MUREX

Operating Manual

Sabre-arc 351i & 351iAS
Air Plasma Cutting Systems

Please ensure that this Instruction Manual and Parts List is made available to the user of the equipment

DECLARATION OF CONFORMITY

Murex Welding Products Ltd.

Declare hereby that:

Murex Sabre-arc 351i & 351iAS Air Plasma Cutting Equipments

Part No: 1416119 & 1416118

- are manufactured in accordance with the Council Directive 73/23/EEC (1973-02-19) and 89/336/EEC (1989-05-03) amended by Council Directive 93/68/EEC relating to electrical equipment designed for use within certain voltage limits.
- conform with the protection requirements of Council Directive 89/336/EEC, amended by Council Directives 91/263/EEC, 92/31/EEC and 93/68/EEC relating to electromagnetic compatibility.
- are manufactured in accordance with EN60974-1 Safety Requirements for Arc Welding Equipment and EN50192 Plasma Cutting Systems.
- are manufactured in accordance with EN50199 Electromagnetic Compatibility for Arc Welding Equipment.

On behalf of ESAB Group (UK) Ltd
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1st September 2002

Contents

WARNING

This cutting equipment has been designed, manufactured and tested to the highest standards to ensure long and trouble free life. However, regular maintenance is an essential part of keeping the machine operating in a reliable and safe manner and your attention is drawn to any maintenance instructions that are contained in this manual.

In general, all welding equipment should be thoroughly inspected, tested and serviced at least annually. More frequent checking will be required when the equipment is heavily used.

Wear and tear, particularly in electro-mechanical and moving components, are gradual processes. Caught in time, repair costs are small and the benefits in performance, reliability and safety are significant. Left alone, they can put the equipment, and you, at risk.

Have this equipment regularly inspected and maintained by an approved service centre.

WARNING

ARC WELDING AND CUTTING CAN BE INJURIOUS TO YOURSELF AND OTHERS. TAKE PRECAUTIONS WHEN WELDING. ASK FOR YOUR EMPLOYER'S SAFETY PRACTICES WHICH SHOULD BE BASED ON MANUFACTURERS' HAZARD DATA.

ELECTRIC SHOCK – Can Kill

- Install and earth the welding unit in accordance with applicable standards.
- Do not touch live electrical parts or electrodes with bare skin, wet gloves, or wet clothing.
- Insulate yourself from earth and work.
- Ensure your working position is secure.

FUMES AND GASES – Can be Dangerous to Health

- Keep your head out of the fumes.
- Use ventilation, extraction at the arc, or both, to keep fumes and gases from your breathing zone and the general area.

ARC RAYS – Can Injure Eyes and Burn Skin

- Protect your eyes and body. Use the correct welding screen and filter lens and wear protective clothing.
- Protect bystanders with suitable screens or curtains.

NOISE– Excessive noise can damage hearing

- Protect your ears. Use ear defenders or other hearing protection.
- Warn bystanders of the risks.

READ AND UNDERSTAND THE INSTRUCTION MANUAL BEFORE INSTALLING OR OPERATING AND SEE WMA PUBLICATION 237 'The arc welder at work' AVAILABLE FROM THE MANUFACTURER.

PROTECT YOURSELF AND OTHERS

SAFETY

In any arc cutting or gouging operation, it is the responsibility of the user to observe certain safety rules to ensure his personal safety and to protect those working near him.

Read all safety articles relevant to arc welding published by the WMA. Pay particular attention to any CAUTION or WARNING Notes included in this manual. CAUTION indicates possible equipment damage. WARNING indicates possible hazard to life.

> ⚠ **WARNING** ⚠
>
> *The ON/OFF switch on this equipment does not isolate the unit from the mains electrical supply.* ***AC POWER IS PRESENT ON THE ON/OFF SWITCH TERMINALS.*** *The On/Off lamp is an indication that the supply is switched on and does not imply that the unit is isolated from the supply.* ***BEFORE REMOVING THE COVERS FOR MAINTENANCE, ISOLATE THE UNIT FROM THE MAINS ELECTRICAL SUPPLY.***

1 Electrical

⚠ Treat electricity with respect. Even the open circuit voltage of this equipment can be dangerous. Adjustments to the torch or replacement of torch parts should be undertaken with the mains supply isolated from the unit.

If damaged torch cables or torch components are found, the unit must be disconnected from the mains and defective parts must be replaced using only Murex spare
⚠ parts.

Do not work on live circuits or cables. Disconnect the main power supply before checking the machine or performing
⚠ any maintenance operation.

Be sure the case of the welding machine is properly
⚠ connected to a good electrical earth.

Have the wiring for the welding machine installed by a qualified electrician. All connections must be made according to specifications in force and to general safety
⚠ standards.

Do not stand in water or on damp floors while using an arc
⚠ welder or cutter. Do not use in the rain.

Do not operate with worn or poorly connected cables. Inspect all cables frequently for insulation failure, exposed
⚠ wires and loose connections.

Do not overload cables or continue to operate with overheating cables. Cables which are too small for the current carried will overheat, causing rapid deterioration of
⚠ the insulation.

Pay attention that live parts of the torch do not touch any metal which is connected to the earth cable. Fix an insulated hook to hang the torch on when it is not in use.

2 Ventilation

⚠ Do not weld or cut on containers which have held combustible or flammable materials, or materials which give off flammable or toxic vapours when heated, without proper cleaning.

⚠ Locate the welding/cutting operation far enough from any vapour-type degreaser using trichlorethylene or other chlorinated hydrocarbons as solvents. The ultraviolet light from the arc can decompose these vapours into toxic gases at a considerable distance from the arc, even though the concentration of the gases is low enough to be undetectable by smell.

⚠ Be sure to provide adequate ventilation for removal and dilution of fume and gases. Fume exhaust facilities near the arc, or a ventilated helmet should be used when cutting in confined spaces or on toxic material.

3 Glare

⚠ Never look at the arc without wearing eye protection.

