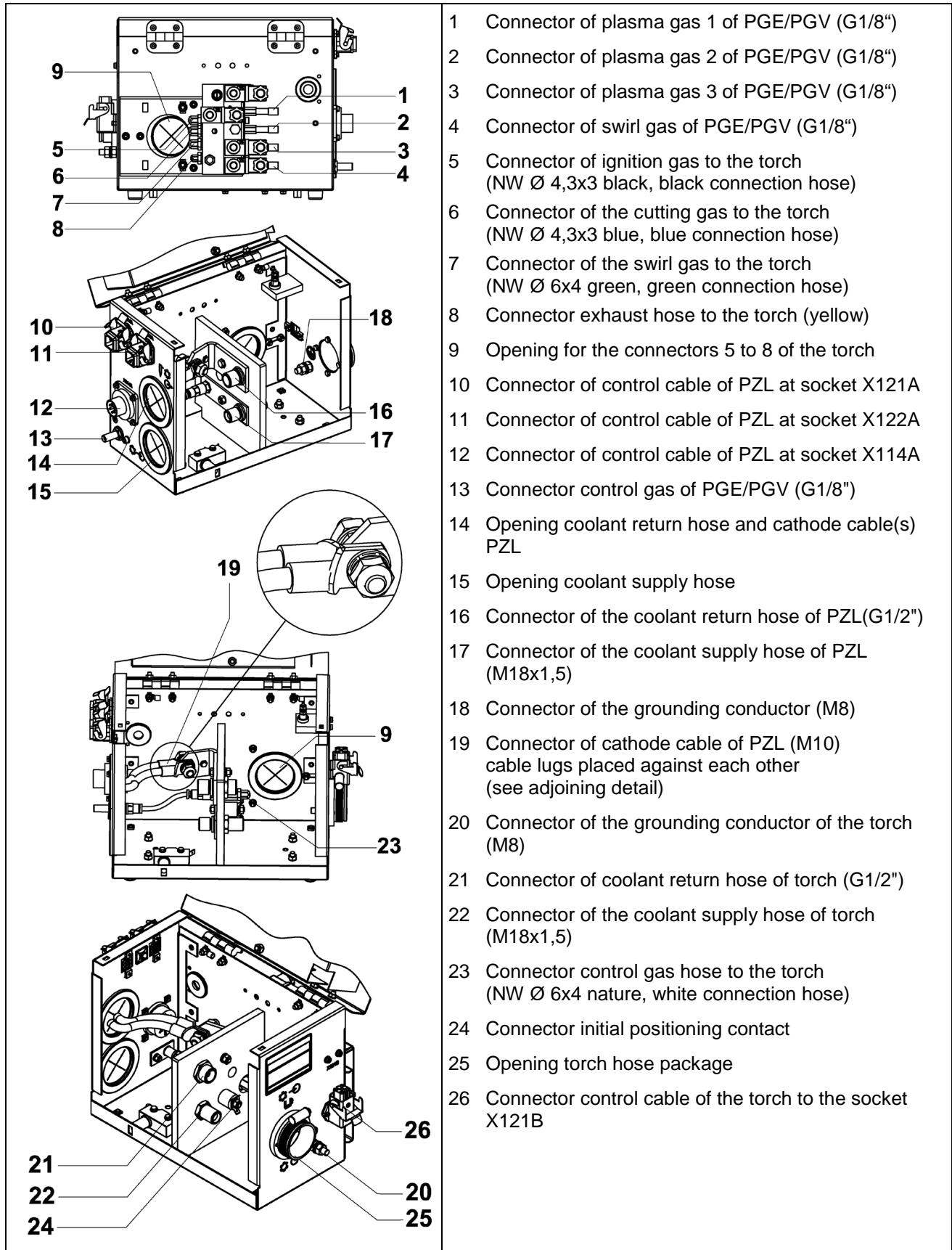
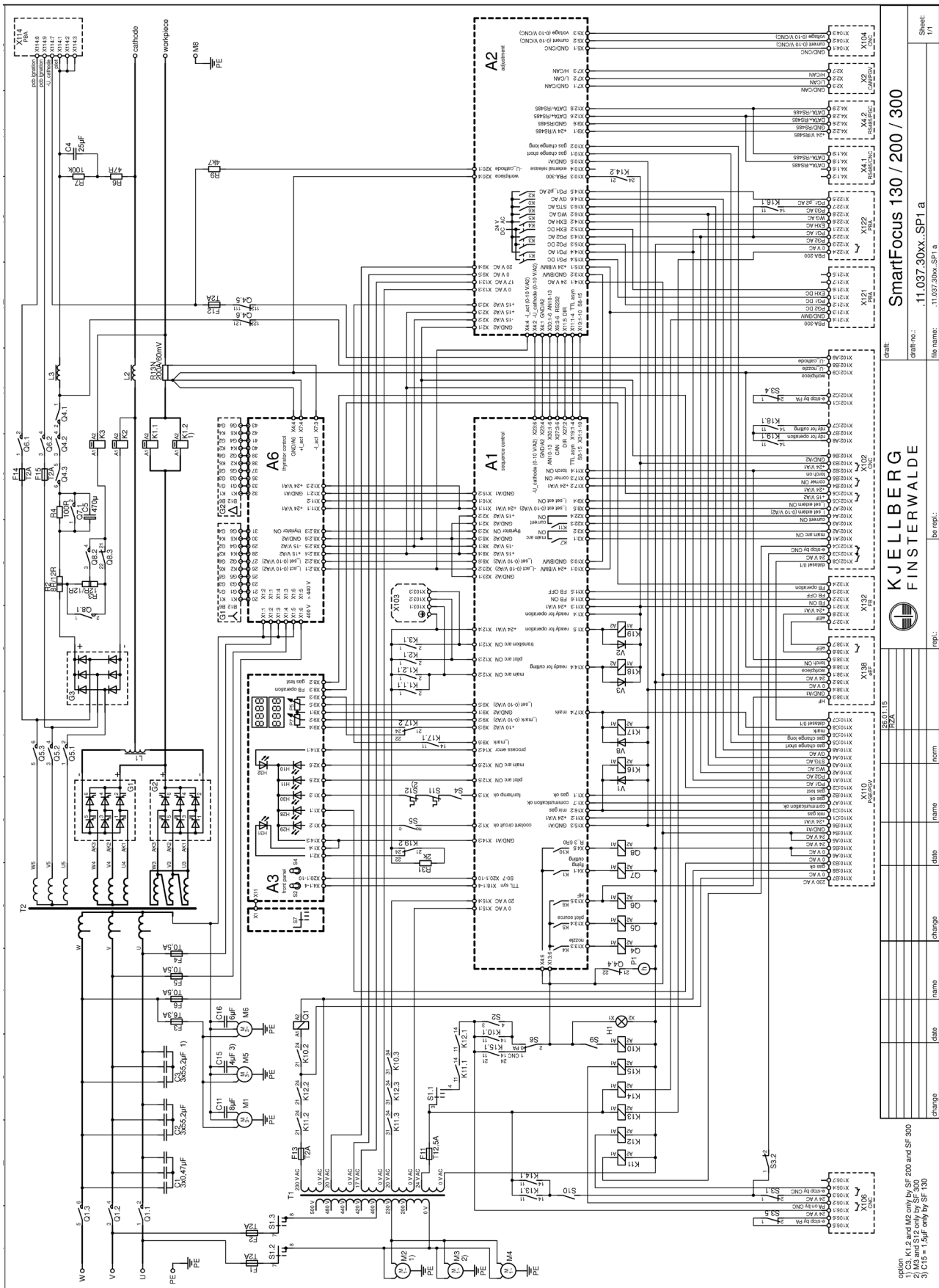


Fig. 49: connectors of the PBA-300

10 Wiring diagrams

for the plasma cutting unit Smart Focus 300	drawing-no.:
Wiring diagram power source	.11.037.1002.SP1 .11.037.2002.SP1 .11.037.3002.SP1
Legend	.11.037.x002.SP1
Wiring diagram CNC-interface	.11.037.1002.SP2 .11.037.2002.SP2 .11.037.3002.SP2
with gas console according to delivery variant:	
PGE-300 wiring diagram for the complete machine	.11.037.3002.SP91
or: FlowControl 300 (PGC 300 + PGV 300) wiring diagram for the complete machine	.11.037.3002.SP92



.11.037.x002.SP1

Code	Beschreibung	Description
A1	LP MR-Ablaufsteuerung	PCB sequence control
A2	LP Anpassung	PCB adjustment
A3	LP Frontwand	PCB front panel
A6	LP Thyristorsteuerung	PCB thyristor control
C1	Endstörkondensator	capacitor interference suppression
C2	Kondensator Blindleistungskompensation	capacitor power factor correction
C3	Kondensator Blindleistungskompensation	capacitor power factor correction
C4	Kondensator Pilotstromunterstützung	capacitor pilot current support
C5	Kondensator Pilotstromreduktion	capacitor pilot current reduction
C11	Kondensator Motoranlauf M1	capacitor motor start up M1
C15	Kondensator Motoranlauf M5	capacitor motor start up M5
C16	Kondensator Motoranlauf M6	capacitor motor start up M6
F1,F2	Sicherungen Steuertrafo	fuse control transformer
F3	Sicherungen Kühlmittelpumpe, Hauptlüfter	fuse coolant pump, main fan
F4,F5,F6	Sicherung Thyristorsteuerung (U/V/W)	fuse thyristor control (U/V/W)
F11	Sicherung Steuerspannung 24 V AC	fuse control voltage 24 V AC
F12	-U Katode	fuse -U_catodhe
F13	Sicherung Steuerspannung 230 V AC	fuse control voltage 230 V AC
F14,F15	Sicherungen HF-Zündgerät	fuse HF ignition unit
G1	Gleichrichter Stern	rectifier star
G2	Gleichrichter Dreieck	rectifier delta
G3	Gleichrichter Pilotquelle	rectifier pilot source
H1	Lampe grün Stromquelle	light green power source
H10	LED weiß Hauptbogen	LED white main arc
H11	LED weiß Pilotbogen	LED white pilot arc
H28	LED grün Gas OK	LED green gas OK
H29	LED grün Kühlmittel OK	LED green coolant OK
H30	LED grün Temperatur OK	LED green temperatur OK
H31	LED gelb Summenfehler	LED yellow cumulative error
H32	LED gelb Prozessfehler	LED yellow process error

