

Kjellberg[®]
FINSTERWALDE

the
FINE FOCUS[™]
company

Instruction manual



- Power source

CUTi 90

- Plasma torch

PHT-51 G/L

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1 General information

1.1 Warranty claim

We point out explicitly that only spare parts and consumables of Kjellberg origin have to be used! Otherwise a warranty claim does not exist. Kjellberg 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.



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

The production takes place according to DIN EN ISO 9001

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 model 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 plasma cutting 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 plasma cutting machine	X	X
Maintenance		
basic maintenance	X	X
special marked maintenance		X
shut down at the end of the lifetime		X

1.4 Principle of the dry plasma cutting without swirl gas

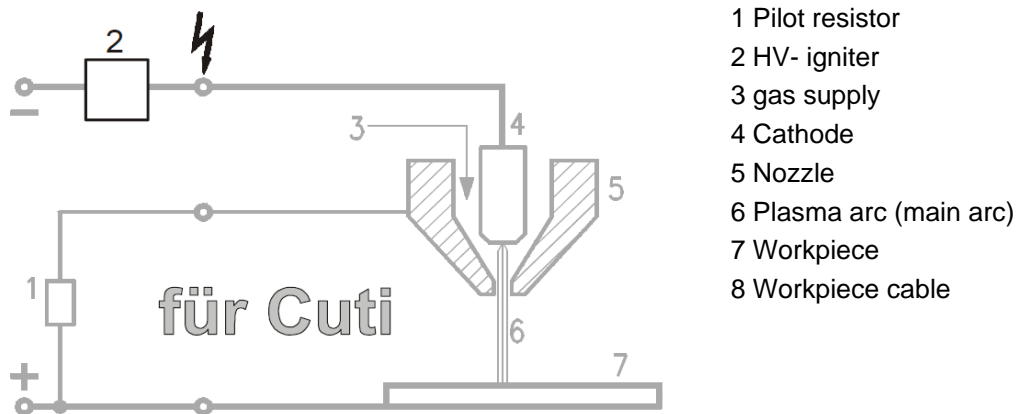


Fig. 1: Principle of plasma cutting without secondary gas

A safe ignition of the pilot arc is granted when following subsequent points:

- The required parameters in regard to gas pressure and mains voltage must be observed.
- The proper mounting of the consumables (Use the special tools according to the scope of delivery.)
- The cathode must always be firmly tightened
- The nozzle end must always be kept clean of dirt, especially of metal spatter. A soft wire brush can be used for cleaning.
- If a plasma torch is available, then the central connector of the plasma hand torch must be tightened to the limit stop



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.

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

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.
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Information and Warning:

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!
6. Wearing of protective clothing (helmet, welder's overall, leather apron, gauntlets, safety shoes). The protective clothing has to be isolating, dry and heavily inflammable. Working with plasma cutting machines 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.

- to ensure stability 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 machine 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.</p> <p>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.</p> <p>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 machine 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 machine:




- 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 unit 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 unit is S-marked and applicable in environments with increased hazard to electric shock.

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




 	 WARNING
<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>	

	 WARNING
<p>Warning of electromagnetic interferences Through the operation of the plasma cutting machine in particular by the temporary high voltage ignition procedure results electromagnetic fields, which can lead to the influencing of a 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 machines!</p>	

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).

	 WARNING
<p>Warning of electromagnetic interferences Through the operation of the plasma cutting machine in particular by the temporary high voltage ignition procedure results electromagnetic fields, which can lead to the influencing of a 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 machines!</p>	

	 WARNING
	<p>The plasma cutting unit 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>

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 Endangerments 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 plasma cutting 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 smokes when cutting galvanized material health damage by inhalation that gases and smokes.
 Carry special breathing mask when cutting galvanized material!**



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

2.8 Measures for prevention of "Oxyhydrogen gas formation"

(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

Danger of the formation of highly explosive oxyhydrogen

- at hollow spaces,
- at the displacing chamber of the water cutting table and
- below the tin plate lying on the cutting table.

There is danger of injury by exploding oxyhydrogen and around flying parts.

The following information have to be observed to avoid the danger!

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



It is not allowed to store the plates on the cutting grating for a longer time!

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 in a meter distance from the pilot arc the following sound level is reached:

Process: Dry plasma cutting						
cutting current (A)	material thickness (mm)	max. sound level with a height of:			material	cutting pressure (bar)/ nozzle
		1 m	3 m	6 m		
		measured	calculated			
		in db(A)	in db(A)	in db(A)		
90	3,0	93	83	78	mild steel	5,0 (1,2)

Fig. 2: 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)!

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, preferable two- step 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. Pressure reducers that are conform to the quality requirements are mentioned in the order specifications of Kjellberg. 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"

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	by application of Hydrogen or Oxygen: inspection of the gas supply (see chapter gas pressure test)	x	
all 4 to 6 month	- Cleaning the power source and all components (control of the filter pads)		x
	- Cleaning small filters inside the gas connectors of the Plasma Gas Control Units	x	
all 6 month	electrical revision		x
yearly	for liquid cooled units: complete change of coolant „Kjellfrost“	x	

3.1.2 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.)

3.1.3 Electrical revision



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



A repeated inspection has to be carried out in electrical installations and equipment in regular time intervals. These have to be executed according to DIN EN 60974-4 "Arc welding equipment - in-service inspection and testing."



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

The operations to be undertaken for inspection and testing are:

- a) visual inspection
- b) electrical inspection
 - open circuit voltage
 - insulating resistance
 - protection conductor resistance
- c) documentation

Manufacturer's instructions to measure the open circuit voltage:

1. disconnect plug 5 and 6 from A4 (HF-LP)
2. connect the gas supply
3. connect the plasma torch
4. connect the measurements between cathode and workpiece
5. connect mains voltage
6. switch ON the CUTi
7. press the push-button of the torch
8. measure the voltage between cathode and workpiece

Manufacturer's instructions to check the insulation values:

1. switch On the mains switch
2. connect the workpiece connection and the torch connection (middle contact/cathode) with each other
3. connect all 3 phases at the mains input
4. measure insulation values at a cold and dry condition between mains input and housing
5. measure insulation values at a cold and dry condition between torch connection (middle contact / cathode) -/workpiece connection and housing
6. measure insulation values at a cold and dry condition between mains input and torch connection (middle contact / cathode) -/workpiece connection

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



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.**

4 Disposal

4.1 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.