Always use the proper protective clothing, filter glasses, and gloves. Be careful to avoid exposed skin areas. Do not use cracked or defective helmets or shields.

⚠ Never strike an arc when there is someone near who is not protected from the strong light of the arc.

⚠ Warn bystanders who are not aware of the dangers of ultra-violet light.

4 General

⚠ Take care when lifting the unit.

⚠ Ensure that cylinders are secured by chains.

⚠ Locate the unit so that there is adequate air flow to the ventilation louvres.

⚠ Always dress correctly to protect against glare, radiation and spatter.

5 Fire

⚠ Ensure that the correct type of fire extinguisher is available in the welding area.

⚠ Do not weld near flammable materials or liquids, in or near explosive atmospheres, or on pipes carrying explosive gases.

6 Vehicle Electrics

⚠ When working on motor vehicles, remove the battery and any circuitry which may be damaged by the arc.

⚠ Whilst welding be aware of the possibility of 'hidden wires' behind panels or bulkheads.

INTRODUCTION

1. Sabre-arc 351i & 351iAS Power Sources

The Murex Sabre-arc 351i & 351iAS are small portable plasma cutting systems designed to work on 230V 1ph electricity supplies as well as 110V with the 'AS' version. They utilise factory compressed air for both the plasma and secondary cooling gas. The power sources use inverter technology to give precise control of cutting current and together with the PT-50 torch and patented HD consumables, enable conducting materials up to 13mm thick to be cut (6mm on 110V).

2. PT-50 Plasma Cutting Torch

The patented Murex PT-50 torch and HD consumables are designed for manual plasma cutting up to 50A at 100% duty using **clean dry air** as both plasma and cooling gases. The PT-50 torch head contains an air flow check valve which, in conjunction with a flow switch in the Murex Sabre-arc power source, provides a safety interlock preventing the torch from being accidentally energised when the heatshield is removed.

The PT-50 is available with either 4.5 or 7.6m cable (4.5m standard with the Sabre-arc 351i) and has a 75° head angle. See Fig 1.

The torch can be used in contact cutting mode for sheet metals up to 5-6mm thick. A stand off (tip to work) distance of 1-2mm is recommended for plates greater than 6mm thickness.

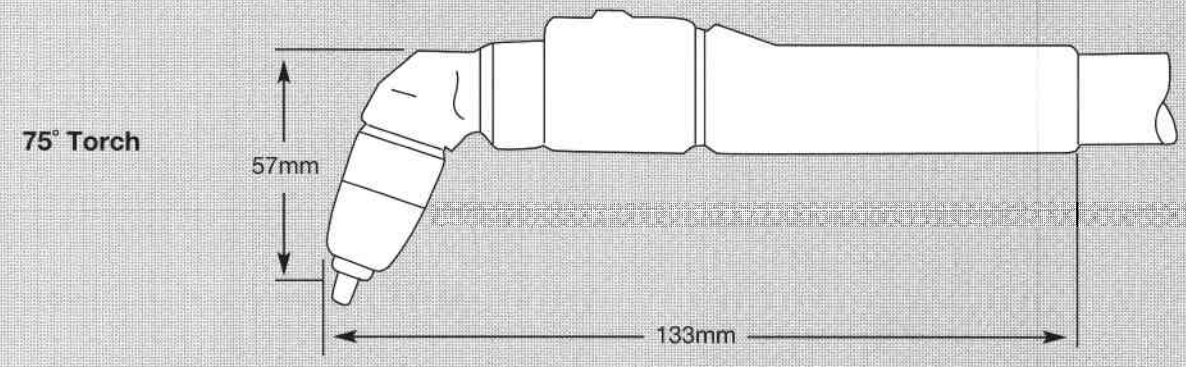
A cutting guide plate can be used to aid straight line cutting, see OPERATION. This technique is also useful when cutting mesh grilles. In addition a Circle Cutting Attachment is available as an Option for cutting accurate circles from 125 to 680mm diameter. The circle cutting attachment dual castor assembly is also useful for maintaining a constant stand-off for general sheet cutting.

SPECIFICATION

	351i	351iAS
Output		
Open Circuit Voltage	230V dc	230V dc
Output Current	15-35A	15-35A (15-25A max on 110V)
	Continuously variable	Continuously variable
Cutting Voltage	120V dc	120V dc
Cutting Thickness (mild steel)	0.5-13mm	0.5-13mm (6mm max on 110V)
Rating (10 minute cycle)	35A 40% duty 30A 60% 22A 100%	35A 40% duty (230V) 30A 60% (230V) 22A 100% (230V)
Input		
Mains Voltage	230V	110/230V (autosetting)
Frequency	50/60Hz	50/60Hz
Phase	1	1
Input Fuse	30A slow	30A slow
Kva	6.6	6.6
Kw	5.3	5.3
Air Requirement	6-10 bar 100-150 lpm	6-10 bar 100-150 lpm
Dimensions		
Height	322mm	322mm
Width	156mm	156mm
Depth	362mm	362mm
Weight	15kg (excl torch)	16kg (excl torch)

PT-50 Torch	
Current Rating	50A 100% duty
Plasma/Cooling Gases	Air
Head Angle	75°
Cable Length	4.5m (7.6m Optional)
Weight (shipping)	0.9kg
Air Pressure	5.2 bar/75psi
Air Flow	120 lpm/250cfh

Fig 1. PT-50 Torch



UNPACKING

The Murex Sabre-arc equipment comprises the following items:

Part No. 1416119/1416118 Sabre-arc 351i/351iAS Power Source. Plus Part No. 558001466 PT-50 plasma torch with 4.5m lead and a work return lead and clamp (fitted). Plus Consumables spares kit.

Check that all the required items are present and inspect carefully for evidence of damage which may not have been apparent on the external packing. If necessary notify the carrier or your Murex Distributor immediately.

INSTALLATION

Installation must only be undertaken by a qualified electrician or a suitably trained person.

1. Choose a location so that the louvres on the front, sides and rear are clear of any obstruction and permit free flow of air through and around the unit. Refer to the safety section for other precautions regarding siting the unit.

