

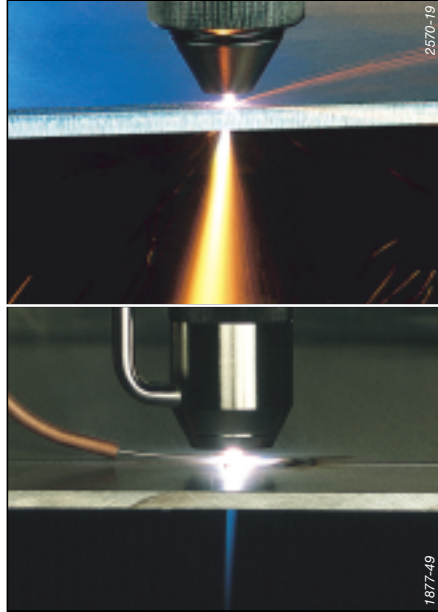


PLASMA

*A welding process
and equipment
to improve
your pipe production
and pre-fabrication.*

The plasma arc : a natural phenomenon tamed by SAF.

The term PLASMA applies to gases at temperatures exceeding 3000°C at atmospheric pressure. It can be regarded as the fourth state of matter, following the solid, liquid and gaseous states on the temperature scale. The PLASMA is made up of excited ions, electrons, atoms or molecules ; it occurs in nature, generated by lightning, for example. Since about 1960, and largely due to SAF, the word PLASMA has gained a new meaning, referring to the high-energy state caused

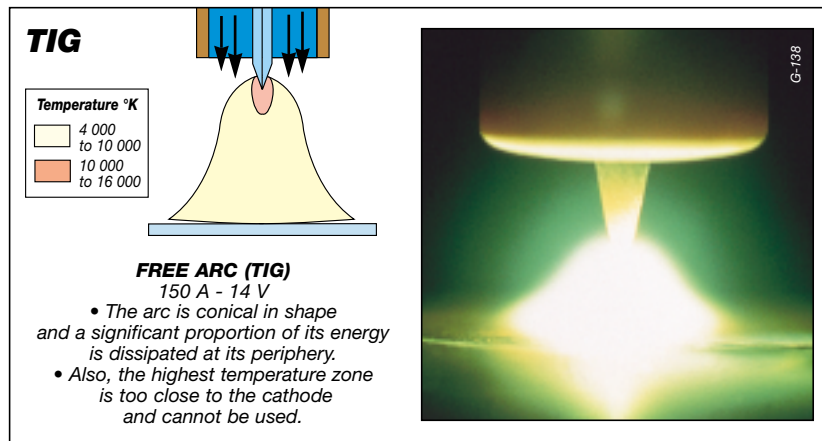


by constricting an electrical arc by means of a diaphragm or nozzle. This principle is now widely used in the steel, chemical and mechanical engineering industries. **As market leader in this sector, SAF has turned it into a powerful cutting and welding tool.** It is generally accepted that the PLASMA welding process is the major technological advance from inert gas shielded free arc welding (the TIG process).

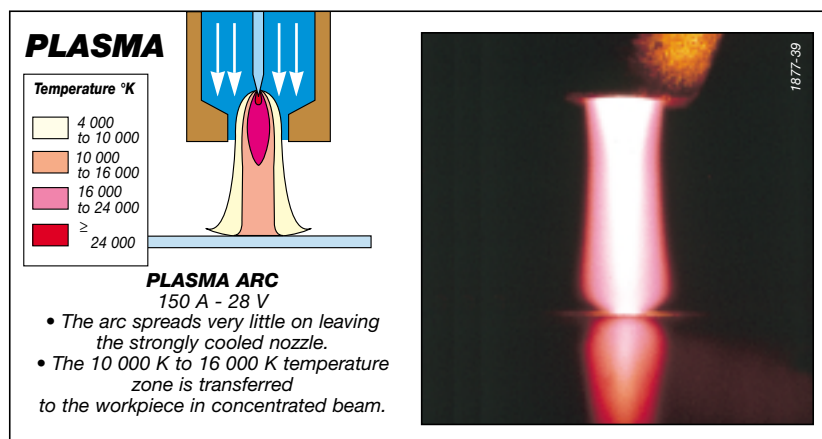
Plasma arc : high temperatures, a concentrated beam, better productivity.