4.2 Disposal of the units

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

5 Power source CUTi 90

5.1 Technical data

primary side: input voltage U₁: max. connecting load S₁: power factor cos phi: efficiency: main connection : voltage [V] fuse, slow [A] cross section, Cu [mm²]	CUTi 90 rotating current, 400 V +10/-10% 50/60 Hz 15 kVA 0,72 0,91 400 25 4 x 2,5
cutting side open circuit voltage U₀: cutting current I_S: arc voltage U_S: duty cycle *: max. thickness d_s : recommended cutting range:	250 V DC 26 - 90 A 90,4 - 116 V DC 40% at 90 A 60% at 74 A 100% at 55 A 35 mm 0,5 - 30 mm
characteristic: ignition process: workpiece cable:	drooping pilot arc ignition by high voltage ignition unit; main arc ignition by pilot arc 16 mm ²
weight m: dimensions (lxbxh): protection class: cooling:	17 kg 470 x 180 x 270 mm IP 21 Air cooled by built-in fan
torch cooling:	gas cooling
gas supply/torch cooling: pressure: flow rate: plasma gas + cooling gas	Air, free of oil and moisture 0.5 MPa (5 bar) 195 l/min
connection:	hose fittings for hose inside Ø 6 mm
<p>* The duty cycle characterises a load-time calculation within a period of 10 min. Example: Duty cycle =40 % means that the indicated cutting current can demand 3,5 minutes from the device, whereupon a cooling phase follows for the remaining 6,5 min.</p>	

Fig. 3: Technical data

5.2 Technical description



Only plasma torches of the type PHT-51 G/L of Kjellberg Finsterwalde are determined for use with power sources CUTi 90 by EN 60974-1. Exclusive these plasma torches forms a safety-related unit with the named power sources in accordance with EN 60974-7!

The following components are required at minimum for the cutting of electrically conductive materials with the plasma cutting unit CUTi 90:

- plasma cutting inverter CUTi 90 with filter pressure reducer
- plasma hand torch PHT-51 G/L with the according consumables and tools
- gas hose
- workpiece cable
- there is a consumable-kit for each plasma inverter (see the corresponding chapter "accessories" at the instruction manual of the plasma torch)

All modules of the CUTi 90 are placed in a portable housing. The control and display elements are placed at the front panel.

The rear panel contains the connection for the workpiece cable connection, the plasma gas connection with the filter pressure reducer and the insertion of the main cable.

The gas supply consists of the gas connector with filter pressure reducer, the solenoid valve and the pressure switch, which switches off the plasma cutting unit in case the pressure drops below 0,4 MPa.

The power set comprises the inverter block and the high voltage igniter too for initiating the pilot arc. All power components are protected against thermal overload by means of a thermal switch.

5.3 Main features and advantages

Due to the extreme high energy density a number of technical advantages will be obtained::

- narrow cutting kerfs
 - low loss of material
 - low heat input
 - Small distortion
 - high cutting speed
 - good cutting quality
-
- recommended material-dependent range of material thickness from 30 mm, 35 mm max. (separating cut) at a maximum cutting power of 90 A
 - control installations guarantee safe functioning:
 - gas pressure monitoring
 - temperature monitoring of the power components through thermal switch
 - easy torch replacement through central connection with safety device
 - ease-of-use through comprehensibly arranged control and display elements with symbols
 - modern industrial design, portable

5.4 Ranges of application

Mild steels, high-alloyed steels, nonferrous metals (e.g. aluminium), and special alloys can be cut. Air is used as plasma gas.

The plasma torches can be used for flying cutting and hole piercing.

Straight, bevel, contour, and position cuts can be carried out as well as fusion drilling. In this manner, semi-finished products such as sheet metal, pipes, profiles, metal blanks, forged and formed parts, sheet stacks, scrap products, and castings can be thermally separated or processed.

Because of the continuously adjustable cutting current, the cutting power can be optimally adapted to the cutting task.

5.5 Commissioning

5.5.1 Transport, check, installation, storage, repack

- 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 up to +40 °C
- relative moisture: max. 90 % bei 20 °C
 max. 50 % bei 40 °C




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

The Plasma Cutting Machine is designed acc. to the requirements of the protection class IP 21 (DIN EN 60529), that means:

- protection against penetration of solid parts above 12 mm size
- protection against dripping water

The unit has to be installed horizontally.

5.5.2 Installation

 	 WARNING
	<p>It is not allowed to operate the machine 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! Generally the plasma cutting unit has to be switched OFF and disconnected visibly from the mains (unplug supply cable) before opening any cover from the power source or from other components!</p>

5.5.2.1 Mains connection

The CUTi 90 is equipped with a mains cable (4 x 2,5 mm², 3 m long) and a 32 A mains plug.

The unit must be connected to the mains supply via a permanently installed socket. Mains fuses must be connected in series up to the current socket according to the table "Technical Data of the Plasma cutting inverter". Connection to the mains supply must be carried out with the power source **switched off**.

The plasma cutting inverter is suitable for operation at electric power generators, if the following minimum requirements are met:

- power output: mind. 22,0 kVA
- max. voltage fluctuations at a rated load of: -10 % / +10 % with rapid change of load (arc ignition / arc interruption)

5.5.2.2 Connection of the plasma torch

For the "Connection of the plasma torch" please refer to the service manual of the plasma torch !!!

5.5.2.3 Workpiece connection / current return line

The workpiece cable is connected to the welding cable socket on the rear panel. The workpiece clamp has to be fastened firmly to the workpiece, component or equipment at which the cutting process is to be carried out. Good contact must be established.