2. The Sabre-arc 351i & 351iAS power supply is equipped with a 3m primary input cable. Connection should be made as follows:-

Brown	L	230Vac or, for the 351iAS, 110Vac
Blue	N	
Green-Yellow	Earth	

A suitable switched isolator should be used and the circuit must be protected by a suitable fuse. Refer to the Specification section.

3. Connect a supply of CLEANED DRY COMPRESSED AIR to the regulator. Supply requirements are 6 bar minimum, 10 bar maximum (90-150psi) at 100-150L/minute. Do not use compressed air that has been oil loaded for pneumatic tools etc.

4. Clamp the earth clamp onto the workpiece ensuring the connection point is free from rust, scale or paint.

WARNING

Electric shock can kill! Precautionary measures should be taken to provide maximum protection against electric shock. Be sure that all power is off by opening the line (wall) disconnect switch and by unplugging the primary cable to the unit when connections are made inside the power supply.

INSTALLATION

Radio Interference

Murex welding power sources have been designed to high standards of electromagnetic compatibility. However, arc welding, by its very nature, generates radio-frequency energy and may cause interference. By installing and using the equipment correctly, in accordance with these instructions, the problems of interference may be minimised.

This equipment satisfies the requirements of the EU Directive 89/336/EC on EMC and complies with the limits in EN 50 199, 'EMC product standard for arc welding equipment'. These limits are designed to provide reasonable protection against interference in heavy industrial areas.

If this equipment is used in domestic areas, eg. for repair or maintenance, particular care should be taken. The time of day should be chosen and the duration of welding limited, to minimise any potential problems.

If this equipment causes interference the guidance given below should be considered. If a solution cannot be found please contact your distributor or the manufacturer.

Before installing this welding equipment an assessment should be made of potential EMC problems that may occur. It is good practice not to install welding equipment next to computers or safety critical control circuits, eg. electronic machine guards, unless they have been suitably protected.

This equipment should be connected to the primary supply using the cable provided. However, for permanent installation, if interference problems occur, shielded cable or conduit should be considered. The primary cabling and welding cables should be kept separate to other mains wiring and control, signalling or communications (eg. telephone) cables. If interference occurs then greater separation or re-routing should be considered. Welding cables should be kept as short as practically possible.

Interference may also be reduced by separating the welding equipment from the other equipment affected. A partition, brick wall or, particularly, a metal screen will also reduce interference. Earthing and equi-potential bonding should also be considered but guidance should be sought from a competent person, the distributor or manufacturer.
To ensure continued compliance with the EMC Directive this equipment should be routinely maintained according to the manufacturer's instructions and using only approved spare parts. In particular, the spark gaps of HF units should be adjusted and maintained according to the manufacturer's recommendations.

All access and service door covers should be closed and properly fastened when the equipment is being used. This equipment should not be modified in any way except for those changes and adjustments approved by the manufacturer.

ASSEMBLING PT-50 TORCH

CONSUMABLES – see Fig. 2

This section deals with fitting the electrode, tip etc. to the torch head.

WARNING

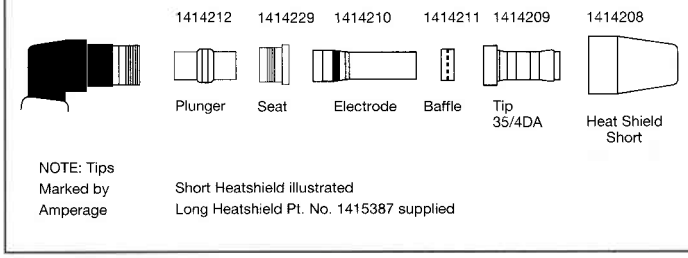
Ensure the power switch on the Sabre-arc is in the off position before installing or inspecting consumable parts.

The Sabre-arc 351i & 351iAS packages are supplied with a kit of consumables parts as follows:-

2	Electrode HD	Part No. 1414210
1	Swirl baffle	Part No. 1414211
3	Tip HD 40A	Part No. 1414209
1	Heatshield Long	Part No. 1415387

NOTE: *The torch head contains a flow check valve that, along with flow sensing circuitry in the Sabre-arc power source, prevents the torch from being accidentally energised with the Heatshield removed.*

Fig 2. PT-50 Consumables



CONTROLS AND FACILITIES – see Fig. 3

1. Power On/Off switch. In the ON position the pilot lamp is illuminated, the control circuitry is powered and the fan will run. Setting the power switch to ON will cause the air flow to cycle once.

WARNING

Placing the power switch in the OFF position does not totally isolate the unit from mains electrical power. Always isolate the machine from the electrical supply before carrying out any work on or in the power source.

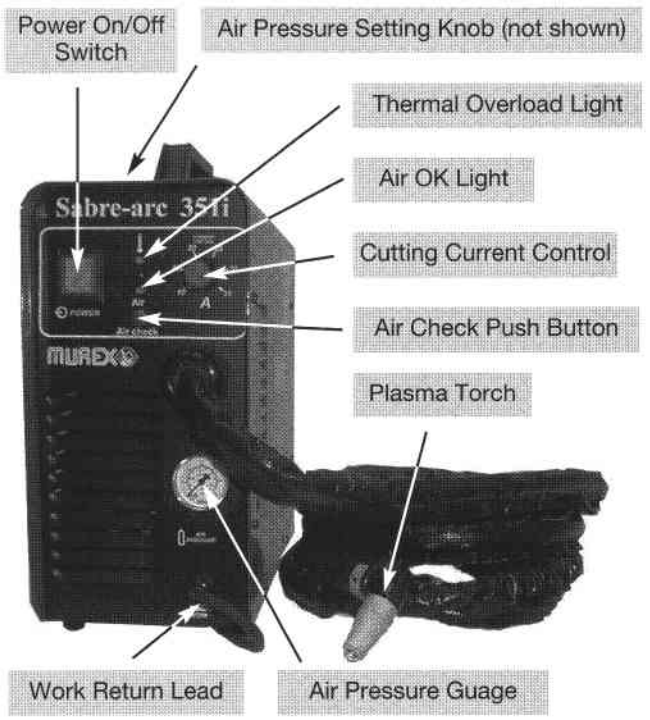
2. Output Current Control. Enables the precise cutting current to be set for the plate to be cut. Control range is per specification, page 4.

