

TOPTIG

A new robot welding process for industry



TIG quality
no spatter
guaranteed

2005-895

2008-145

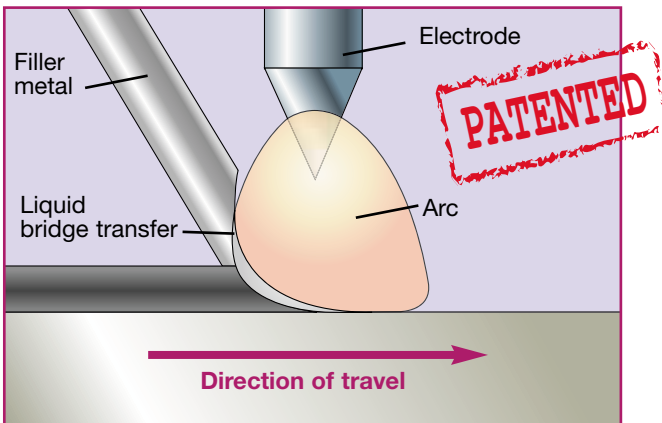
TOPTIG process innovation



TOPTIG process is a major innovation in the world of robotized welding. Developed in the Air Liquide Welding research centre, TOPTIG is a new process development from arc welding classical solutions. This new process can be used effectively on carbon or stainless steel plates up to 3 mm as well as on Titanium or Nickel alloys or on galvanized sheets with weld brazing.

TOPTIG innovative process principle

The filler metal is fed through the nozzle directly into the arc with an angle of 20° to the electrode, precisely where the temperatures are the highest. This concept guarantees a high deposition rate and an efficient metal transfer. Parameter adjustments permits the choice of a liquid bridge transfer or a droplet transfer mode. In addition the wire speed can be pulsed and synchronized with the current, giving a waved weld bead appearance. Whatever the parameters selected, due to the precise control of energy, the TOPTIG process guarantees a TIG quality result with a complete absence of spatter and avoids distortion on thin sheets.