	 WARNING
	<p>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 unit, as far cutting is not performed at those parts!</p>

5.5.3 Operation

5.5.3.1 Control and display elements

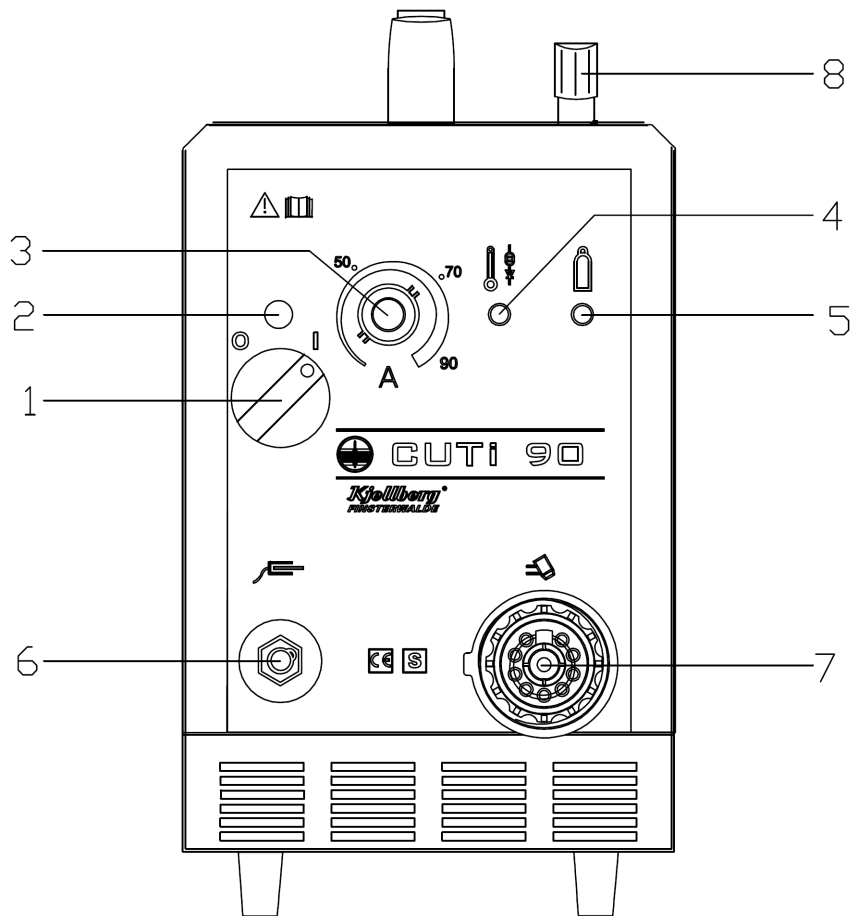


Fig. 5: control and display elements CUTi 90 (front panel)

- 1 mains switch S1 mains on**
 - position 0: CUTi 90 "OFF"
 - position 1: CUTi 90 "ON"
- 2 signal lamp H1 green :**
 - ON, mains voltage or mains switch ON
- 3 potentiometer "cutting current"**
 - adjusting the cutting current from 26 – 90A
 - (observe max. cutting current of the respective nozzle!)
- 4 LED signal lamp H2 yellow: temperature error**
 - LED on, when the inverter is terminally overloaded (exceeded maximum duty cycle)
 - unit cooling by running fan
- 5 LED signal lamp H3 green:**
 - glows when the required gas pressure is above 0.4 MPa (4 bar)
- 6 workpiece connection**
- 7 central connector**
 - for plasma torch PHT-51 G/L
- 8 filter pressure reducer**

5.5.3.2 Switching ON the CUTi 90

Before cutting, the following steps must be carried out:

Inspection of the plasma hand torch

- proper and undamaged condition
- mounting of the consumables required for the process (see chapter “cutting operation“ and “consumables and their exchange“ at the instruction manual of the plasma hand torch)
- proper condition of the Kjellberg consumables

Inspection of the CUTi 90

- mandatory mains safeguard (see section “Mains connection“)
- correct connection of the workpiece cable (see section “Connection of Gas Supply“)
- functionality of the gas supply (see section “Protective installations“)

Switching ON

	 WARNING
Immediately after switching on, carry out the pressure setting of the filter pressure reducer to 0.5 MPA (5 bar) by flowing gas!	




- switch the mains switch **(1)** S1 at the front panel to position 1
 - fan ON
 - cooling air is discharged from the rear panel
- green LED illuminated signal lamp H3 **(5)**
 - • adjust potentiometer **(3)** to the desired cutting current

5.5.3.3 Switching OFF the CUTi 90

By switching the mains switch S1 on the front panel to position 0, the system is switched off. When the CUTi 90 is not in use for a longer period of time, it is to be visibly unplugged from the mains.

5.6 Cutting operation

(applications closer explained in the chapter “cutting operation“ of the plasma torch)

 	 WARNING
It is not allowed to operate the machine 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! Generally the plasma cutting unit has to be switched OFF and disconnected visibly from the mains (unplug supply cable) before opening any cover from the power source or from other components!	

The following applications and operations are possible:

- cutting start and ignition of pilot arc
- hole piercing
- cutting with spacer spring
- cutting with connecting cap
- cutting with bevelling cap
- cutting with wheel guide
- cutting with circular cutting attachment
- cutting with bevelling cutting attachment
- cutting with long consumables
- gouging

5.7 Protective installations




The plasma cutting inverter is switched OFF by the following installations:

- **gas pressure monitoring** if the gas pressure is < 0,4 MPa (4 bar)
- **temperature monitoring** in case of thermal overload of the inverter

The following protective installations protect the operator against high contact voltage:

- **Protection against accidentally touching the nozzle:** The plasma hand torch can only be operated with the protective cap screwed on
- **Safety circuit of the central connection:** The manual plasma cutting inverter can only be operated if the plasma hand torch is screwed on (mechanical lock)

5.8 Trouble shooting

	 WARNING
	<p>Warning of dangerous electric voltage Electric shock can be deadly. Further personal and material damages can result from impact.</p> <p>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.</p> <p>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.