3. Air Check Push Button. When pressed, the air filter regulator can be adjusted to the required pressure, normally 75psi, before cutting operations. In this mode air flows continuously and it is recommended, at least at the beginning of each shift, that the system is purged of any condensation that may have accumulated during the off period.

4. Air OK Light. The green light is illuminated when air is flowing and the flow switch is correctly operated.

5. Overload Light. This yellow light will be illuminated and the machine output will be shut off when the duty cycle has been exceeded. The duty cycle of the Sabre-arc 351i & 351iAS on a 230V sypply is 40% at rated output current of 35A based on a 10 minute cycle, i.e. 4 minutes cutting and 6 minutes idling. Leave the machine with the power on and fan running, the thermal protection will automatically reset after a few minutes. The Sabre-arc 351iAS is rated at 25A at 60% on 110V supplies.

Fig 3. Sabre-arc 351i/351iAS controls



OPERATION

WARNING

Before attempting cutting operation read the safety notes at the front of this manual.

PROTECT YOURSELF AND OTHERS

WARNING

Never touch any parts forward of the torch handle (electrode, tip, heatshield etc.) unless the Power Switch is in the OFF position.

NOTE: *Do not depress the torch switch unless the torch tip is touching or within 0.5mm of the workpiece. Locate the power supply at least 3m from the work area. Sparks and hot slag from the cutting process can damage it.*

1. Hold the tip torch on or within 0.5mm of the workpiece where cutting is to start. To prevent damage to the tip from splash-back or splatter it is recommended that the torch is held at a 15-30° angle from the vertical in a slightly trailing mode, see Fig. 5.

NOTE: *If the plate to be cut is heavily painted or coated in an insulating medium, it may be necessary to scratch or score the surface where cutting is to start to aid initiation.*

2. Depress the torch switch – air should start flowing through the torch.

3. Two seconds later the plasma arc will start cutting.

4. After starting the cut, the tip can be dragged along the work if cutting up to 6mm thick sheet. When cutting plates greater than 6mm, maintain a stand-off distance (tip to work) of 1-2mm. Fig. 4 and 5 are a guide to cutting settings and technique, see also below regarding Piercing, Mesh Cutting and Cutting Guides.

5. When ending a cut, the torch switch should be released and the torch lifted away from the work just before the end, to minimise possible double-arcing which can damage the torch consumables.

6. In the postflow mode, the arc can be reignited immediately by operating the torch switch. The two-second preflow will be automatically overidden.

PIERCING

Materials up to 6mm thick can be pierced with the tip touching the work. When piercing ensure the torch tip is immediately lifted off the work to a 1-2mm stand-off after the arc start. This will reduce the possibility of splatter entering the torch or welding the tip to the plate. The torch should be angled at about 30° from the vertical when starting the pierce and then straightened after piercing has been accomplished.

MESH CUTTING

Do not release the torch switch. This avoids the two-second preflow period. Alternatively a cutting guide plate can be used to keep the arc alive during the 'gaps' in the mesh, see below.

CUTTING GUIDES – see Fig. 6

To assist in maintaining a straight line a cutting guide can be used, see Fig. 6. The guide plate should be no more than 2mm thick and of a conducting material, stainless or mild steel are ideal. The guide plate should be placed on the work and the specially machined step in the end of the torch tip rested on its edge so that the hole in tip is over the line to be cut and within 1mm of the work.

After the arc strike the torch can be simply moved along the edge of the guide.

Do not use cutting guides more than 2mm thick.

Fig 4. Sabre-arc Cutting Range

Material	Thickness mm	Current Amps	Travel m/min
Carbon Steel	1.6	15	1.0
	3	20	1.0
	3	25	1.5
	6	25	0.5
	10	28	0.3
	15	35	0.3

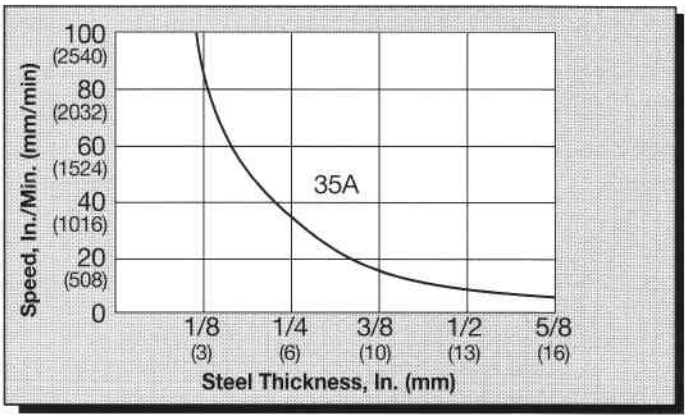


Fig 5. Cutting Technique

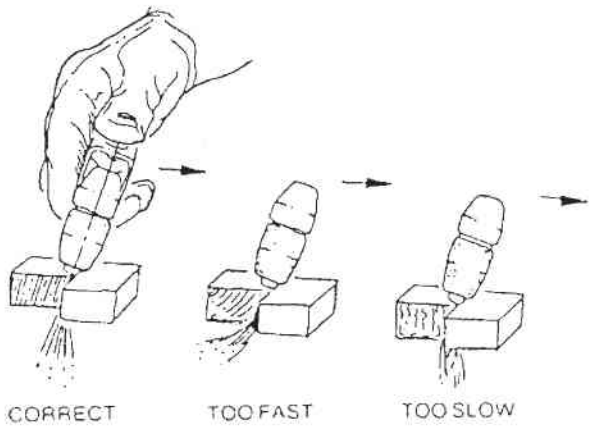
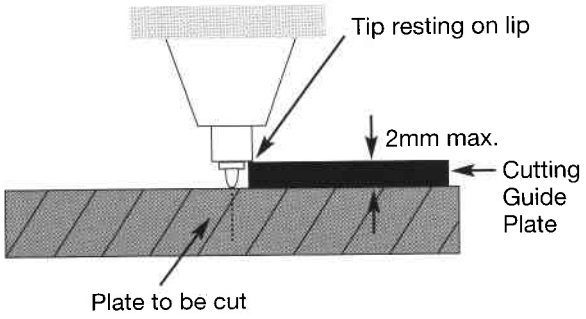