Wiring diagrams

.11.037.x002.SP1

Code	Beschreibung	Description
K1.1, K1.2	Stromrelais DC Hauptbogen	current relay DC main arc
K2	Stromrelais DC Pilotquelle	current relay DC pilot arc
K3	Stromrelais DC Übergangsbogen	current relay DC transfer arc
K10	Relais AC PA EIN	relay AC PA ON
K11, K12	Relais AC Not-Halt Kanal (1,2)	relay AC emergency stop channel (1,2)
K13	Relais AC PBA-200	relay AC PBA-200
K14	Relais AC PBA-300	relay AC PBA-300
K15	Relais AC PA EIN von CNC	relay AC PA ON by CNC
K16	Relais DC Mixgas	relay AC mix gas
K17	Relais DC Markieren	relay AC mark
K18	Relais DC Schneidbereit	relay AC ready for cutting
K19	Relais DC Betriebsbereit	relay AC ready for operation
L1	Saugdrossel	balance choke
L2	Schneidkreisdrossel	cutting choke
L3	Entstördrossel	suppressor choke
M1	Hauptlüfter	main fan
M2	Lüfter Gleichrichter G1	fan rectifier G1
M3	Lüfter Gleichrichter G2	fan rectifier G2
M4	Lüfter LP-Gehäuse	fan PCB-box
M5	Lüfter Wärmetauscher	fan heat exchanger
M6	Pumpe Kühlkreislauf	pump coolant circuit
P1	Zähler Schneidzeit	counter cutting time
Q1	Hauptschütz	main contactor
Q4	Schütz Düse	contactor nozzle
Q5	Schütz Pilotquelle	contactor pilot source
Q6	Schütz HF-Zündgerät	contactor HF ignition unit
Q7	Schütz fliegend Anschneiden	contactor flying cutting
Q8	Schütz Übergangswiderstand	contactor transfer resistor

.11.037.x002.SP1

Code	Beschreibung	Description
R2	Vorwiderstand	pre-resistor
R3	Übergangswiderstand	transfer resistor
R4	Pilotwiderstand	pilot resistor
R6	Vorwiderstand	pre-resistor
R7	Entladewiderstand	charging resistor
R13N	Shunt	shunt
R31	Vorwiderstand	pre-resistor
S1	Schlüsselschalter	key switch
S2	Taster grün PA EIN	pushbutton green PA ON
S3	Schalter rot Not-Halt	switch red emergency stop
S4	Windschalter Hauptlüfter	airflow switch main fan
S5	Durchflussschalter	flow switch
S6	Umschalter PA/CNC	switch PA/CNC
S7	Technologieschalter	technology switch
S9	Schwimmerschalter	coolant level switch
S10	Schalter Anschlussmulde	switch connection box
S11	Thermoschalter G1	thermal switch G1
S12	Thermoschalter G2	thermal switch G2
T1	Steuertransformator	control transformer
T2	Haupttransformator	main transformer
X2	D-Sub 9-pol. Stecker CAN/PGV	Sub-D 9-pol. plug CAN/PGV
2	Daten L/CAN	data L/CAN
3	Versorgung GND/CAN	supply GND/CAN
7	Daten H/CAN	data H/CAN
X4.1	D-Sub 9-pol. Stecker RS485 CNC	Sub-D 9-pol. plug RS485 CNC
8	Data +	Data +
9	Data -	Data -
X4.2	D-Sub 9-pol. Buchse RS485 PGC	Sub-D 9-pol. socket RS485 PGC
2	Versorgung +24 V DC	supply +24 V DC
6	Versorgung GND DC	supply GND DC
8	Data +	Data +
9	Data -	Data -

Wiring diagrams

.11.037.x002.SP1

Code	Beschreibung	Description
X102	25-pol. Buchse CNC	25-pol. socket CNC
A1-A2	potentialfrei, Hauptbogen EIN	potential-free, main arc ON
A3-A4	potentialfrei, Strom fließt	potential-free, current ON
A7	Signal 0-10 V A2 I_soll extern	signal 0-10 V A2 I_set extern
A8-B7	potentialfrei, Betriebsbereit	potential-free, ready for operation
A8-C7	potentialfrei, Schneidbereit	potential-free, ready for cutting
A9	Sekundär 0 bis -200 V DC, Katodenspannung	secondary 0 till -200 V DC, cathode voltage
B2	Signal +24 V A1, Brenner EIN	signal +24 V A1, torch ON
B3,B4	Versorgung +24 V A1	supply +24 V A1
B5	Signal +24 V A1, Ecke	signal +24 V A1, corner
B6	Versorgung GND A2	supply GND A2
B8	Sekundär 0 bis -100 V DC, Düsenspannung	secondary 0 till -100 V DC, nozzle voltage
C1-C2	potentialfrei, Not-Halt von PA	potential-free, emergency stop by PA
C3	Versorgung 24 V AC	supply 24 V AC
C4	Signal 24 V AC, Not-Halt von CNC	signal 24 V AC, emergency stop by CNC
C5	Signal +15 V A2 I_soll extern EIN	signal +15 V A2 I_set extern
C6	Versorgung +15 V A2	supply +15 V A2
C8	Signal 24 V AC, Datensatz 0/1	signal 24 V AC, Dataset 0/1
C9	Sekundär GND DC, Werkstück	secondary GND DC, workpiece
X104	4+1-pol. Buchse, CNC	4+1-pol. socket CNC
1	Versorgung GND DC	supply GND DC
2	Signal 0-10 V DC, Strom	signal 0-10 V DC, current
3	Signal 0-10 V DC, Spannung	signal 0-10 V DC, voltage
4	PE	PE
X106	7+1-pol. Buchse Fernschaltung von CNC	7+1-pol. socket remote control
1	Versorgung 24 V AC	supply 24 V AC
2	Signal 24 V AC, PA EIN von CNC	signal 24 V AC, PA ON by CNC
3	Versorgung 24 V AC	supply 24 V AC
4	Signal 24 V AC, Not-Halt von CNC	signal 24 V AC, emergency stop by CNC
5-6	potentialfrei, Not-Halt von PA	potential-free, emergency stop by PA

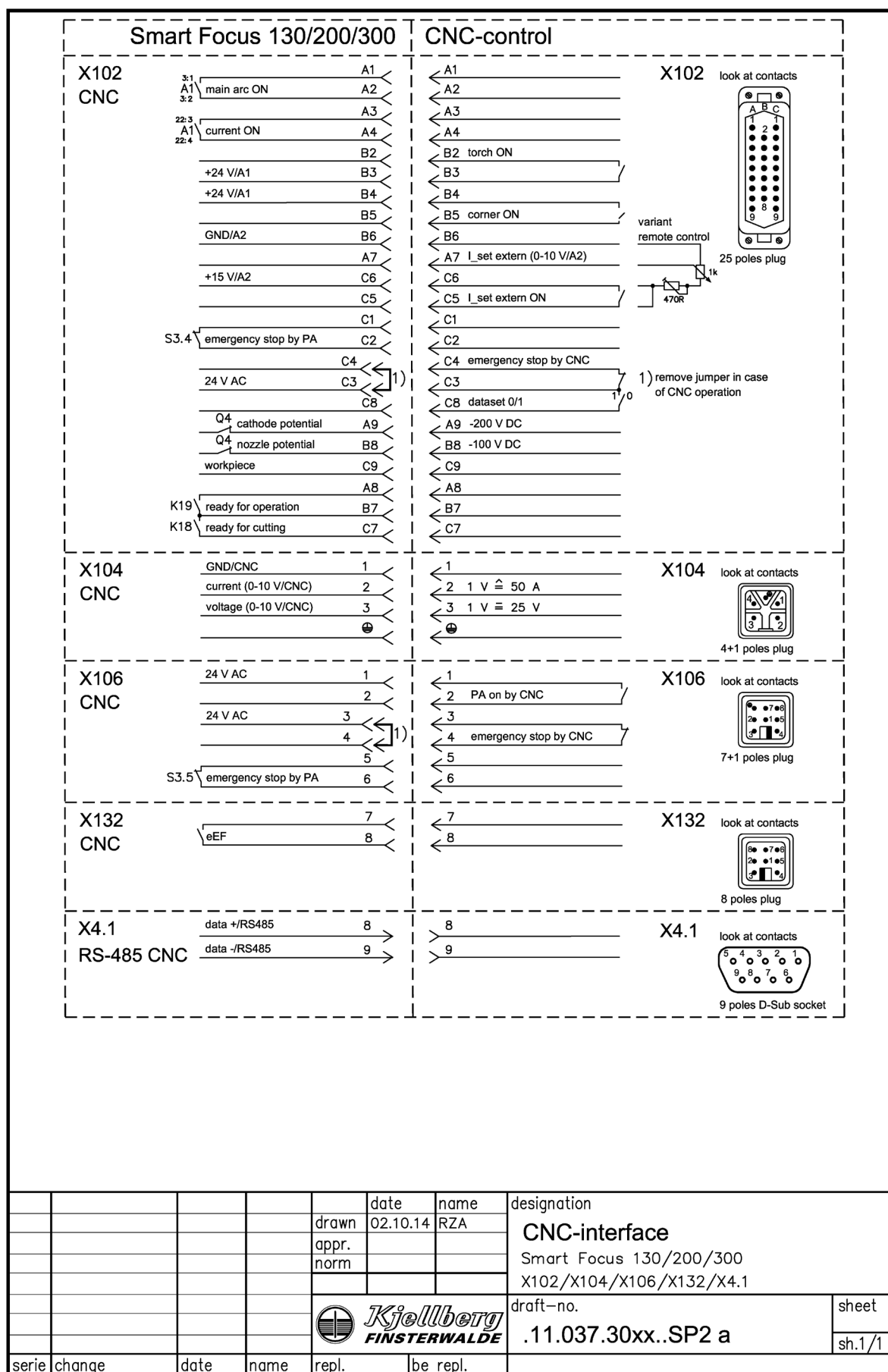
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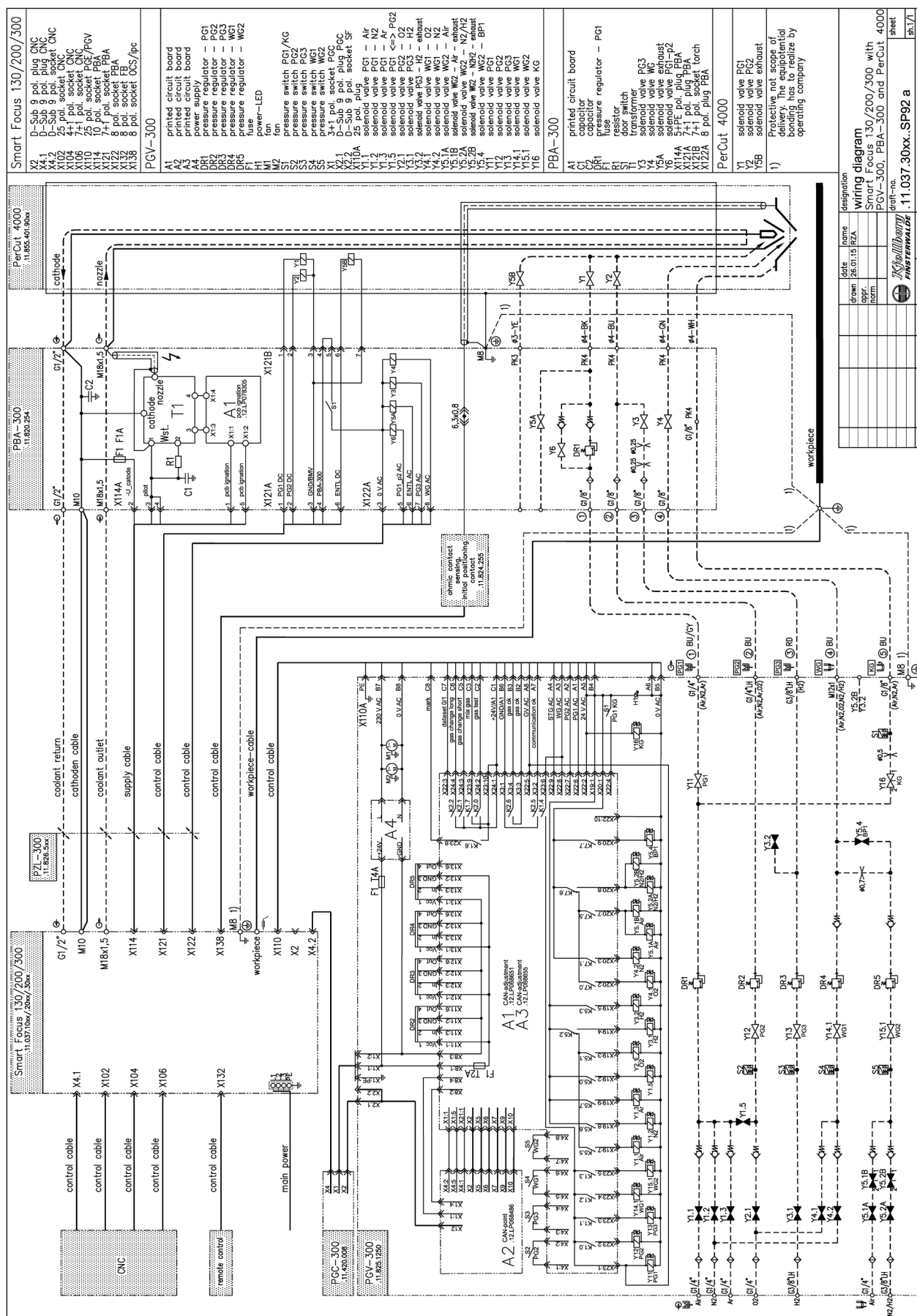
Code	Beschreibung	Description
X110	25-pol. Buchse Gaskonsole	25-pol. socket gas console
A1	Signal 24 V AC, Plasmagas 1 AC	signal 24 V AC, PG1 AC
A2	Signal 24 V AC, Plasmagas 2 AC	signal 24 V AC, PG2 AC
A3	Signal 24 V AC, Wirbelgas AC	signal 24 V AC, WG AC
A4	Signal 24 V AC, Startgas AC	signal 24 V AC, StG AC
A5	Versorgung 24 V AC	supply 24 V AC
A6	Versorgung 0 V AC	supply 0 V AC
A7	Signal +24 V A1, Kommunikation Ok	signal +24 V A1, communication ok
A8	Signal 24 V AC, Gasversorgung	signal 24 V AC, gas supply AC
B2-B3	Signal +24 V A1, Gas Ok	signal +24 V A1, gas ok
B4	Versorgung 24 V AC	supply 24 V AC
B5	Versorgung 0 V AC	supply 0 V AC
B6	Versorgung GND A1	supply +24 V A1
B7	Versorgung 230 V AC	supply 230 V AC
B8	Versorgung 0 V AC	supply 0 V AC
C1	Versorgung +24 V A1	supply +24 V A1
C2	Signal +24 V A1, Gastest	signal +24 V A1, gas test
C3	Signal +24 V A1, Mixgas	signal +24 V A1, mix gas
C5	Signal +24 V A1, Gaswechsel kurz	signal +24 V A1, gas change short
C6	Signal +24 V A1, Gaswechsel lang	signal +24 V A1, gas change long
C7	Signal 24 V AC, Datensatz 0/1	signal 24 V AC ,dataset 0/1
C8	Signal +24 V A1, Markieren	signal +24 V A1, marking
X121	8-pol. Buchse PBA/PB	8-pol. socket PBA/PB
1	Signal +24 V BMV, PG1 DC	signal +24 V BMV, PG1 DC
2	Signal +24 V BMV, PG2 DC	signal +24 V BMV, PG2 DC
3	Versorgung GND BMV	supply GND BMV
4	Signal 0 V AC, PBA-300	signal 0 V AC, PBA-300
6	Signal +24 V BMV, Entlüftung DC	signal +24 V BMV, exhaust DC