1. green LED signal lamp H3 (**5**) not on or goes out during the plasma cutting process
 - air pressure below 0,4 MPa
 - compressor performance insufficient (falling pressure after longer cutting time)
 - repair: increase primary pressure of the gas, increase compressor performance, increase minimum start up pressure of the compressor
2. no full cutting power
 - workpiece is not connected
 - plasma gas supply is not correct
 - the adjusted current values for thicker materials are too low (readjust through a potentiometer)
 - wrong nozzle (orifice diameter of the nozzle does not match to the adjusted cutting current)
3. unit not ready for cutting, yellow LED signal lamp H2 (**4**) is on
 - the Inverter was thermally overload (maximum duty cycles exceeded)
 - cooling the CUTi through a running fan (do not switch OFF!)


6 Plasma hand torch PHT-51 G/L

6.1 Technical data

	PHT-51 G/L in connection with CUTi 90				
open circuit voltage U_o, max.:	270 V				
cutting current, max I_S:	90 A				
pilot arc current, max. I_{PB}:	25 A				
Duty cycle:	100 % bei 90 A				
Ignition:	high voltage ignition by pilot arc				
Cutting thickness, max (separating cut):	35 mm bei 90 A				
Cooling:	gas cooling				
Gas supply / torch cooling:	Air, oil and water free				
Pressure:	0.5 MPa (5 bar)				
Flow rate:	<table style="border: none;"> <tr> <td style="padding-right: 10px;">plasma gas</td> <td rowspan="2" style="font-size: 2em; vertical-align: middle;">}</td> </tr> <tr> <td>cooling gas</td> </tr> </table>	plasma gas	}	cooling gas	195 l/min
plasma gas		}			
cooling gas					
Connection:	hose fittings for hose inside \varnothing 6 mm				
Hose package:	length 6 m or 12 m with central connector				
Protection system:	Protection against accidental contact with the live nozzle by means of a protective cap with safety circuit				

Fig. 6: Technical data

6.2 Technical description

	<p>The plasma torch of the type PHT-51 G/L of Kjellberg Finsterwalde are determined for use with power sources CUTi 90 by EN 60974-1. Only these Plasma torches and power sources are safety-related units in accordance with EN 60974-7!</p>
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The plasma torch basically consists of the torch head, the handle with torch switch, and the consumables, as well as the hose package with the central connection plug.

The cutting current is transferred to the cathode by a flexible copper strand, which is inserted in the electrically insulating gas hose.

By replacing the consumables, the plasma hand torches can be used for plasma cutting with a spacer spring, with a contact cap, with a bevelling cap, and with cathode/nozzle (long).

6.3 Main features and advantages

- perform different procedures (see “range of application”)
- quick and easy conversion by replacing the consumables of the plasma torch
- recommended material-dependent range of material thickness from 30 mm, max.35 mm (separating cut) at a maximum cutting power of 90 A
- continuously adjustable cutting current from 26 up to 90 A for optimal adaptation of the cutting power to the cutting task
- easy handling through the following ignition methods:
 - pilot arc ignition with high voltage igniter
 - ignition of the main arc through the pilot arc
- high operational safety through protection against accidental contact at the plasma hand torch with safety circuit
- easy torch replacement through central connection with safety device
- high efficiency and low operating costs due to the utilisation of air as plasma gas

6.4 range of application

- Cutting with spacer spring
 - for cutting tasks during which the plasma arc has to be observed, for example along an incipient crack
- Cutting with contact cap
 - for frequent hole piercing
 - for cutting with templates (template thickness 1 - 3 mm)
 - for cutting with a ruler (ruler thickness 10 - 14 mm)
- Cutting with a bevelling cap
 - for cutting bevels
- Cutting with cathode and nozzle (long)
 - for cutting contours
- Gouging

	Process				
	plasma cutting with				gouging
	spacer spring	contact cap	beveling cap	nozzle/cathode (long)	
thickness	up to 50 mm	up to 40 mm	up to 20 mm	up to 20 mm	
cutting current	up to 90 A	up to 90 A	up to 90 A	up to 70 A	up to 90 A
cathode	cathode PHT-51 G/L			cathode (long) PHT-51 G/L	
gas guide	gas guide PHT-51 G/L				
nozzle/∅	1,0 mm (20 - 50 A) / 1,2 mm (50 - 90 A)				2,5 mm
plasma gas	Air				
plasma gas pressure	0,5 MPa				

Fig. 7: process

6.5 Commissioning



Before using the plasma torch, it must be checked whether the consumables for the respective method are inserted in the torch.



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)!

Consumables are the cathode, nozzle, gas guide, spatter protection and distance spacer. The multiple wrench serves to mount the parts



The operating personal may change only consumables at the plasma torch!
Repairs are only allowed by the service personal of the firm Kjellberg Finsterwalde and authorised companies.



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.

6.5.1 Connection of the hand torch to the plasma unit

The torch lock cap must be unlocked with the included special wrench. Then the central connection plug of the plasma machine torch is plugged into the central connection socket of the plasma cutting unit (rear panel) and fastened by turning the coupling ring to the right.

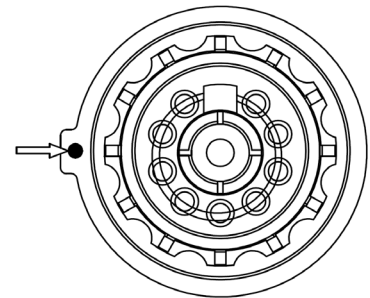




Fig. 8: central connector

6.5.2 Cutting operation

	 WARNING
	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!
	Avoid “flash burn” of the eyes by wearing safety glasses!


The pilot arc can only be ignited if the protective cap is screwed on (safety circuit).

6.5.2.1 Cutting start and ignition of pilot arc

The pilot arc is ignited by pressing the torch button after an initial flow of gas. Place the spacer spring or contact cap on the edge of the workpiece, or hold the bevelling cap near the edge of the workpiece. The minimum distance between nozzle and workpiece **must** be 3 mm. This corresponds with the distance which the spacer spring creates between the nozzle and the workpiece.

When the pilot arc touches the workpiece, the main arc is automatically started and cutting can begin. The workpiece is cut by guiding the torch as evenly as possible.