Fig 6. Cutting Guide Plate



COMMON CUTTING PROBLEMS

Problem	Remedy
1. Insufficient Penetration	• Travel speed too fast • Damaged tip • Air pressure incorrect • Current too low
2. Main Arc Extinguishes	• Travel speed too low • Stand-off distance too large • Earth clamp loose • Worn electrode and tip • Duty cycle exceeded
3. Excessive Dross Formation Note it may be impossible with some materials and thicknesses to get totally dross-free cuts	• Incorrect travel speed • Incorrect air pressure • Faulty tip or electrode
4. Double-Arcing	• Low air pressure • Contact cutting at high current • Damaged or loose tip • Heavy spatter
5. Uneven Arc	• Damaged or worn tip and/or electrode
6. Unstable Cutting Conditions	• Incorrect travel speed • Loose cables and connections • Faulty air supply
7. Main Arc Does Not Strike	• Heavily insulated plate • Work return not connected • Excess air pressure • Worn electrode and tip • Tip too far from work
8. Poor Consumable Life	• Improper air pressure • Contact cutting at high current • Piercing thick plate • Spatter • Contaminated air supply

MAINTENANCE

1. PT-50 Torch

WARNING

Set power switch to OFF before removing consumables.

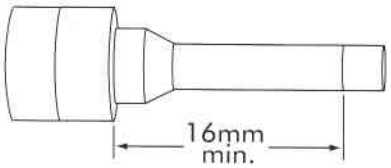
Inspect the torch and the consumables at frequent intervals for excessive wear and erosion. Failure to do so may result in damage to the torch head itself or a safety risk.

1. With the torch head facing up unscrew and remove the heatshield. Examine the heatshield, tip, swirl baffle and electrode, see Fig. 2.

2. Replace the heatshield if it is chipped, cracked or excessively eroded.

3. Replace the electrode when it has worn down to a length of 16mm.

HD Electrode Pt. No 1414210



Replace electrode when it erodes to less than 16mm

4. Replace the tip if the hole is excessively oversize or elongated or excess side wall damage is evident.

5. Replace the swirl battle if the holes become blocked or damaged.

6. Visually inspect the seat and plunger for signs of deterioration or damage.

7. Inspect the 'O' ring on the torch head for signs of deterioration and replace if necessary. Ensure the new ring is located in the 2nd groove, see Spare Parts section and apply a small quantity of Silicon grease to the ring.

8. The air flow check valve is part of the safety interlock and is permanently assembled inside the torch head. The head must be replaced should this valve malfunction. The light spring force used to close the valve can be felt by pushing down on the electrode when assembling the torch front-end parts.

9. The torch cable and connections should be periodically inspected for signs of deterioration or damage. See Spare Parts section for notes on how to disassemble the torch.

2. Sabre-arc 351i & 351iAS Power Source.

WARNING

The unit must always be isolated from the mains electrical supply before any maintenance work is undertaken.

1. At regular intervals, and wearing eye and face protection, blow out the inside of the unit using low-pressure, clean, dry compressed air.

2. Check all electrical connections and fittings are tight and that cables are in good condition.

3. Check the air systems for leaks.

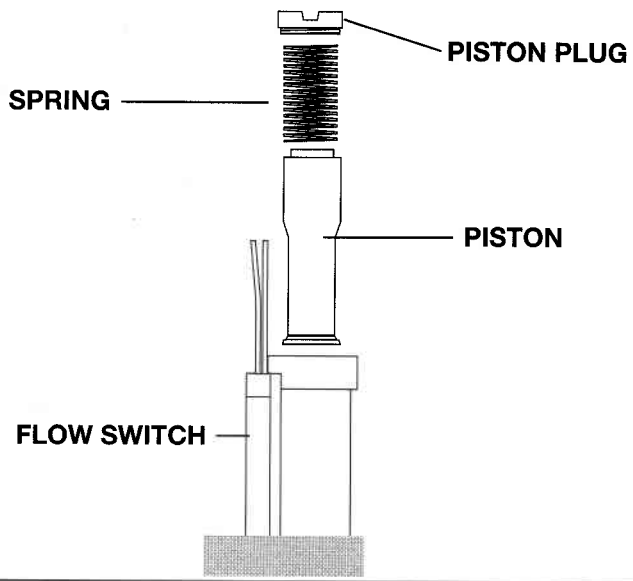
4. Check and bleed water or oil from the regulator filter assembly.

5. When excessive contamination is found in the air, the flow switch (FS) should be disassembled and cleaned, see Fig. 7.

NOTE: *It is not necessary to remove the flow switch from the machine for cleaning.*

A. Ensure the machine is disconnected from both air and electrical supplies and that there is no trapped air under pressure in the hoses.
B. Remove the piston plug.
C. Remove spring. Use care when handing to avoid damage.
D. Remove piston.
E. Clean all parts with a suitable solvent.
F. Reassemble.

Fig. 7 Disassembly/Assembly of Flow Switch



TROUBLESHOOTING

For cutting difficulties see Common Cutting Problems section.

WARNING

Ensure the machine has been isolated from the mains supply before attempting inspection or work inside the unit.

The troubleshooting flow chart, Fig. 8 is a guide to a fault finding in the Sabre-arc. If the cause cannot easily be located, disconnect the input power, remove the cover and carry out a simple visual inspection. Look for secure connections, loose or burned wiring or components, damaged capacitors etc.

The cause of control malfunction can be found by referring to the operation sequence Fig. 9 and electrical schematic Fig. 10 and testing various components using volt-ohmmeter.