Wiring diagrams

.11.037.x002.SP1

Code	Beschreibung	Description
X122	3+1-pol. Buchse PBA/PB	3+1-pol. socket PBA/PB
1	Signal +24 V AC, Plasmagas 1 AC	signal +24 V AC, PG1 AC
2	Signal +24 V AC, Plasmagas 2 AC	signal +24 V AC, PG2 AC
3	Versorgung 0 V AC	supply 0 V AC
4	Signal +24 V AC, PBA-200	signal +24 V AC, PBA-200
5	Signal +24 V AC, Plasmagas 1 p2 AC	signal +24 V AC, PG1_ p2 AC
6	Signal +24 V AC, Entlüftung AC	signal +24 V AC, exhaust AC
7	Signal +24 V AC, Plasmagas 3 AC	signal +24 V AC, PG3 AC
8	Signal +24 V AC, Wirbelgas AC	signal +24 V AC, WG AC
X132	8-pol. Buchse Fernbediensatz	8-pol. socket remote control
1	Versorgung +24 V A1	supply +24 V A1
2	Signal +24 V A1, FB EIN	signal +24 V A1, FB ON
3	Signal +24 V A1, FB AUS	signal +24 V A1, FB OFF
4	Signal +24 V A1, FB Betrieb	signal +24 V A1, FB operation
7-8	potentialfrei, Erstfindung	potential-free, initial positioning
X138	8-pol. Buchse ohmscher Kontaktsensor elektrische Erstfindung	8-pol. socket ohmic contact sensor/ elec. initial positioning
1	Versorgung 24 V AC	supply 24 V AC
2	Versorgung 0 V AC	supply 0 V AC
3	Signal 24 V AC HF	signal 24 V AC HF
4	Versorgung GND A1	supply GND A1
5	Signal +24 V A1, Brenner EIN	signal +24 V A1, torch ON
6	Sekundär GND DC, Werkstück	secondary GND DC, workpiece
7-8	potentialfrei, Erstfindung	potential-free, initial positioning





11 Spare parts lists

for the plasma cutting machine
with gas console according to the delivery option:
Plasma gas control unit PGE-300 or Plasma gas valve unit PGV-300
with plasma machine torch according to the delivery option:
PerCut 2000/2000A or PerCut 4000/4000A
with plasma torch connection unit according to the delivery option:
PBA-200 or PBA-300

Dear customer,

with the plasma cutting system you have purchased a quality product from the Kjellberg Finsterwalde Plasma und Maschinen GmbH.

When ordering spare parts, please mention the complete article no. of the torch and also the complete designation with article no. of the spare parts according to this list.

This information is required to be able to fulfil your wishes at short notice.

We reserve ourselves for technical reasons conditioned changes in the quantity production.

Claims of whatever kind can't be derived from this spare parts list. Please direct your order straight to us or to your contractor.

For more information we are always at your disposal.

Spare parts lists

11.1 Spare parts list Smart Focus 300

.11.037.3002

27.01.2015

pos.	article-no.	designation	code	pcs.
01.00	.16.500.368	Front wall		
01.01	.10.110.316	emergency stop switch without spacer ring	S3	1
01.04	.10.110.318	key switch	S1	1
01.05	.10.110.317	pressure button	S2/H1	1
01.08	.10.110.311	LED green 24VAC/DC ultra bright	(S2/H1)	1
01.09	.12.LP066520	Technology range switch	S7	1
01.10	.10.187.202	Knob 28mm black with line	(S7,A3:P5,P7)	3
01.11	.10.187.203	Cover 28mm black with line	(S7,A3:P5,P7)	3
01.12	.10.187.204	Arrow ring 28mm black	(S7,A3:P5,P7)	3
01.15	.10.105.671	Frame for LCD display	(A3)	2
01.19	.10.110.319	flat lens green	(S2/H1)	1
01.20	.10.108.418	Schlegel module holder MHR_3	(S1,S2)	2
01.21	.10.108.419	non-holding closing contact MTI	(S1,S2)	2
01.22	.10.108.421	Non-holding closing contact MTIV	(S1)	2
01.23	.10.108.424	Module holder MHR_5	(S3)	1
01.24	.10.108.425	Light socket ML BA9s 250V/2W	(S2/H1)	1
01.25	.10.108.420	Non-holding opening contact MTO	(S3)	4
01.26	.12.LP066586	PCB 066586A front panel SF equipped	A3	1
02.00	.16.500.369	Rear wall		
02.03	.10.189.300	Fuse holder 6,3x32 500V	F1-F15	11
02.04	.10.189.302	Fuse cap 6,3 x 32 mm	F1-F15	11
02.06	.10.189.309	G-Fuse 6,3x32 6,25A/440V	F3	1
02.07	.10.189.305	Fuse T 2A, 6,3X32 mm	F1,F2,F12-F15	6
02.08	.10.189.311	Fuse T 500 mA	F4,F5,F6	3
02.09	.10.164.174	Female insert 7-pol.+PE crimp connection	X106,X121	2
02.10	.10.164.200	Metall housing	X104,106,132	3
02.10	.10.164.200	Metall housing	X138,121,122	4
02.11	.10.164.201	Crimp Contact, Female 0,75-1,5 qmm	X	90
02.12	.10.603.008R	Cable gland M63x1.5 27-48mm	Power	1
02.13	.10.603.017	Nut M 63x1.5	Power	1