The isotherm diagram opposite shows clearly that the energy distribution is strongly modified within the PLASMA arc :

- the 16 000 K to 24 000 K temperature zone is outside the nozzle,
- the 10 000 K to 16 000 K temperature zone is entirely transferred to the workpiece and causes the "keyhole" effect (penetration of the workpiece). With a FREE arc (TIG process) the highest temperature zone is too close to the cathode to be usable.



The 4 000 K and 10 000 K temperature zone is narrow in PLASMA welding and much more spread in TIG welding. This zone is not without its uses : it causes surface melting of decreasing depth relative to the plane of the joint, providing a gentle transition from the welded area to the basic metal. This zone is excessively wide in TIG welding, however, and the excess limits performance.



PLASMA WELDING

Why choose plasma welding for prefabricated pipework ?



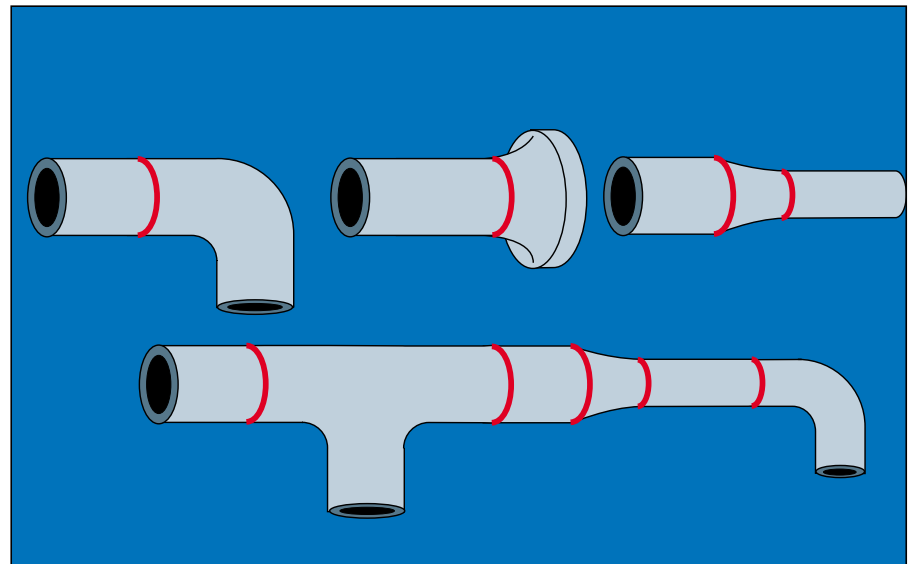
Because the manual prefabrication of pipework is still the preserve of highly skilled operators using traditional methods (covered electrode, manual TIG or MIG welding) and because high-performance manufacturing processes reduce non-quality, inspections, costs and lead times.

PREFABRICATED PIPEWORK

FOR WHICH TYPES OF JOB ?

Prefabricated pipework is assembled in the factory by preparing and welding subassemblies made up of standard components (pipe, flange, elbow, etc). Prefabricated pipework is used in varied sectors of industry :

- shipbuilding,
- off-shore platforms,
- refineries,
- power stations,
- chemical and agriculture/food processing plants,
- gas expansion and distribution stations etc.



MATERIALS USED

Carbon steel, stainless steel from the 300 series, noble metals, titanium and its alloys, zirconium ... PLASMA welding is fully effective for prefabrication of pipework

in diameters exceeding 1.5 inch. Smaller diameter parts can be TIG welded using the same equipment. Thicknesses from 2.5 mm up to 6 or 7 mm can be welded

with no special preparation. Thicknesses exceeding 7 mm require a chamfer.