The pilot and main arc go out when the torch button is released. At the end of the workpiece the main arc automatically goes out

	As this is a hand-held device, the quality of the cut is dependent in each case on the skill of the operator.
---	--

6.5.2.2 Hole piercing

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

For piercing, the spacer systems (spacer spring, contact cap, crown-shaped contact cap) can be directly placed on the workpiece with material thicknesses of up to 6 mm.

If the material is thicker than 6 mm, the plasma torch should be held at an angle and after the pilot arc is ignited swayed into the workpiece. The molten material is thus blown out of the cutting joint in a better way, preventing the material from spraying to the nozzle.

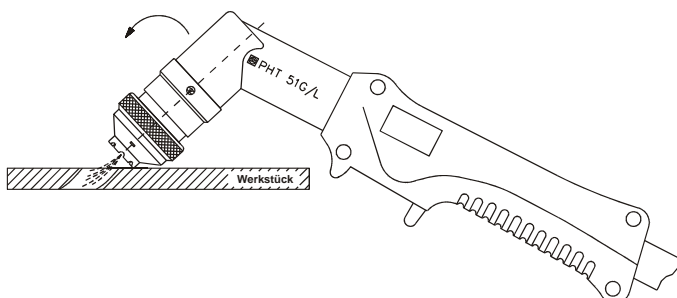


Fig. 9: hole piercing

6.5.2.3 Cutting with spacer spring

The spacer spring guarantees a constant distance between the plasma torch and the workpiece.
The spacer spring is inserted onto the spatter protector

PHT-51 G/L		
	article no.	designation
1	.11.844.101.310	cathode PHT-51 G/L
2	.11.844.101.153	gas guide PHT-51 G/L
3	.11.844.101.410	nozzle 1,0 (50 A) P2210
	.11.844.101.412	nozzle 1,2 (90 A) P2212
4	.11.844.101.160	protection cap PHT-51 G/L
5	.11.844.101.161	spatter protection PHT-51 G/L
6	.11.844.101.162	spacer spring PHT-51 G/L

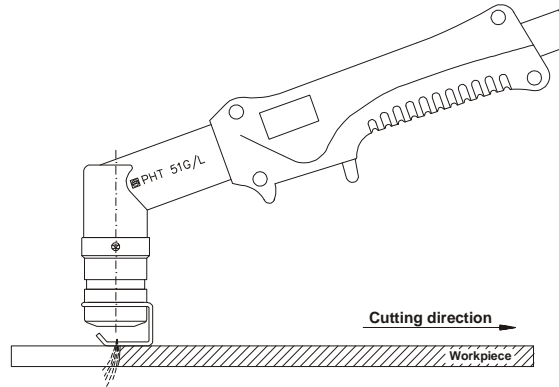


Fig. 10: Cutting with spacer spring

6.5.2.4 Cutting with contact cap

The plasma torch is easy to handle, as it is placed directly upon the workpiece. The contact cap must be placed firmly upon the workpiece.

- high life time of the consumables
- no burning together through double arcs, as the contact cap is potential-free
- for cutting with templates (template thickness 1 - 3 mm)
- for cutting with a ruler (ruler thickness 10 - 14 mm)

PHT-51 G/L		
	article no.	designation
1	.11.844.101.310	cathode PHT-51 G/L
2	.11.844.101.153	gas guide PHT-51 G/L
3	.11.844.101.410	nozzle 1,0 (50 A) P2210
3	.11.844.101.412	nozzle 1,2 (90 A) P2212
4	.11.844.101.160	protection cap PHT- 51 G/L
5	.11.844.101.161	spatter protection PHT- 51 G/L
7	.11.844.101.164	contact cap PHT-51 G/L



Fig. 11: cutting with contact cap

6.5.2.5 Cutting with bevelling cap

This method is advantageous for defined angular cutting, e.g. for preparing welding seams.

PHT-51 G/L		
	article no.	designation
1	.11.844.101.310	cathode PHT-51 G/L
2	.11.844.101.153	gas guide PHT-51 G/L
3	.11.844.101.410	nozzle 1,0 (50 A) P2210
3	.11.844.101.412	nozzle 1,2 (90 A) P2212
4	.11.844.101.160	protection cap PHT-51 G/L
5	.11.844.101.161	spatter protection PHT-51 G/L
8	.11.844.101.163	bevelling cap PHT-51 G/L

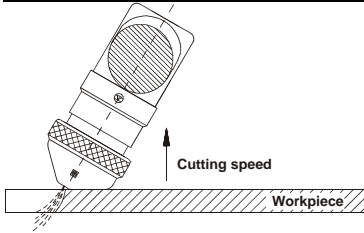


Fig. 12: cutting with bevelling cap

6.5.2.6 Cutting with wheel guide

The illustration shows the plasma torch equipped with the wheel guide, which is part of the circle cutting attachment. It **cannot** be delivered individually.

The wheel guide facilitates to a considerable extent manual guidance of cutting by means of easy-running wheels.

The wheel guide is attached to the torch head to the limit stop and fastened with the spanner (part of the delivery).

The correct distance between torch head and workpiece is thus established.



Fig. 13: cutting with wheel guide

6.5.2.7 Cutting with circular cutting attachment

The illustration shows the plasma torch equipped with the circle cutting attachment. The torch holder is attached to the torch head to the limit stop and fastened with the grub screw.

With the compass rod, which can be detached from the holder, circular parts with a diameter of 100 to 1000 mm can be cut.

The torch head is rotatable in the holder.

The tip of the compass can be shifted and arrested.



Fig. 14: cutting with circular cutting attachment

6.5.2.8 Cutting with bevelling cutting attachment

The illustration shows the bevelling attachment (Art. No. 11.822.630) for trimming sheet metal and preparing welding seams.

The bevelling attachment is guided manually and guarantees a constant distance with a fixed angle of inclination of the torch to the workpiece. The height and angle of inclination of the plasma torch to the workpiece can be adjusted continuously.



Fig. 15: cutting with bevelling cutting attachment

6.5.2.9 Cutting with long consumables

The illustration shows the plasma torch equipped with long wearing parts that are used to cut workpiece contours which are difficult to access.