.11.037.3002

27.01.2015

pos.	article-no.	designation	code	pcs.
02.14	023.763.000	DIX TBE 35-70 Mounting jack	DIX	1
02.15	.10.164.065	Female insert 4 pol.+PE screw connection	X104	1
02.17	.10.164.197	Female insert 8-pol.42V crimp connection	X132,138,122	3
02.18	.10.164.110	Female insert 25-pol.+PE crimp connection	X102,110	2
02.19	.10.164.113	Plug Base	X102,110	2
02.20	.10.164.176	Female insert 10-pol.+PE screw connection	X114	1
02.21	.10.164.179	Plug Base	X114	1
02.22	.10.164.702	SUB-D socket 9pol/insert/soldered conn.	X4.2	1
02.23	.10.164.701	SUB-D plug 9pol./insert/soldered connect.	X4.1,X2	2
02.24	.10.164.704.1	SUB-D clamping bolt short 8 mm	X2,X4.1,X4.2	6
02.25	.10.164.714	SUB-D cover plate for socket red	X4.2	1
02.26	.10.164.715	SUB-D Cover plate for plug blue	X2,X4.1	2
02.28	.10.580.139	Clamp		1
02.29	.10.274.024	Knurled nut M6		2
02.33	.10.504.563	Handle part PA black		2
02.34	.11.034.402.755	Handle 595 lg		1
02.35	.10.109.518	Micro switch KS A4 F	S10	1
02.37	.10.164.168	Protective cover+rubber seal		1
02.38	.10.189.312	FUSE M 12A, 6,3x32 mm,	F11	1
03.00	.16.500.204	Side view		
03.01	.10.269.566	Lifting eye M 10		4
03.02	.10.140.696	Fan dia. 300	M1	1
03.03	.11.036.112.100	Transformer complete	T2	1
03.04	.11.036.112.450	Choke FF800	L2	1
03.05	.10.129.108	fixed resistor 24 Ohm 5A 400W 29x300 10%	R2/R3	2
03.06	.11.035.002.510	balance coil	L1	1
03.08	.10.502.246	Steering toller PL-CK 160x50		2
03.09	.11.035.002.590	Rectifier unit B6C 380/505-150	G1/G2	2
03.10	.11.036.112.020	Airflow switch	S4	1
03.12	.10.502.262	Wheel PB-CK 160x50		2
03.15	671.100.008	Capacitor B - 8 MFD - VIS M8	C11	1
03.20	.11.034.902.410	Current relay	K3 / K2	2
03.21	.10.161.730.230	Contacteur B145 00 220-240V 50/60HZ	Q1	1
03.22	.10.101.915	shunt 100mV/300A Form A	R13N	1
03.23	.10.164.300	Protective terminal 35qmm small		1
03.24	.10.164.078	Protective terminal 70qmm		1

Spare parts lists

.11.037.3002

27.01.2015

pos.	article-no.	designation	code	pcs.
03.25	.10.164.079	Terminal strip 70 qmm		3
03.27	.10.133.360	Capacitor MKP 400,3 8,33 kVA 3x55,2uF	PFC	2
03.29	.10.148.283	Tumbler switch, 1-pole	S6	1
03.31	.10.535.619	Fan W2E250HL0619 wire, Dm.250.	M5	1
03.32	.10.615.050	Heat exchanger		2
03.33	.11.037.3002..320	Pump compl. SF300	M6	1
03.34	.10.102.475	Rectifier DB 380/505-25 SI2 S	G3	1
03.35	.10.535.603	Fan Boxer 119x119x25	M4	1
03.36	.10.615.610	Filler neck		1
03.37	.10.615.612	Cover for filler neck		1
03.38	.11.037.3002..310	Coolant canister mounted	Tank	1
04.00	.16.500.371	Control Unit		
04.03	.10.161.703	Contact G481 02 for type CF/BF	(Q4)	1
04.04	.10.101.603	Operating hours counter 24V AC 50/60Hz	P1	1
04.08	.10.190.126	isolating transformer 230/400/500V-24/16A	T1	1
04.09	.10.190.029	Suppressor choke	L3	1
04.10	.101.20.031	Resistor 100K 4,50 W 5% TK 200	R7	1
04.11	671.100.025	Capacitor B - 25 MFD - VIS M8	C3	1
04.12	.101.30.056	Resistor 47R 7,00 W 5% TK 200	R6	1
04.13	.10.535.603	Fan Boxer 119x119x25	M4	1
04.14	.10.140.724	Filter Medium125 x 125 x 8 mm F100S	(M4)	1
04.17	.11.037.3002..470	Current relais	K2,K3	2
04.19	.10.164.170	Female insert 3-pol.+PE screw connection	X103	1
04.20	.10.164.200.1	Case Base Plastic	(X103)	1
04.21	.12.LP077788	PCB 077788A thyristor control SF 300 400V	A6	1
04.22	.12.LP066486	PCB 066486A sequence control SF smd equip	A1	1
04.24	.12.LP066686	PCB 066686A Adaption (SF)	A2	1
04.27	.10.110.529	Socket for relay	(K13-19)	7
04.28	.10.110.528	Frame for relay	(K13-19)	7

.11.037.3002

27.01.2015

pos.	article-no.	designation	code	pcs.
04.30	.10.110.480	Relay 24 VAC SPU.2 5A 250 VA	K13,K14	2
04.33	.10.110.530	Recovery-diode	(K16-19)	4
04.34	.10.110.461	Relay, 24 VDC coil	K16-19	4
04.36	.10.161.722.25	Contactactor BF25 01 A024 50/60Hz	Q4,Q7,Q8	3
04.37	.10.161.719.24	Contactactor BF18 10 24V 50/60Hz	Q5	1
04.38	.10.110.526	Socket 92.03 for relay type 62.32/33	(K10-12)	3
04.39	.10.110.527	mounting bracket 092.71 for relay	(K10-12)	3
04.40	.10.110.533	Relay 62.33, 24V AC, 16A,	K10-12	3
04.41	.10.110.493	Relay 24VAC SPU. 1 changer 16A 250VA	K15	1
04.42	.10.161.715.24	Contactactor BF09 10 24V 50/60Hz	Q6	1