THE BENEFITS OF THE SAF PLASMA WELDING PROCESS

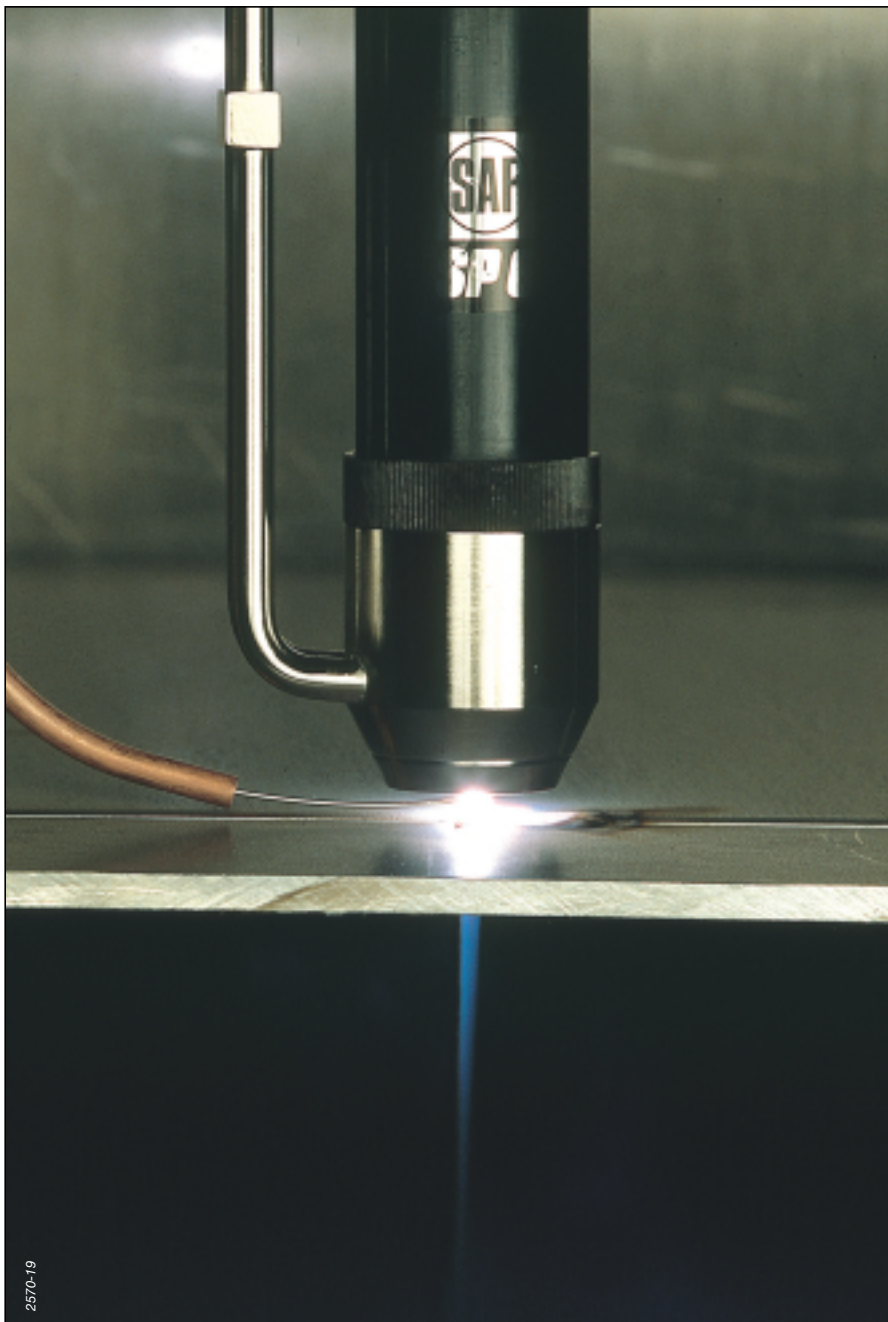
■ **Preparation times reduced** by eliminating chamfers for thicknesses up to 7 mm.

■ **Welding times reduced** 4 or even 5 times compared to manual welding.

■ **Assured regular penetration** inside the pipes by keyhole welding of butt-jointed pipe tacked by manual TIG welding.

■ **High quality, proof against** the most stringent inspections. Plasma arc welding eliminates penetration defects at the start of the weld and difficult "reworking" after systematic grinding of the weld bead start and end points.

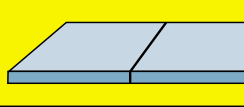
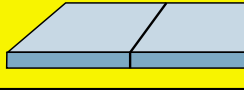
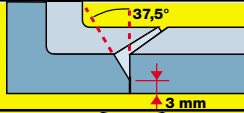
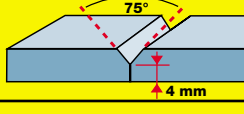
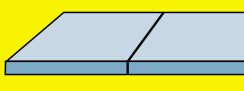
■ **Excellent reproducibility guaranteed** through storage of complete welding programs defined by simple data : grade of steel, diameter and thickness to be welded.
■ **Faultless weld bead overlap quality** thanks to total control of the welding parameters.