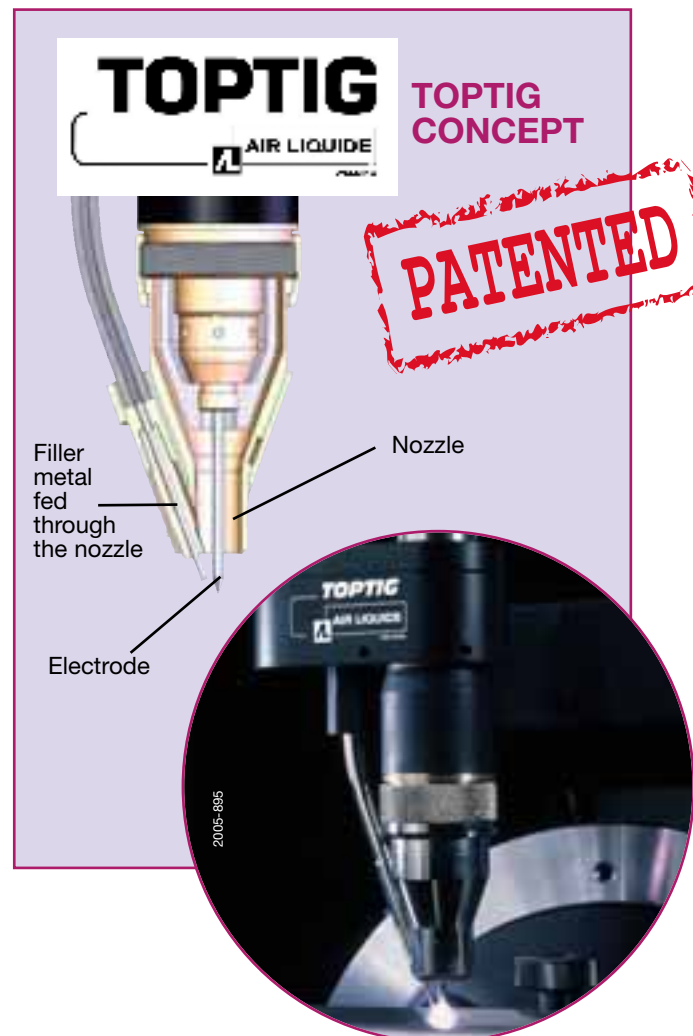
TOPTIG unique torch design

In addition to assuring good welding performance, the TOPTIG torch compactness simplifies the parameter adjustment and the robot trajectory programming. Actually, the TOPTIG torch is practically as compact as a MIG torch, and guarantees a good access angle. In addition, the torch permits multidirectional travelling which is faster, easier to program and relieves the 6th axe

of the robot. Electrode changing is simple and quick, and can be made manually or automatically, which improves the productivity of the installation.

TOPTIG high-performance solution

The TOPTIG torch is interfaced to a high-quality push-push wire feeder that provides the required feeding precision. According to the application and the necessary power, TOPTIG can be equipped with 2 dedicated power sources TOPTIG 220 A or NERTAMATIC 450 A, with a 180 A air cooled torch or a 350 A water-cooled torch.

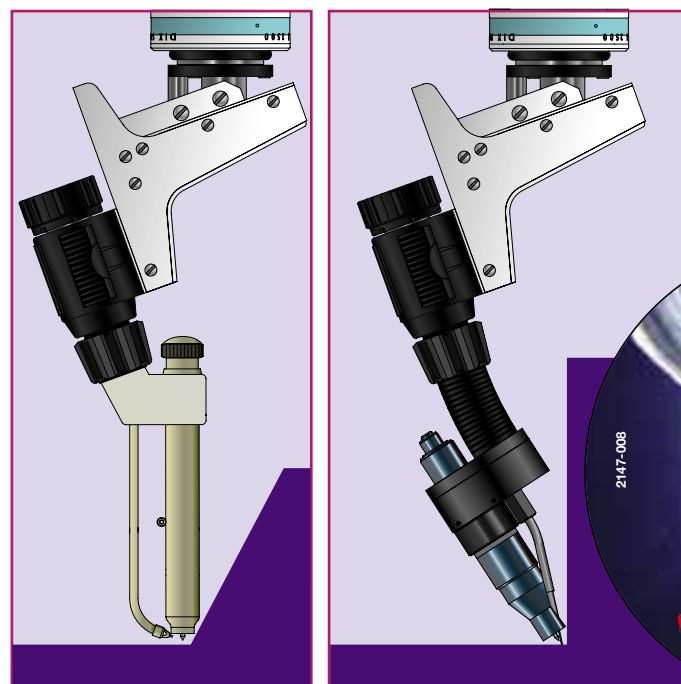


TOPTIG process advantages

The reasons for investment in robots or machines are: to increase productivity, to improve quality, to save costs, to remain competitive in the global market, to transfer laborious work from man to machine. TOPTIG is a productive and competitive robot process, and due to its welding quality and performance, TOPTIG can also replace some robotized and manual TIG applications.

TIG high quality welding and guaranteed spatter free

The absence of spatter is guaranteed by the major TOPTIG innovation: the filler metal is brought through the nozzle into the arc with an optimal angle and this helps to absorb energy and to prevent excessive heating and spattering. In addition the quality level avoids the finishing and cleaning stages after welding, that contributes to increase the global productivity of the robotized installation.



Conventional TIG torch

TOPTIG torch

Good global productivity

TOPTIG process allows a high travel speed which varies in accordance to the base metal, the thickness and the welding position. The automatic electrode changer option makes the TOPTIG installation fully automatized and increases the productivity still further.

Excellent appearance of the weld bead

Contrary to MIG, with the TOPTIG process, the welding current is not transferred through the wire, the welding current and the wire speed are controlled independently. This precise control of the energy guarantees a good weld bead appearance, allowing the HAZ to be reduced and avoiding distortion on thin sheets. Additionally, the synchronized pulsed wire function can give a wave appearance to the weld bead comparable to manual TIG welding.