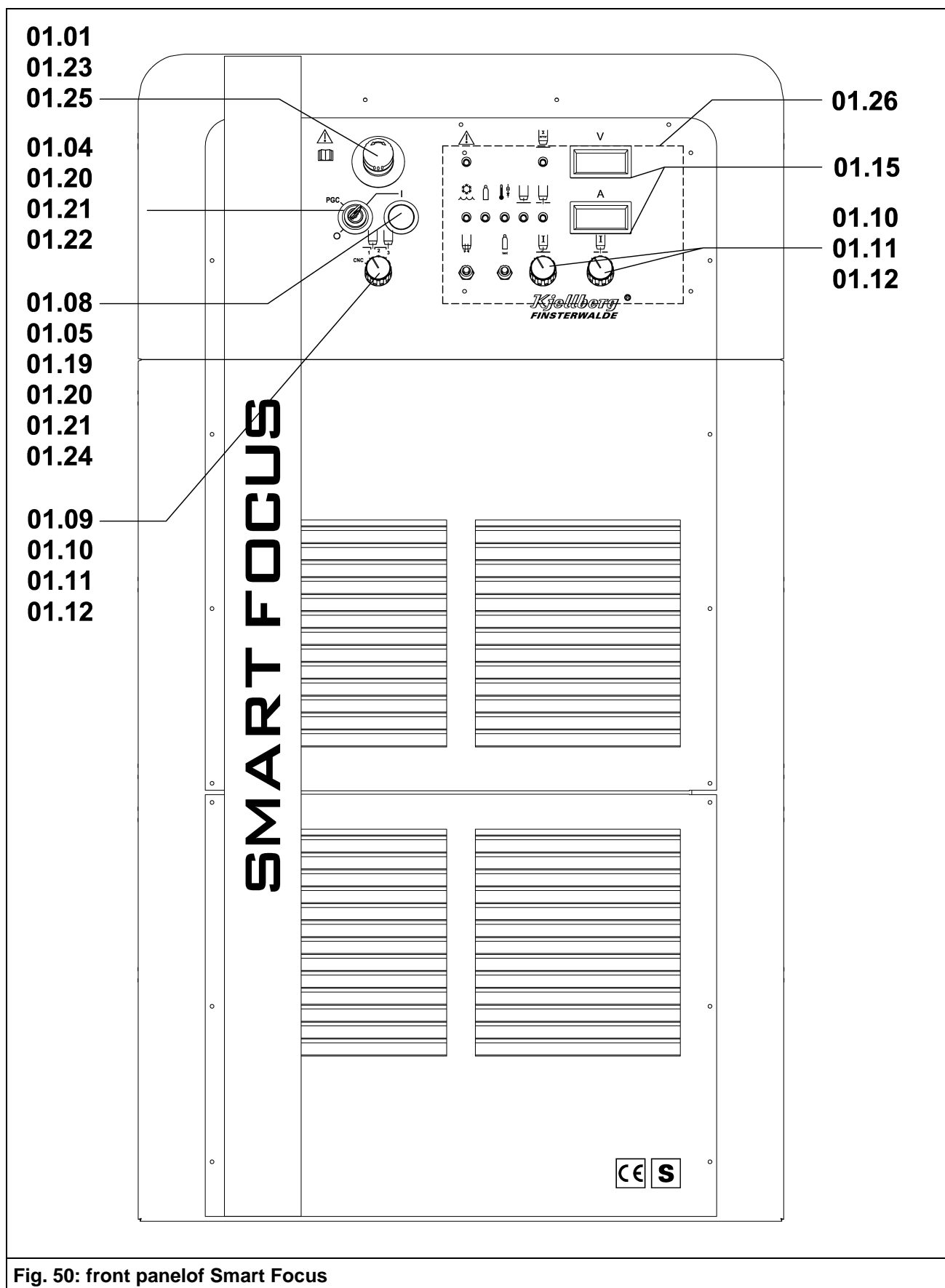


Fig. 50: front panel of Smart Focus

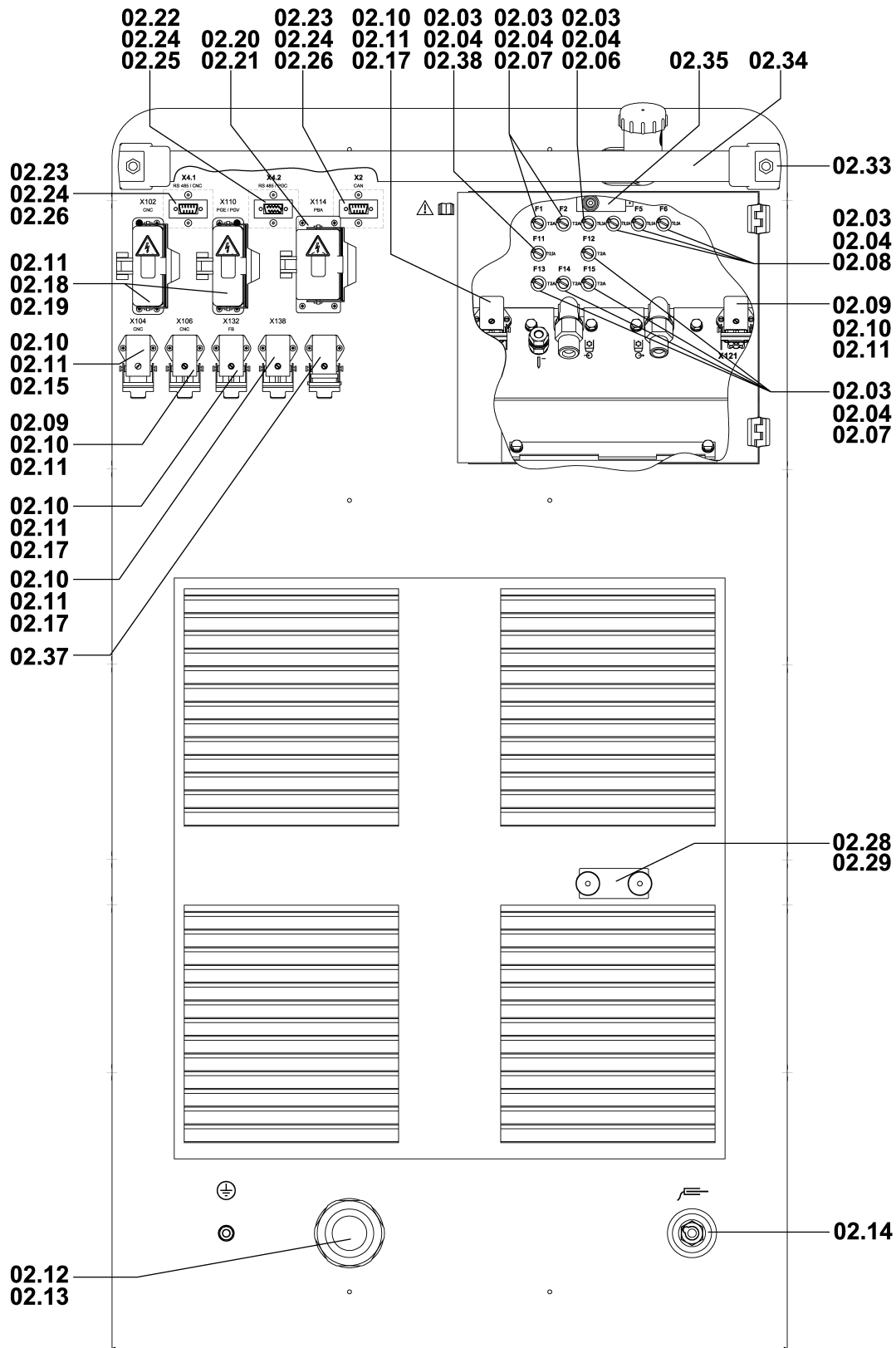
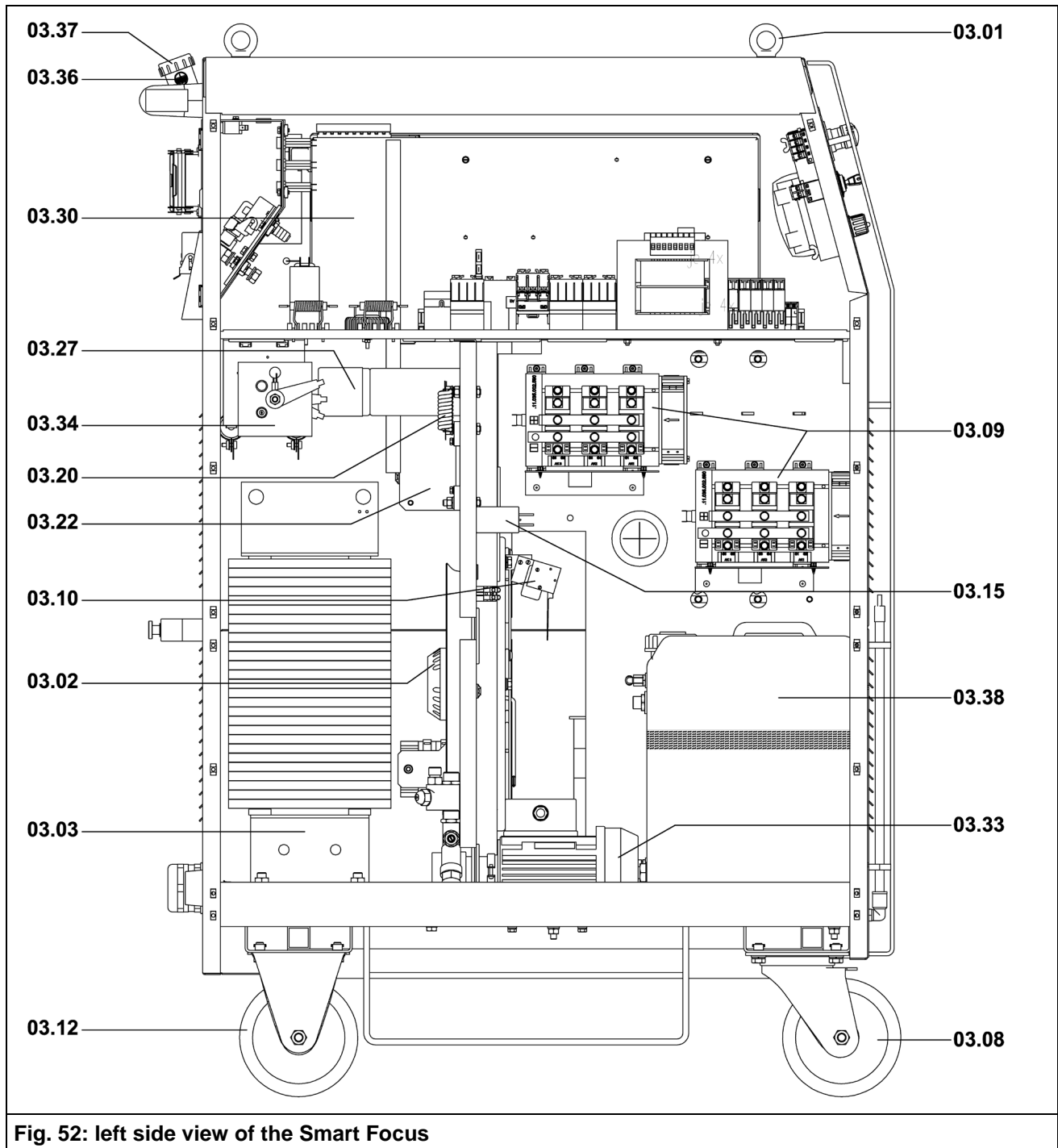