PHT-51 G/L		
	article no.	designation
1.1	.11.844.104.310	cathode, long PHT-51 G/L
2	.11.844.101.153	gas guide PHT-51 G/L
3.1	.11.844.104.410	nozzle, long 1,2 (50 A) P2412
3.1	.11.844.104.412	nozzle, long 1,4 (90 A) P2414
4	.11.844.101.160	protection cap PHT- 51 G/L
5	.11.844.101.161	spatter protection PHT- 51 G/L
9	.11.844.101.165	nozzle cap, long PHT-51 G/L



Fig. 16: Cutting with long consumables

6.5.2.10 Gouging

Hold the torch sideways above the workpiece in such a way that the discharge direction of the arc coincides with the welding seam to be gouged.

Do **not** attach the nozzle to ignite! Tilt the torch in such a way that the pilot arc touches the workpiece, the main arc is then established.




Guide the torch at an angle of 25° to 40° with an arc length of 10 to 30 mm above the workpiece as shown in the lower figure.


PHT-51 G/L		
	article no.	designation
1	.11.844.101.310	cathode PHT-51 G/L
2	.11.844.101.153	gas guide PHT-51 G/L
3.2	.11.844.102.425	nozzle 2,5 Fugen P2325
4	.11.844.101.160	protection cap PHT- 51 G/L
5	.11.844.101.161	spatter protection PHT- 51 G/L
9	.11.844.101.165	nozzle cap, long PHT-51 G/L



Fig. 17: plasma gouging

6.6 Consumables and their exchange

 	 WARNING
	<p>In order to change consumables, the plasma cutting machine 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 unit!</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>The operator has to follow national and local regulations (for example Employer's Liability Insurance Association)!</p>
---	--

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 and the number of ignitions.

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


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

Removal of consumables

1. Screw off the protective cap (if necessary, screw off the spatter protector from the protective cap)
2. manually pull off the nozzle
3. manually pull off the gas guide
4. Unscrew the cathode (with the multiple wrench which is part of the wearing parts kit)

Placement of consumables

1. Screw in the cathode (fasten with multiple wrench)
2. Plug in the gas guide
3. Plug in the nozzle
4. Screw on the protective cap (screw on the spatter protector)

	<p>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.</p>
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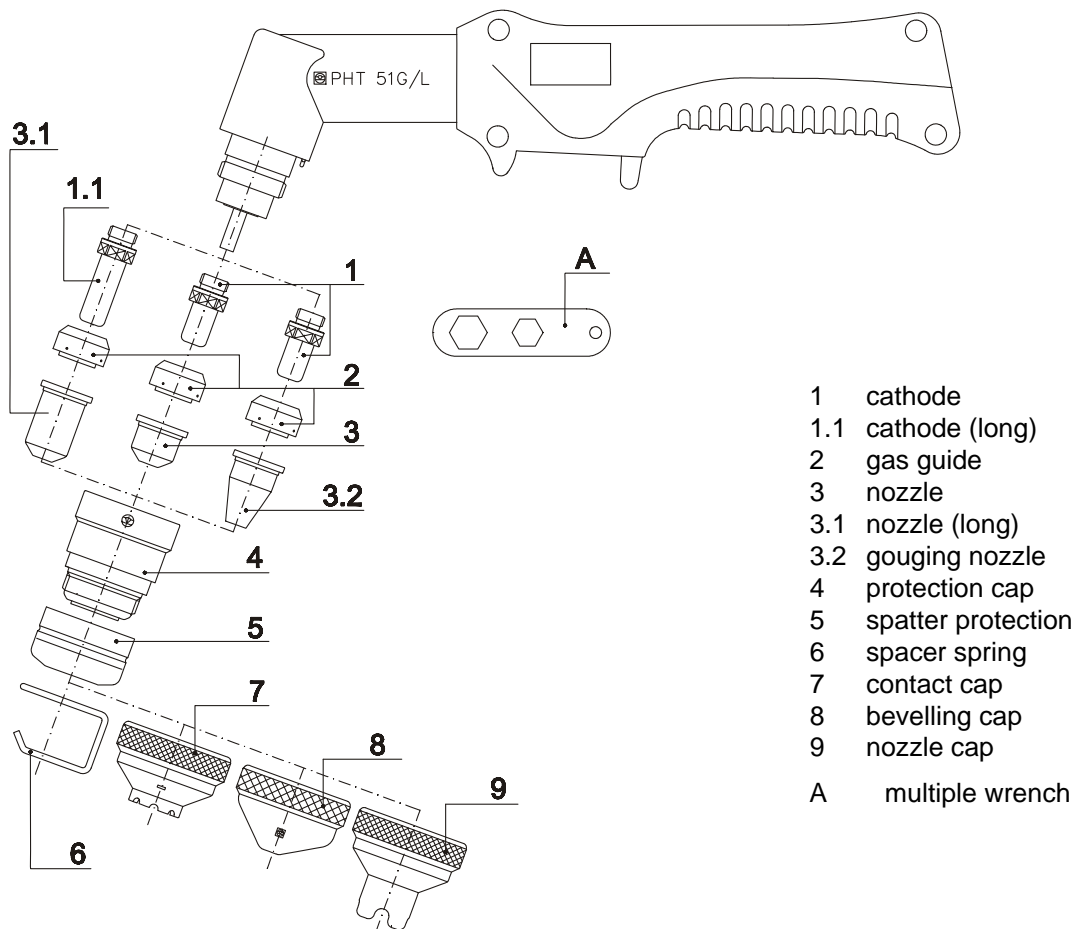


Fig. 18: consumables of the plasma hand torch PHT-51 G/L

6.7 Accessories

Required accessories are the multiple wrench for replacing wearing parts in the plasma torch, which is part of the wearing parts kit, and the gas hose.