HOW THE SAF PLASMA WELDING PROCESS PERFORMS IN PIPEWORK PREFABRICATION

The joints are prepared for the PLASMA welding equipment by one or more fitters who tack the parts using manual TIG welding and fit the plugs or partitions delimiting the gas shielding inside the pipes.

(Gas supply during welding is controlled by the PLASMA equipment).

WELDING TIME					
pipe outside Ø (mm)	wall thickness (mm)	steel	joint preparation	automatic plasma welding operation time (excluding set-up)	Approximate time for same operation using manual welding
60	2.9	carbon		2 minutes 20 seconds (2 consecutive passes)	15 minutes
133	3.8	carbon		4 minutes (2 consecutive passes)	24 minutes
406	9.52	carbon		14 minutes (2 consecutive passes)	45 minutes
114	8	AISI 304		4 minutes 10 seconds (2 consecutive passes)	38 minutes
170	3.2	AISI 304		2 minutes (1 pass)	55 minutes

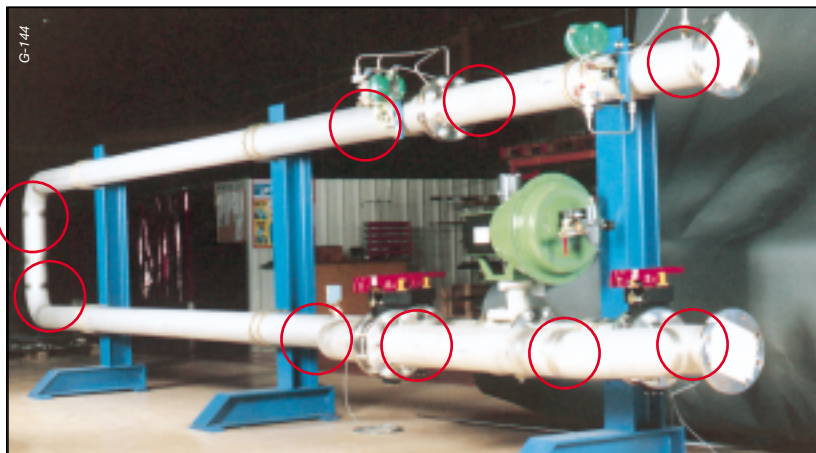
GAS CONSUMPTION

■ PLASMA gas
Nature : pure Argon
Flowrate : 5 - 6 l/min

■ Torch shield gas
Nature : Argon + 5% H₂
Flowrate : 20 l/min

■ Back of joint shield gas
Nature : Argon
or Argon + 5% H₂
Flowrate : 5 - 15 l/min