Fig. 51: rear panel of Smart Focus

Spare parts lists



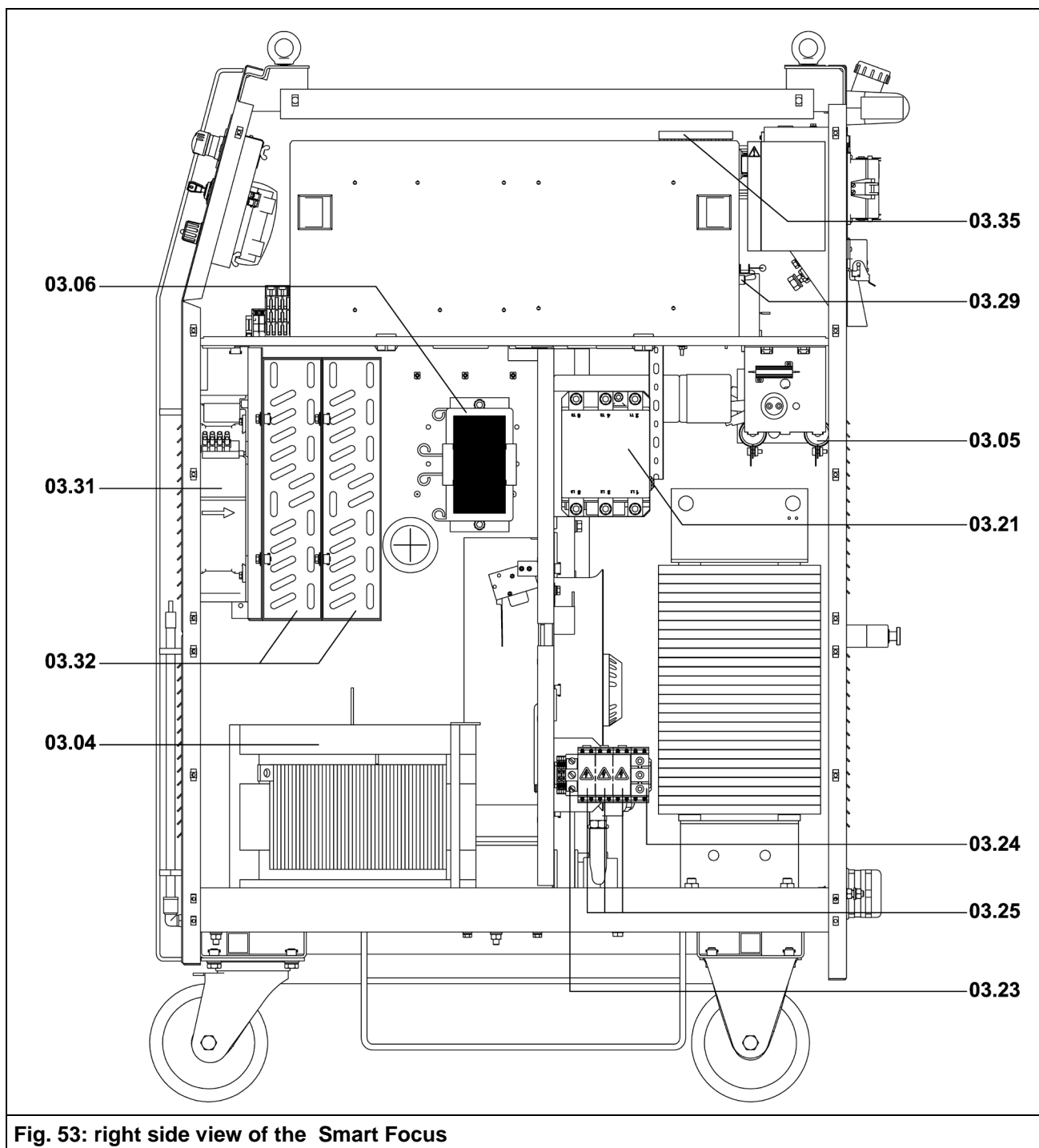


Fig. 53: right side view of the Smart Focus

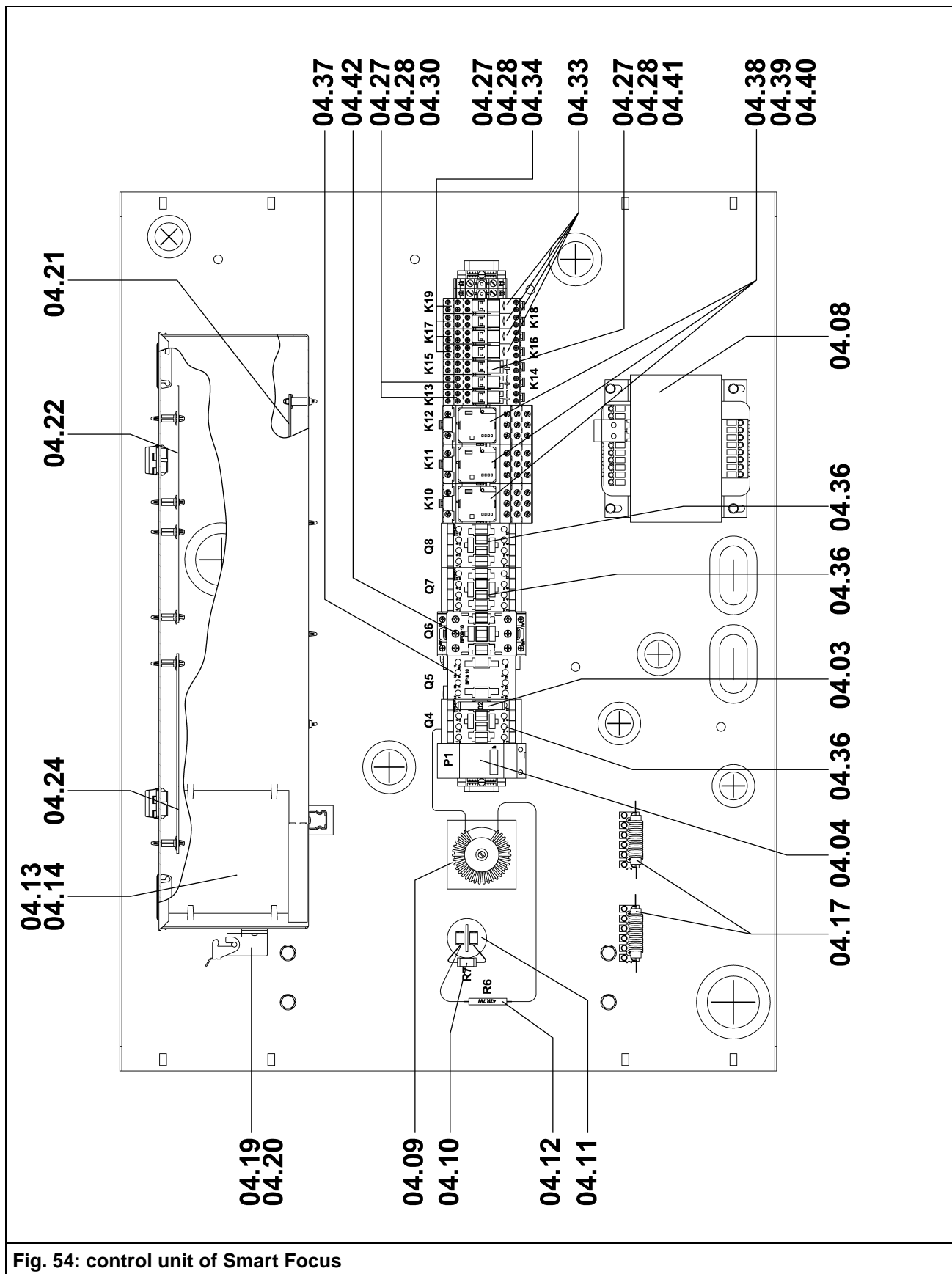


Fig. 54: control unit of Smart Focus

11.2 Spare parts list PGV-300

.11.825.1250

27.01.2015

pos	article no.	designation	code	pcs.
01.01	.10.102.049	Power supply 115-230 VAC/22,5-28,5VDC/5A	A4	1
01.02	.10.105.629	LED Type S 311, green	H1	1
01.03	.10.148.902	Pressure switch 804-10-213 1/4"	S1-S5	4
01.04	.10.164.111	Male insert 25-pol.+PE crimp connection	X110	1
01.05	.10.164.113	Plug Base	X1	1
01.06	.10.164.131	Terminal strip WK2,5/U		2
01.07	.10.164.170	Female insert 3-pol.+PE screw connection	X1	1
01.08	.10.164.173	Plug base	X1	1
01.09	.10.164.704.1	SUB-D clamping bolt short 8 mm	X2.1, X2.2	4
01.10	.10.189.300	Fuse holder 6,3x32 500V	F1	1
01.11	.10.189.302	Fuse cap 6,3 x 32 mm	F1	1
01.12	.10.189.308	Fuse T 4A	F1	1
01.13	.10.296.511	Spacer bolt 6KT 13 MS 0907000-0300010		2
01.14	.10.504.590	steel handle bar form B, L=100 black elox		2
01.15	.10.504.883	Rubber foot 6 x 30 x 30 BLACK		4
01.16	.10.505.843	O-ring 8X2 VMQ ISO 1629 70 shore		4
01.17	.10.505.884	O-ring 14X2 VMQ ISO 1629 70 shore		4
01.18	.10.535.608	Fan, 230 V, 50 Hz, 15 W	M1, M2	2
01.19	.10.535.610	Protective grid LZ 30 P		2
01.20	.10.575.152	Manometer profile gasket R1/4" Cu		1
01.21	.11.825.1200..810	Gas inlet PGE-300, mounted	Y1.1 - Y5.2	1
01.22	.11.825.1200..855	Y5.4-assembly, mounted	Y5.4	1
01.23	.11.825.1250..241	D-SUB-cable X2.1/X2.2 - A2 PGV-300	A2, X2.1, X2.2	1
01.24	.11.825.1250..912	Pressure reducer 2 PGV-300	DR2	1
01.25	.11.825.1250..913	Pressure reducer 3 PGV-300	DR3	1
01.26	.11.825.1250..914	Pressure reducer 4 PGV-300	DR4	1
01.27	.11.825.1250..915	Pressure reducer 5 PGV-300	DR5	1
01.28	.11.825.150.008	holding fixture		1
01.29	.12.250.013	SV with DGN M13x1 O2 and HyLok 6M	Y12, Y14,1	2
01.30	.12.250.113.70	Pressure reducer 7 bar with KG-connection	DR1	1
01.31	.12.250.319	SV 3/2 with DGN M13x1 and Hylok 6M	Y16	1
01.32	.12.250.321	SV 3/2 M13x1/6M 90° bent	Y5.1B	1
01.33	.12.250.322	SV 3/2 M13x1/6M 60° bent	Y5.2B	1

Spare parts lists

.11.825.1250

27.01.2015

pos	article no.	designation	code	pcs.
01.34	.12.250.400	SV with 2xDGN M13x1	Y11	1
01.35	.12.250.403	SV with DGN M13x1 and HyLok 6M	Y13, Y15.1	2
01.36	.12.251.100	SV currentless open 6M-G1/4" A	Y3.2	1
01.37	.12.251.200	non-return valve G1/8" with DGN M13x1	Y5.1B, Y5.2B	2
01.38	.12.29270	Filter M5x22	Air, Ar, O2, N2	5
01.39	.12.49050	Filter M 8 X 25, 9T2228	H2, N2/H2	2
01.40	.12.LP068486	PCB 068486 A CAN	A2	1
01.41	.12.LP068651	PCB 068651-B part LP-1	A1	1
01.42	.12.LP068655	PCB 068651-B part LP-2	A3	1
02.01	.10.500.057	Support sleeve, brass		1
02.02	.10.500.058	Clamp ring set 6 mm brass		1
02.03	.10.500.065	Nut CN-6M, brass		1
02.04	.10.508.019	Polyamide plastic hose 6/4 mm blue		1
02.05	.10.508.020	Polyamide plastic hose 6/4mm red		1
02.06	.10.508.021	Polyamide plastic hose 6/4 mm black		1
02.07	.10.508.023	Polyamide plastic hose 6/4mm green		1
02.08	.10.508.024	Polyamide plastic hose 6/4 mm grey		1