Consumable kit for PHT-51 G/L

- 3 pcs. cathode PHT-51 G/L
- 1 pcs. nozzle 1,0 mm (20 - 50 A)
- 4 pcs. nozzle 1,2 mm (50 - 90 A)
- 1 pcs. spatter protection PHT-51 G/L
- 1 pcs. contact cap PHT-51 G/L
- 2 pcs. spacer spring PHT-51 G/L
- 1 pcs. bevelling cap PHT-51 G/L
- 1 pcs. multiple wrench
- 1 pcs. safety wrench for central connector

Available as optional accessories are the circle cutting attachment with wheel guide for cutting out circles with a diameter of 100 to 1000 mm.

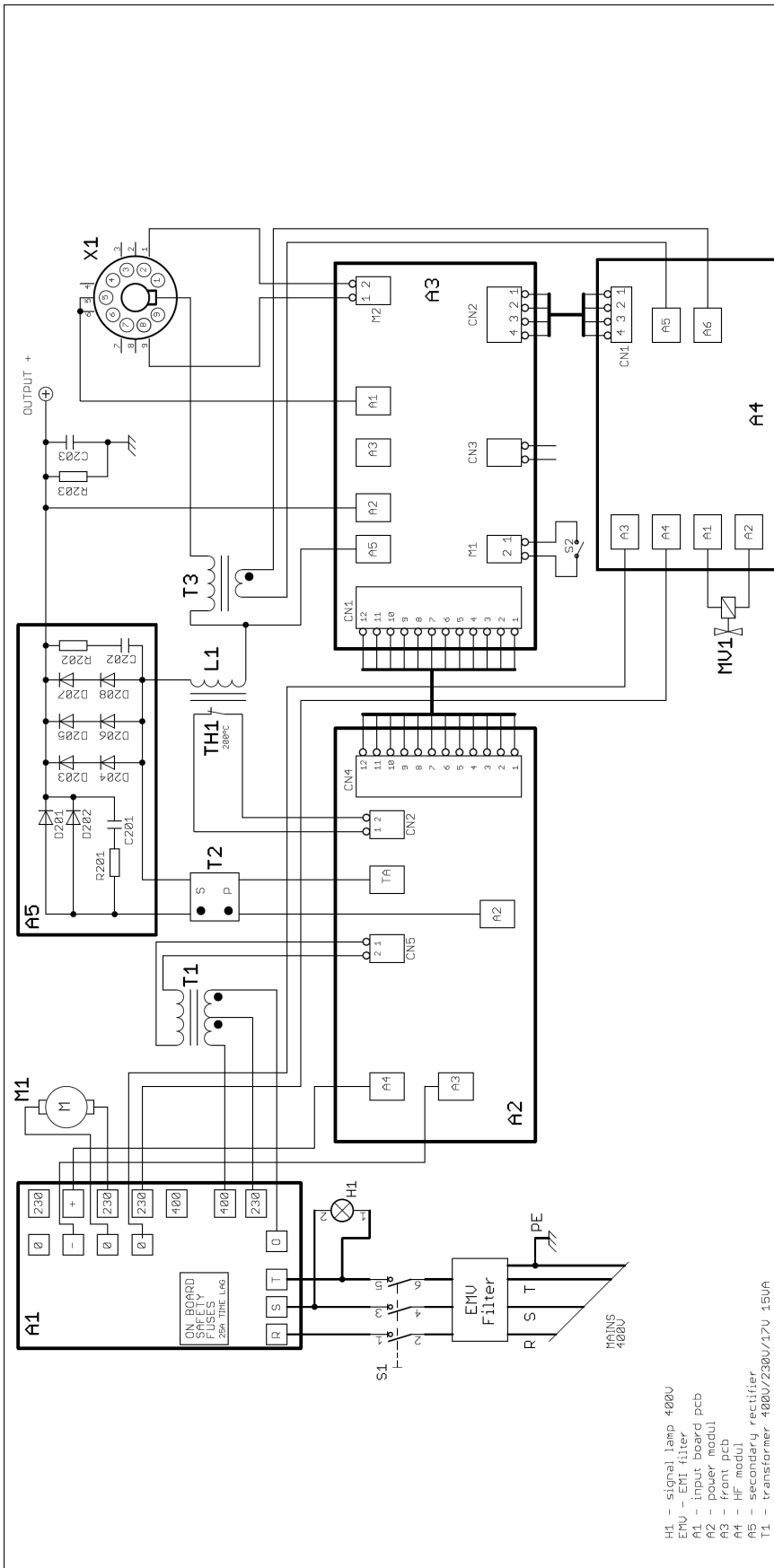
6.8 Protective installations

The following protective installations protect the operator against high contact voltage

- **Protection against accidentally touching the nozzle:** The plasma hand torch can only be operated with the protective cap screwed on
- **Safety circuit of the central connection:** The manual plasma cutting inverter can only be operated if the plasma hand torch is screwed on (mechanical lock)

7 Wiring diagrams

for the plasma inverter CUTi 90	
Wiring diagram of the power source	.11.035.502.SP1 a 11



- H1 - signal lamp 400V
- EMU - EMU filter
- A1 - input board pcb
- A2 - power modul
- A3 - front pcb
- A4 - HF modul
- A5 - secondary rectifier
- T1 - transformer 400V/230V/17U 15VA
- T2 - main transformer
- T3 - HF transformer
- M1 - solenoid valve 230V AC
- S1 - main switch
- S2 - pressure switch
- TH1 - thermo switch
- X1 - torch socket
- M2 - fan
- R201 - resistor 1500hm/3W
- R202 - resistor 1000hm/3W
- C203 - resistor 6,810hm
- C201 - capacitor 4nF/250V AC
- D204 - capacitor 22µF/250V AC
- D202 - diode 30A
- D201 - diode 15A
- L1 - coil

ZustÄnderung	Datum	Name	Benennung
	2009	Datum	CUTI 90
	Bearb.	Name	
	Gepf.	Schmidt	
	Norm		
KJELLBERG FINSTERWALDE			
Zeichn.-Nr. 11.035.502 SP1 a			Blatt Sheet: 1/1
Date: nicht gespeichert!			

8 Spare parts lists

for the plasma cutting unit
CUTi 90
Plasma machine torch
PHT-51 G/L

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.