PLASMA WELDING FOR YOUR FABRICATION REQUIREMENTS

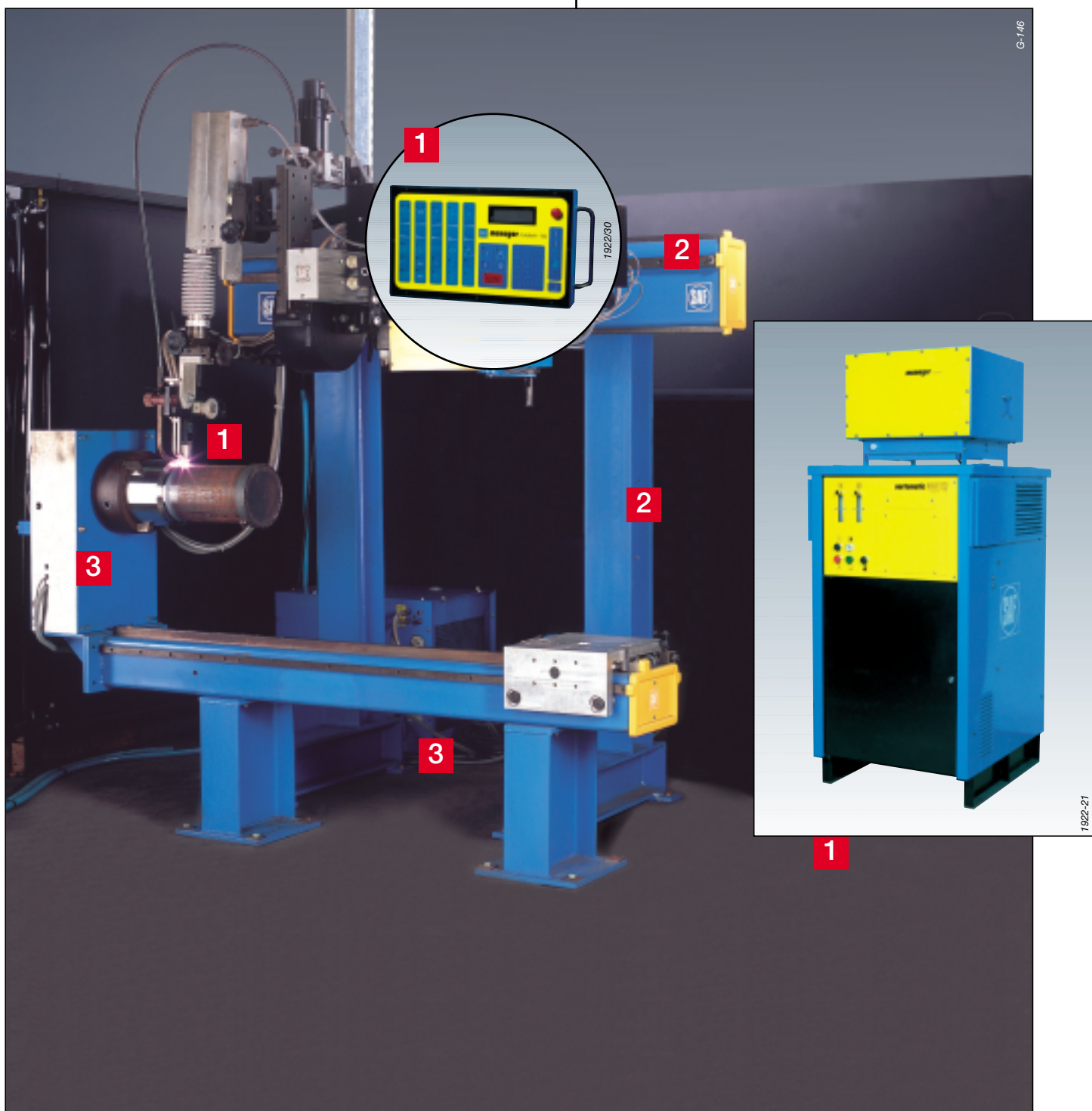


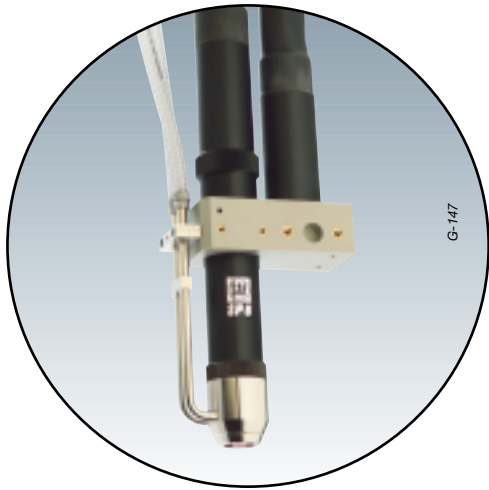
Circled in red: plasma arc welds on prefabricated pipework.