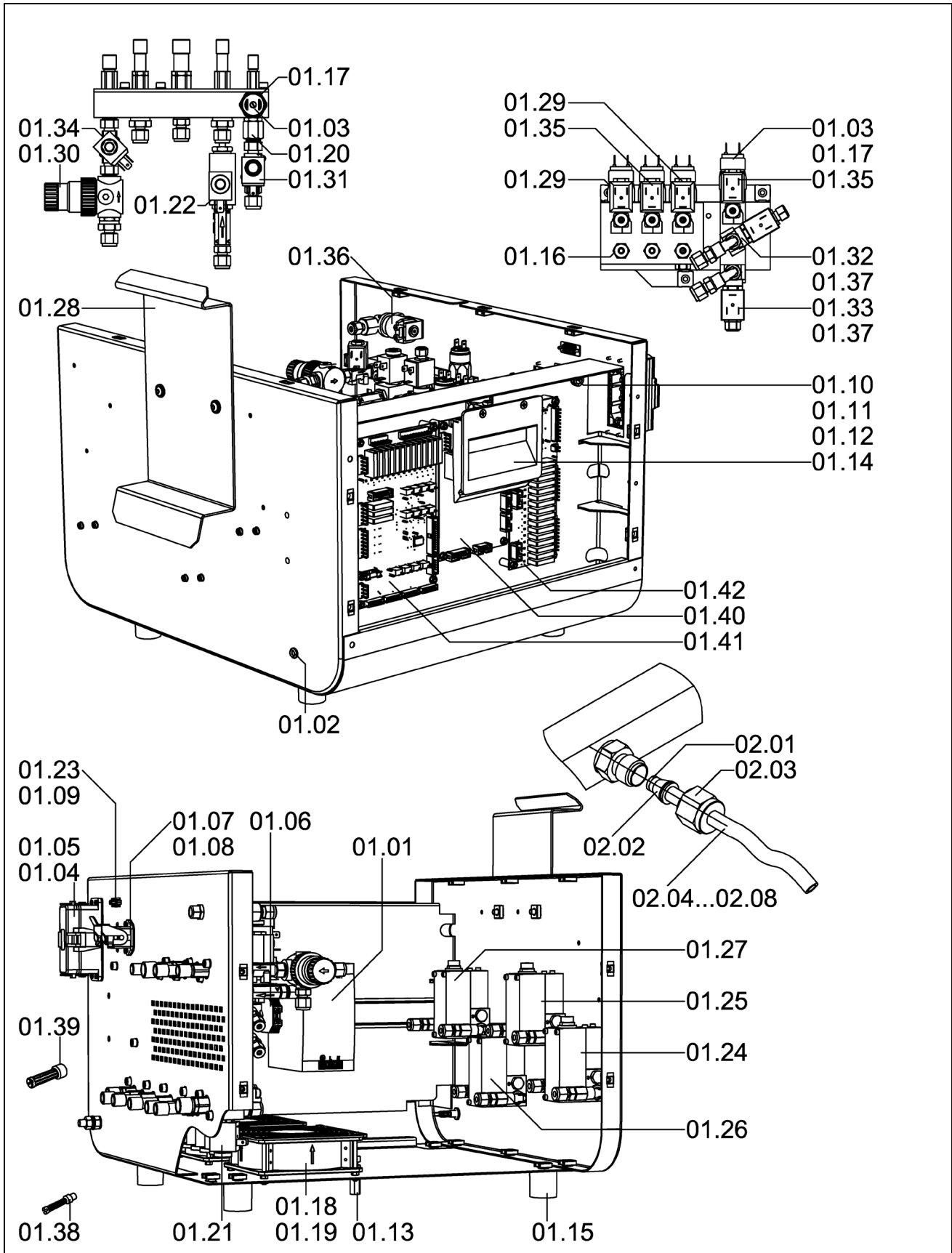


Fig. 55: Overview PGV-300

Spare parts lists

11.3 Spare parts list PerCut 2000

.11.856.401.E0

28.01.2015

pos.	article-no.	designation	code	pcs.
00.01	.11.856.401.9015	Shaft - PerCut 2000 - 200A/C/1,5m		1
00.31	.11.855.401.970	Bolt carrier - PerCut 4000		1
00.32	.11.848.401.972	Stop screw - PerCut 450M		1
00.33	.10.505.958	o-ring 42x2 VMQ ISO 1629 70 shore		1
00.35	.10.505.944	o-ring 35x1,5 VMQ ISO 1692 70 shore		1
00.36	.11.848.401.971	Threaded pin M6x8 - PerCut 450M		3
00.37	.10.257.543	Threaded pin M4x4 DIN913		4
00.41	.10.505.869	O-ring 10 X 1 VMQ ISO 1629 70 shore		1
00.42	.11.852.401.956	WV socket PerCut 451		1
00.43	.11.852.401.955	Current socket B10 - PerCut 451		1
00.44	.10.505.873	O-ring 12x1 VMQ ISO 1629 70 shore		1
00.45	.10.505.981	o-ring 5,0x1,5 VMQ 70Shore red		1
00.46	.11.852.401.9554	Valve tappet for socket - PerCut 451		1
00.47	.10.221.504	Compression spring d=0,5; De=5,5; Lo=14,0		1
00.48	.11.852.401.9553	Guide valve tappet - current socket		1
01.01	.11.855.401.100	Quick-change head PerCut 4000		1
01.08	.10.505.923	o-ring 28x2,0 VMQ ISO 1629 70 shore		1
01.09	.10.505.956	o-ring 40x2 VMQ ISO 1629 70 shore		1
01.10	.10.505.958	o-ring 42x2 VMQ ISO 1629 70 shore		1
01.11	.11.852.401.1785	Contact clip - PerCut 451		1
01.12	.10.505.826	o-ring 6x1,5 VMQ ISO 1629 70 shore		1
01.13	.11.852.401.182	Current plug S10 - PerCut 451		1
01.14	.11.852.401.182	Current plug S10 - PerCut 451		1
01.15	.10.505.034	o-ring 9x1,5 VMQ ISO 1629 70 shore		1
01.16	.10.505.831	o-ring 7x1,5 VMQ ISO 1629 70 shore		1
01.17	.10.505.826	o-ring 6x1,5 VMQ ISO 1629 70 shore		1
01.18	.10.505.913	o-ring 8x1 VMQ ISO 1629 70 shore, red		1

.11.856.401.E0

28.01.2015

pos.	article-no.	designation	code	pcs.
01.19	.11.852.401.174	PI- insulating socket - PerCut 451		1
01.20	.11.848.401.178	Pilot plug - PerCut 450M		1
01.21	.11.855.401.1781	EF-plug - PerCut 4000		1
01.22	.10.505.818	o-ring 4,5x1,5 VMQ ISO1629 70Shore red		1
01.23	.10.505.981	o-ring 5,0x1,5 VMQ 70Shore red		1
01.24	.11.852.401.181	Nipple PG/WG - PerCut 451		1
01.25	.10.505.799	o-ring 3,5x1,5 VMQ ISO 1629 70 shore		1
01.26	.10.505.800	o-ring 3x1 VMQ ISO1629 70Shore		1
01.27	.11.852.401.184	Nipple KG - PerCut 451		1
01.28	.11.848.401.079	Locking sleeve - PerCut 450M		1
01.29	.11.848.401.078	Locking ring - PerCut 450M		1
01.30	.11.848.401.080	Sealing ring - PerCut 450M		1
60.00	.16.500.006	herramienta de antorcha		
60.01	.12.38180	socket wrench f. cooling tube		1
60.02	.11.848.401.810	Torch tool - PerCut 440-450		1
60.03	.11.848.401.815	Gas guide puller PerCut 440-450		1
60.10	.10.615.909	Torque screwdriver		1
60.11	.10.615.909.1	Connecting shaft E 6,3 / 1/4"		1
60.12	.10.615.909.7	Hexagon application, long 1/4" SW 5		1
60.13	.10.615.909.6	Hexagon application, long 1/4" SW 8		1
60.14	.10.615.909.4	Hexagon application, long, 1/4" SW 6		1
60.20	.11.852.401.860	Socket wrench f. current- / WV-plug		1
60.30	.11.852.401.865	Socket wrench f. current- /WV-socket		1
70.00	.16.500.129	accesorios		
70.01	.10.616.104	Lubricante para O2 LC 40 fluido 25 ml		1
70.10	.11.855.401.830	station f. change head PerCut 4000		1



11.4 Spare parts list PerCut 4000

.11.855.401.E0

28.01.2015

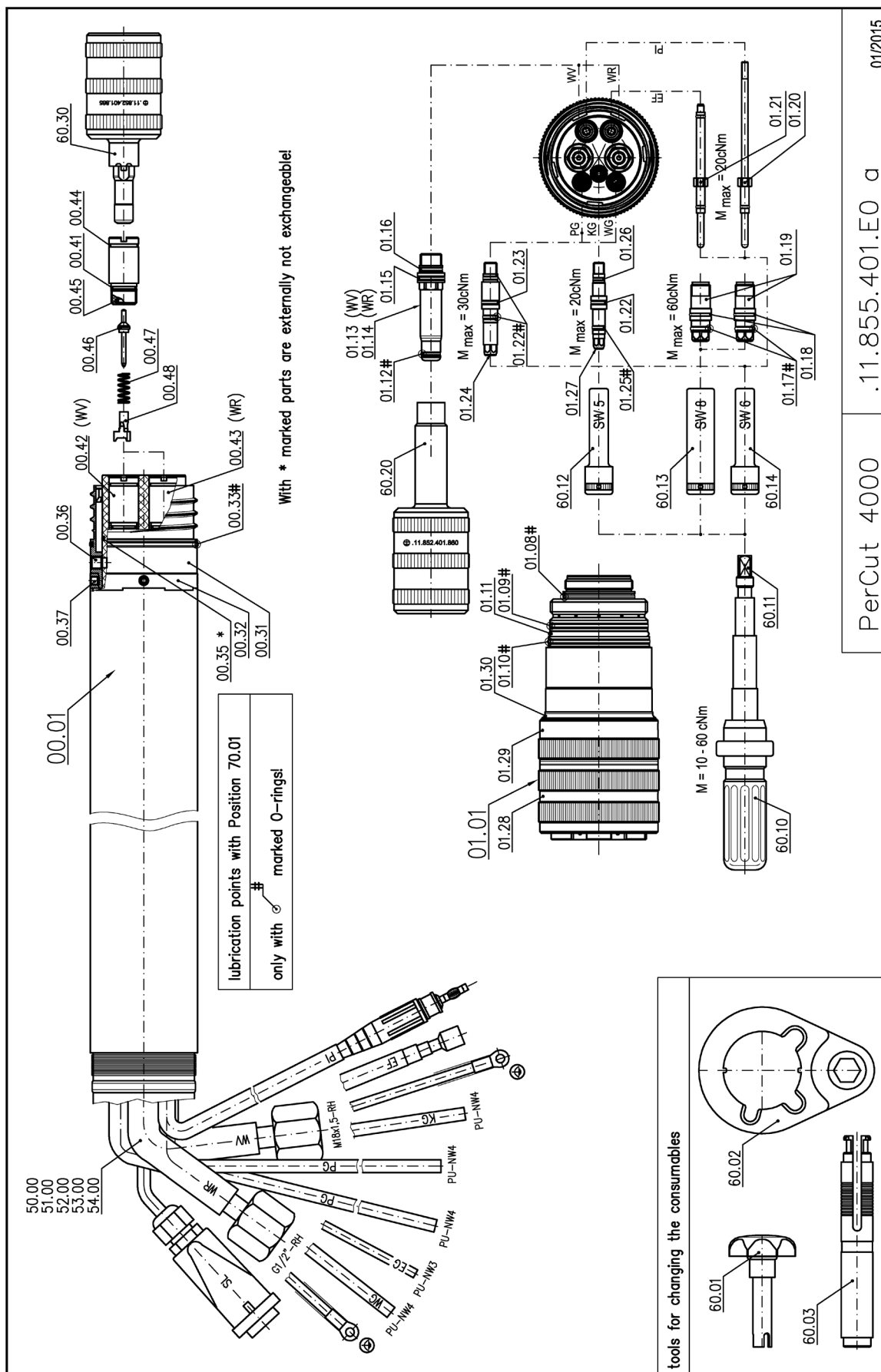
pos.	article-no.	designation	code	pcs.
00.01	.11.855.401.9015	Shaft - PerCut 4000 - 440A/C/1,5m		1
00.31	.11.855.401.970	Bolt carrier - PerCut 4000		1
00.32	.11.848.401.972	Stop screw - PerCut 450M		1
00.33	.10.505.958	o-ring 42x2 VMQ ISO 1629 70 shore		1
00.35	.10.505.944	o-ring 35x1,5 VMQ ISO 1692 70 shore		1
00.36	.11.848.401.971	Threaded pin M6x8 - PerCut 450M		3
00.37	.10.257.543	Threaded pin M4x4 DIN913		4
00.41	.10.505.869	O-ring 10 X 1 VMQ ISO 1629 70 shore		1
00.42	.11.852.401.956	WV socket PerCut 451		1
00.43	.11.852.401.955	Current socket B10 - PerCut 451		1
00.44	.10.505.873	O-ring 12x1 VMQ ISO 1629 70 shore		1
00.45	.10.505.981	o-ring 5,0x1,5 VMQ 70Shore red		1
00.46	.11.852.401.9554	Valve tappet for socket - PerCut 451		1
00.47	.10.221.504	Compression spring d=0,5; De=5,5; Lo=14,0		1
00.48	.11.852.401.9553	Guide valve tappet - current socket		1
01.01	.11.855.401.100	Quick-change head PerCut 4000		1
01.08	.10.505.923	o-ring 28x2,0 VMQ ISO 1629 70 shore		1
01.09	.10.505.956	o-ring 40x2 VMQ ISO 1629 70 shore		1
01.10	.10.505.958	o-ring 42x2 VMQ ISO 1629 70 shore		1
01.11	.11.852.401.1785	Contact clip - PerCut 451		1
01.12	.10.505.826	o-ring 6x1,5 VMQ ISO 1629 70 shore		1
01.13	.11.852.401.182	Current plug S10 - PerCut 451		1
01.14	.11.852.401.182	Current plug S10 - PerCut 451		1
01.15	.10.505.034	o-ring 9x1,5 VMQ ISO 1629 70 shore		1
01.16	.10.505.831	o-ring 7x1,5 VMQ ISO 1629 70 shore		1
01.17	.10.505.826	o-ring 6x1,5 VMQ ISO 1629 70 shore		1
01.18	.10.505.913	o-ring 8x1 VMQ ISO 1629 70 shore, red		1