8.1 Spare parts list PHT-51 G/L

.11.844.101.000E

23.03.2009

Pos	Article-no.	Designation	Code	pcs.
00.00.00	.11.844.101.006	PHT-51 G/L 6m/120A Plasma Hand Torch		1
01.00.00	.11.844.101.190	Torch head PHT-51G/L without components		1
02.04.01	.11.844.101.310	Cathode PHT-51 G/L		1
02.04.02	.11.844.104.310	Cathode Long PHT-51 G/L		1
02.05.00	.11.844.101.153	Gas guide PHT-51 G/L		1
02.07.01	.11.844.101.410	Nozzle 1.0mm (20-50A) P2210		1
02.07.01	.11.844.101.412	Nozzle 1.2mm (50-90A) P2212		1
02.07.01	.11.844.101.414	Nozzle 1.4mm (90-120A) P2214		1
02.07.02	.11.844.104.412	Nozzle Long 1.2 mm P2412		1
02.07.02	.11.844.104.414	Nozzle Long 1.4 (70A) P2414		1
02.07.03	.11.844.102.425	Nozzle 2.5 P2325 Gouging		1
02.08.00	.11.844.101.160	Protection Cap PHT-51 G/L		1
02.08.01	.11.844.101.162	Spacer Spring PHT-51 G/L		1
02.08.02	.11.844.101.163	Bevelling Cap PHT-51 G/L		1
02.08.03	.11.844.101.164	Contact Cap PHT-51 G/L		1
02.08.04	.11.844.101.165	Nozzle Cap, Long PHT-51 G/L		1
02.09.01	.11.844.101.161	Spatter Protection		1
03.01.00	.11.844.101.250	Handle complete for PHT-51 G/L		1
03.01.01	.11.844.001.255	Push button		1
04.00.00	.11.844.101.700	Hose parcel for PHT-51 G/L - 6 m -		1
08.00.01	.11.844.101.820	Multiple Wrench		1
09.00.01	130.866.003.1	Safety Wrench for Central Socket		1
10.00.00	.11.844.101.890	Circle Cutting Attachment PHT-51 G/L		1
11.00.00	.11.844.101.880	Spare Part Set PHT-51 G/L		1

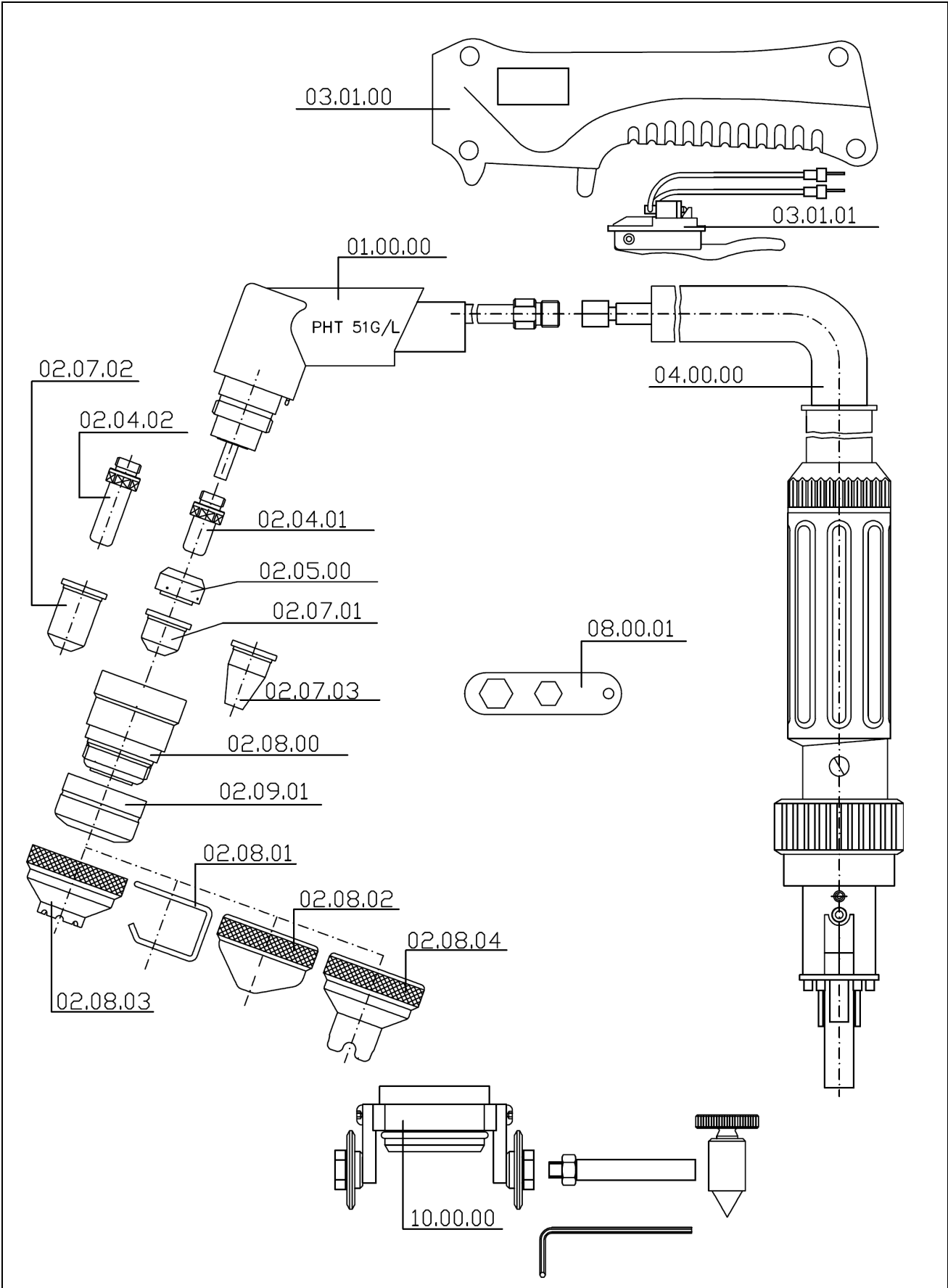


Fig. 19: Plasma torch PHT-51 G/L