THE COMPLETE PLASMA WELDING PACKAGE FOR PREFABRICATION OF PIPEWORK

The complete package
comprises three subassemblies :

- 1 THE PLASMA WELDING EQUIPMENT**
- 2 THE SUPPORT STRUCTURE FOR THE PLASMA WELDING EQUIPMENT**
- 3 THE PIPE ROTATION SYSTEM**





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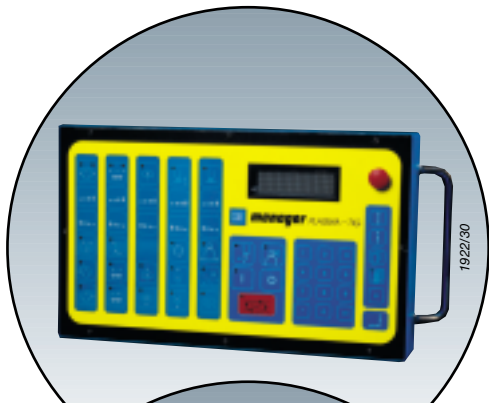
1 PLASMA WELDING EQUIPMENT (standard order code LD 04 020) comprises three main components and the video option :

SP 6 PLASMA WELDING TORCH

The heart of your installation, designed as a real mechanical tool, the SPS 6 torch guarantees highly accurate reproducibility of the plasma conditions. The micrometer mechanism for adjusting the electrode allows accurate centering to eliminate imbalances in the plasma jet.

Specifications:

- 380 A at 100%,
- electrode diameters (mm) from 2.4 to 4.8,
- nozzle main orifice diameters (mm) 1.5 - 2.5 - 3 - 3 CD (convergent/divergent),
- insulated and cooled gas shielding nozzle,
- electrode removable from above without dismantling the nozzle,
- optional gas shielding extender.



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MANAGER AUTOMATIC CONTROLLER

Designed and built specifically by SAF for our plasma welding process and easily programmed and used by workshop welders, this unit employs sophisticated software for highly accurate and reproducible welding programs :

- controls all functions and the complete welding cycle of the entire installation :
 - arc current with striking and extinguishing ramps,
 - pulsed current frequency and level,

- arc voltage (pipe out of round correction),
- filler wire,
- plasma gas flowrate and progressive closure of the "keyhole" at the end of the first pass,
- assembly rotation speed and angle swept for all passes on the same weld,
- program hard copy facility.
- programmed via front panel keypad or from a micro computer,
- stores 100 different welding programs.



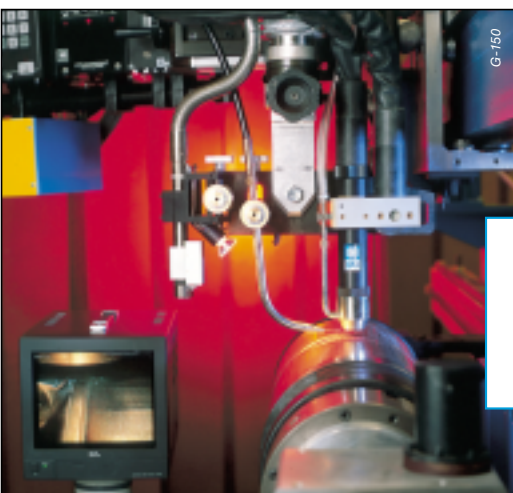
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NERTAMATIC 300 TR

This high-technology power source offers a totally regulated welding current from 3 A to 300 A with a pulsed current facility at frequencies from 1 Hz to 500 Hz. Pulsing the plasma arc current at two levels (e.g. 100-200 A) produces a very high level of confinement of the energy

in the arc (the electromagnetic pinch effect combining with the pneumatic and mechanical confinement imparted by the nozzle). It offers great operator comfort combined with better penetration control and appearance (back of weld).

Welding current (100%)	3 - 300 A DC ($\pm 1\%$)
Pulsed current frequency	1 - 500 Hz
Primary voltage (50-60 Hz)	220/230/380/400/415/440/500 V
Supply current	30.5 A 16.4 A 12.6 A
Plasma pilot arc	1 - 25 A (switch mode)
Gas circuits	with built-in gyrometer
Programming 10 basic welding programs	(8-bit microprocessor) optional add-on
Dust protection	2 interchangeable filters
Dimensions (h x w x d)	1 225 x 700 x 790 mm
Weight	245 kg
NERTAMATIC 300 TR cat. no.	9114-0542
Insulation	class H
Protection	IP 23



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PLASMA ARC VIDEO SURVEILLANCE OPTION

An optional add-on for the installation comprises a colour video system which enables the operator to monitor the arc with x 5 magnification. The SAF process video system integrates

fully into the installation and benefits weld quality through the facility for precise observation. It eliminates operator discomfort (due to UV radiation from the plasma arc).