Spare parts lists

.11.855.401.E0

28.01.2015

pos.	article-no.	designation	code	pcs.
01.19	.11.852.401.174	PI- insulating socket - PerCut 451		1
01.20	.11.848.401.178	Pilot plug - PerCut 450M		1
01.21	.11.855.401.1781	EF-plug - PerCut 4000		1
01.22	.10.505.818	o-ring 4,5x1,5 VMQ ISO1629 70Shore red		1
01.23	.10.505.981	o-ring 5,0x1,5 VMQ 70Shore red		1
01.24	.11.852.401.181	Nipple PG/WG - PerCut 451		1
01.25	.10.505.799	o-ring 3,5x1,5 VMQ ISO 1629 70 shore		1
01.26	.10.505.800	o-ring 3x1 VMQ ISO1629 70Shore		1
01.27	.11.852.401.184	Nipple KG - PerCut 451		1
01.28	.11.848.401.079	Locking sleeve - PerCut 450M		1
01.29	.11.848.401.078	Locking ring - PerCut 450M		1
01.30	.11.848.401.080	Sealing ring - PerCut 450M		1
60.00	.16.500.006	herramienta de antorcha		
60.01	.12.38180	socket wrench f. cooling tube		1
60.02	.11.848.401.810	Torch tool - PerCut 440-450		1
60.03	.11.848.401.815	Gas guide puller PerCut 440-450		1
60.10	.10.615.909	Torque screwdriver		1
60.11	.10.615.909.1	Connecting shaft E 6,3 / 1/4"		1
60.12	.10.615.909.7	Hexagon application, long 1/4" SW 5		1
60.13	.10.615.909.6	Hexagon application, long 1/4" SW 8		1
60.14	.10.615.909.4	Hexagon application, long, 1/4" SW 6		1
60.20	.11.852.401.860	Socket wrench f. current- / WV-plug		1
60.30	.11.852.401.865	Socket wrench f. current- /WV-socket		1
70.00	.16.500.129	accesorios		
70.01	.10.616.104	Lubricante para O2 LC 40 fluido 25 ml		1
70.10	.11.855.401.830	station f. change head PerCut 4000		1



Spare parts lists

11.5 Spare parts list PBA-300

.11.820.254

17.10.2014

pos	article no.	designation	code	pcs.
01.01	.10.109.519	push button Z-15 GQ 250V/10A 1 changer	S1	1
01.02	.10.164.171	Male insert 3-pol.+PE screw connection	X122A	1
01.03	.10.164.173	plug base	X121A, X122A	2
01.04	.10.164.198	Male insert 8-pol. 42V crimp connection	X121A	1
01.05	.10.164.316	Connector plug C01620C0051002	X114A	1
01.06	.10.501.003	Non-return valve R06BM2R stainless steel		2
01.07	.10.505.913	o-ring 8x1 VMQ ISO 1629 70 shore, red		2
01.08	.101.30.029	Resistor 4K7 4.00W 5% TK 200		1
01.09	.11.035.002.070	HF-Transformer	T1	1
01.10	.11.820.2454.800	solenoid valve unit of PBA-300		1
01.11	.11.820.249.925	Coolant and control gas connection, sold.		1
01.12	.11.820.249.930	Coolant return connection, soldered		1
01.13	.12.29270	Filter M5x22	1-3	3
01.14	.12.LP078305	PCB_078305_a ignition unit	A1	1
01.15	.12.190.006.3	Cone-type bush for G1/4"		1

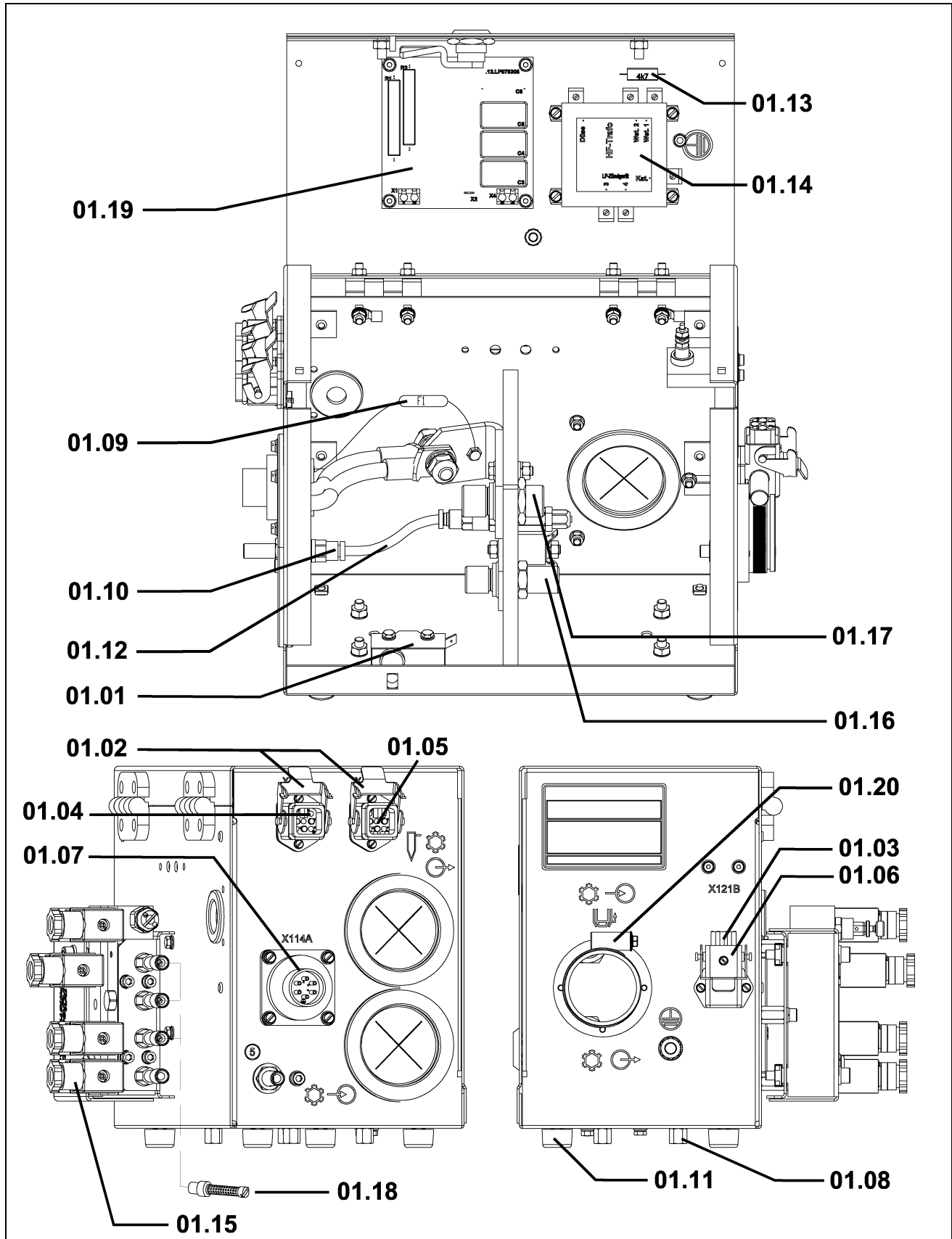


Fig. 56: Overview PBA-300

12 List of Abbreviations

Abkürzung Abbreviation	Deutsch German	Englisch English
Air	Luft	Air
BV	Brennermagnetventil	Torch solenoid valve
CAN	CAN-Bus	Controller Area Network
ccw	linksdrehend, entgegen Uhrzeigersinn	counterclockwise
cw	rechtsdrehend, im Uhrzeigersinn	clockwise
EMV	Elektromagnetische Verträglichkeit	Electromagnetic compatibility (EMC)
FB	Fernbediensatz	Remote control
GND	Masse, Bezugspotential, 0 V	Ground, reference potential, 0 V
HB	Hauptbogen	Main arc
HF	Hochfrequenz	High frequency
IG	Identgas	Identification gas
KCU	Kjellberg Verbindungseinheit	Kjellberg connection unit
KG	Kontrollgas	Control gas
KWE	Kühleinheit	Cooling unit
LP	Leiterplatte	Printed Circuit Board (PCB)
MG	Markiergas	Marking gas
MGC	Gasdruckregler	Microgascontroller
MR	Mikrorechner	Micro processor
MV	Magnetventil	Solenoid valve

Abkürzung Abbreviation	Deutsch German	Englisch English
PA	Plasmaschneidanlage	Plasma cutting system
PBA	Plasmabrenneranschlusseinheit	Plasma torch connection unit
PFC	Plasmagasregeleinheit	Plasma flow control
PG	Plasmagas	Plasma gas
PGA	Plasmagasanschlusseinheit	Plasma gas connection unit
PGC	Plasmagassteuerung	Plasma gas controller
PGE	Plasmagaseinstelleinheit	Plasma gas control unit
PGV	Plasmagasventileinheit	Plasma gas valve unit
PM	POWER MODUL	POWER MODUL
PZE	Plasmazähleinheit	Plasma counter unit
PZL	Plasmazündereinheit, Leitungssatz zum	Cable set for plasma ignition unit
RV	Rückschlagventil	Non-return valve
SG	Schneidgas	Cutting gas
SpG	Sperrgas	Sealing gas
StG	Startgas	Start gas
WG	Wirbelgas	Swirl gas
ZG	Zündgas	Ignition gas

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