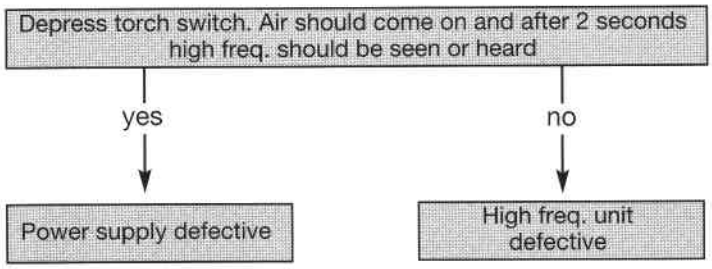
WARNING

Voltages inside the plasma cutting unit are high enough to cause injury or even death. Be careful around the equipment whilst the covers are off.

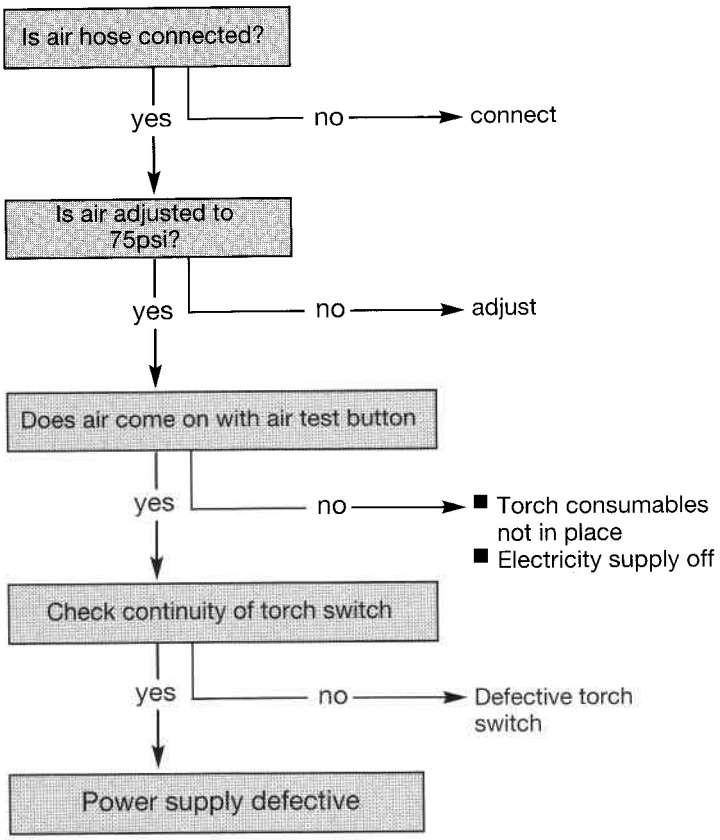
Fig. 8. Troubleshooting Flow Chart

1. Difficult Starting

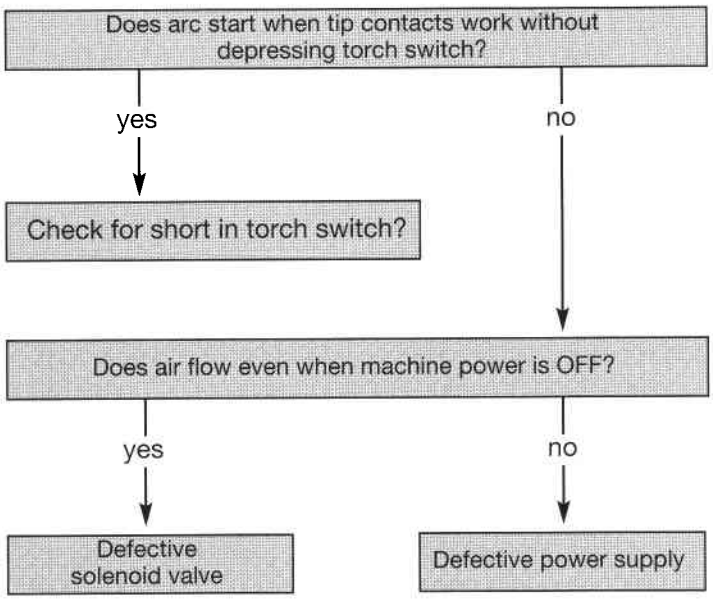
- **Change electrode**
- **Change tip**
- **Check for clean ground connection**
- **Check air pressure 75psi**
- **Check torch power cable for continuity**



2. No air



3. Air does not shut off



4. White "Power" light not energised

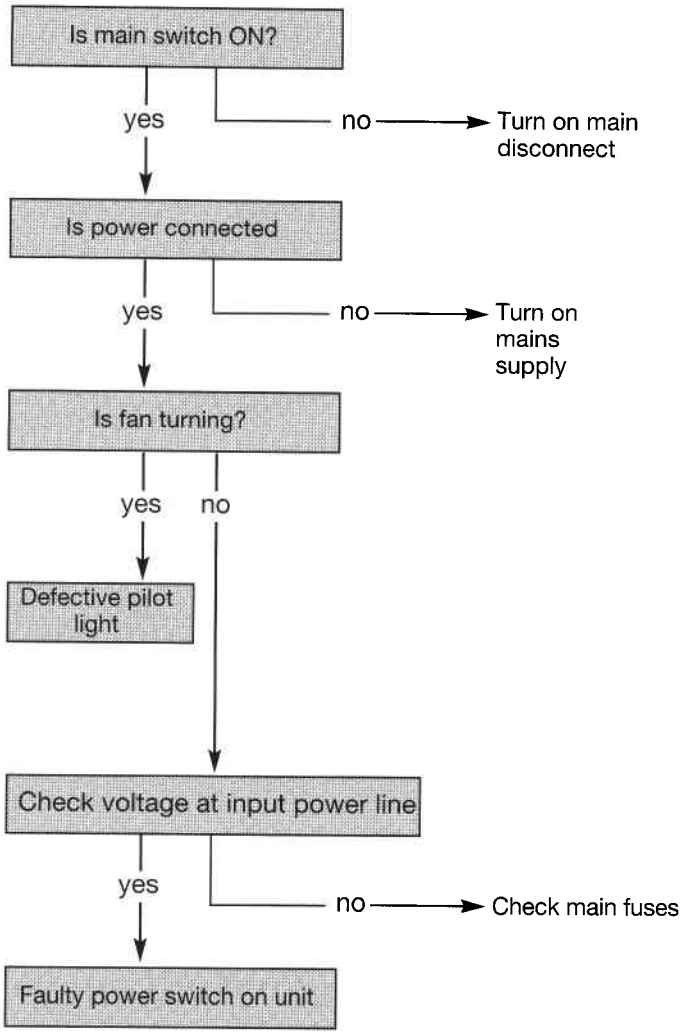
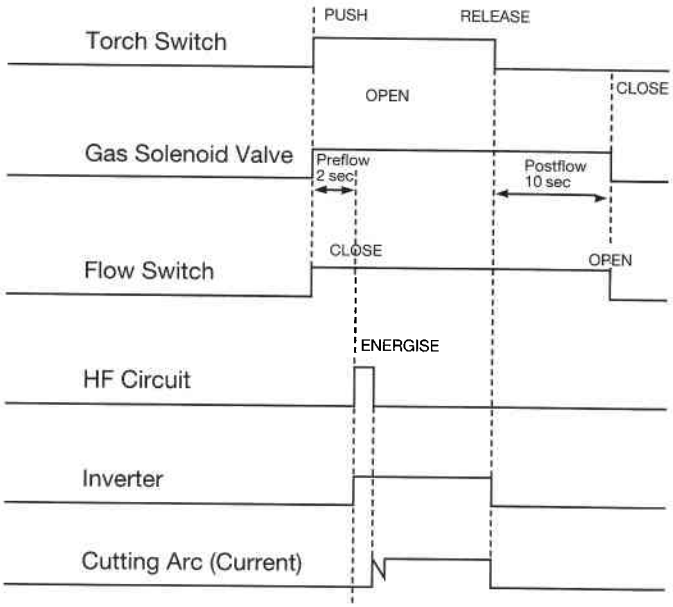


Fig. 9. Operational Sequence



NOTES:

1. When the torch switch is pushed during postflow period, the postflow and preflow times are cancelled, and the HF is energised immediately.
2. When the yellow overload pilot comes on, cutting operations should be stopped. The postflow time starts from the moment the torch switch is released.

WARRANTY

Murex offers a full, normally on-site, guarantee on all its welding and cutting equipment. The Sabre-arc 351i & 351iAS power source is guaranteed for a period of 2 years from date of purchase. If during this period the product proves defective due to incorrect design, materials or workmanship, Murex or its authorised Service Centre will, free of charge, repair or at the discretion of the company replace the product or its defective parts.

Please note that the guarantee on the PT-50 plasma torch is 12 months.

This guarantee excludes:

1. Normal wear and tear of consumable parts, cutting tips, electrodes, heatshields, etc

2. Damage resulting from misuse, accident, lack of maintenance, incorrect installation or misapplication.

3. Repairs carried out by non-authorised personnel or the use of non Murex replacement parts.

4. Loss of use of the product and other incidental or consequential costs incurred by the purchaser.

OPTIONS

1414206	PT-50 Torch 7.6m Lead
1414214	Plasma Circle Guide Kit

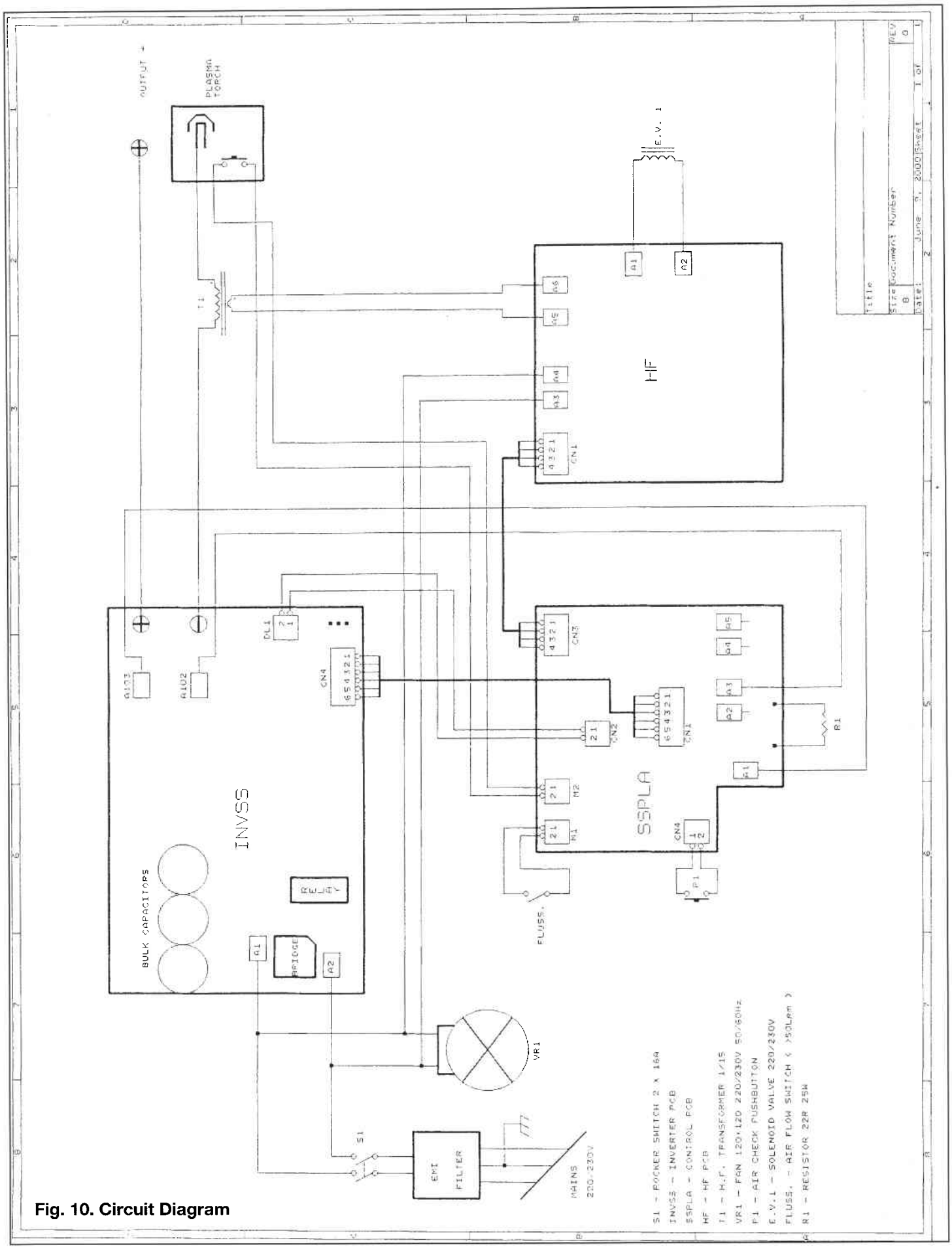


Fig. 10. Circuit Diagram

REPLACEMENT

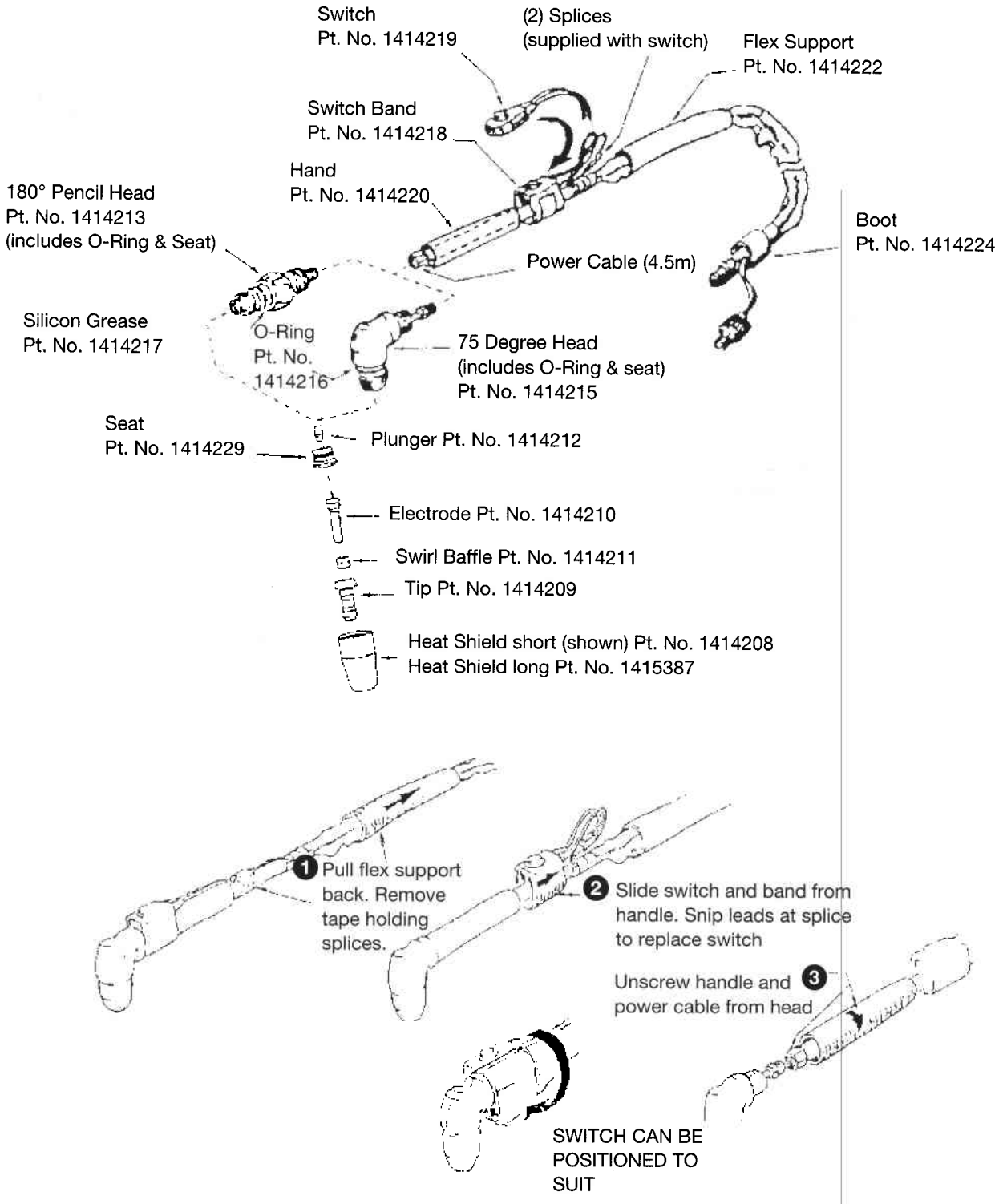


Fig. 11. PT-50 Plasma Torch

By following steps 1, 2 and 3 the leads can be removed from the torch. To disassemble the lead, lay the cable out straight, remove the tape from around the switch lead splices, and free the switch by cutting the leads close to the splices. (Replacement switches have extra long leads to make up for any loss due to cutting). Remove the rubber boot from the inlet end of the cable and remove the tape that secures the sheath at each end. Pull the sheath off the cable (over small fitting at torch end). Note that the switch leads wrapped around the power cable are secured with tape several places along the cable. The leads, switch plug and strain relief can now be removed. DO NOT remove the white tape that forms a band around the power cable at each end. The sheath is taped to the cable in front of band which acts as a shoulder to prevent the sheath sliding back on the cable. (Replacement cables have this in place). Reassemble in reverse order.