Torch accessibility and simplified robot trajectories

The TOPTIG torch compactness gives accessibility and a good access angle. Welding is multidirectional, so the robot trajectories are simplified and the scope of robotization is widened. On classical robotic TIG torches, the filler metal is brought by an external cross and the wire is oriented with an angle close to 90° relative to the electrode. Moreover, the cross can only be positioned ahead of the torch and these features bring problems in terms of access, positioning and reliability.

Flexible solution and reasonable cost

TOPTIG is a flexible process that can be installed on a robot or on an automatic machine. Due to its welding performance, TOPTIG meets the most demanding industrial requirements for a reasonable investment cost.

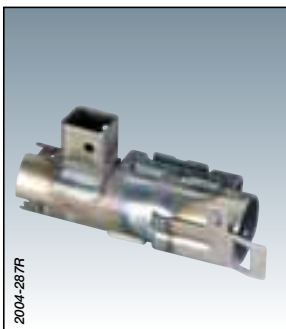
TOPTIG industrial applications



2008-134

TOPTIG process is an innovative solution that meets the most demanding industrial welding applications. Its performance is recognized in the automotive industry where manufacturers of components use TOPTIG for thin sheet welding. The boilermaking industry has various applications on carbon or stainless steel that require a high quality welding process. TOPTIG interfaced with a robot or with an automatic machine is perfectly appropriate for the modern industries of today.

Automotive industry



2004-287R

Steering columns

On carbon steel steering columns, the TOPTIG process guarantees good mechanical characteristics that are essential for the safety of car components.

In addition no spatter can be accepted inside mechanical components, which requires a spatter free process TOPTIG.

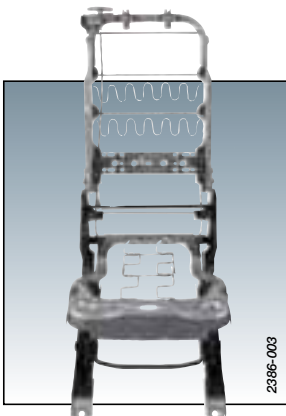


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Exhaust systems

TOPTIG is an appropriate process for exhaust manifolds, exhaust pipes or mufflers welding in carbon or stainless steel.

These applications do not tolerate spatter that could cause surface deterioration and engine damage.



2386-003

Seats frames and mechanisms

The automotive seat is a product in constant evolution meeting many constraints such as safety and weight reduction.

TOPTIG process avoids distortion on seat sliding rails which must be thin but sturdy.

Boilermaking industry



2008-131

Water heater tank

TOPTIG process permits productivity to be increased compared to a classical TIG robotized solution.

Due to multidirectional travelling the robot trajectories are simplified and the branch connections welding is easier.



1311-024

Barrels

TOPTIG process interfaced with an automatic machine is particularly well adapted for the manufacturing of stainless steel food barrels.

The weld bead shape is constant with a good appearance.



2386-002

Stainless steel components for the nuclear industry

The compactness of the torch allows good access notably for root penetration. These applications must be free from cracks or porosity, in accordance with TOPTIG process quality.

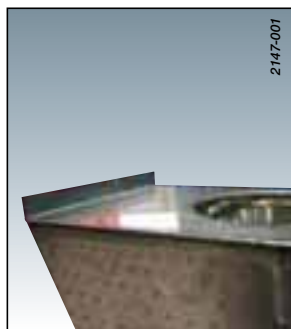
The metal joinery and furniture industries are robotizing their welding processes with a higher level of quality. With the TOPTIG process, the finishing work after welding can be minimised, in order to increase productivity. Aeronautic and aerospace are fields of activity where specifications and constraints are very strict. TOPTIG performance on Titanium and Nickel alloys is fully compatible with criteria such as mechanical stress, fatigue resistance and corrosion.

Metal joinery and furniture industry



Electrical cabinets

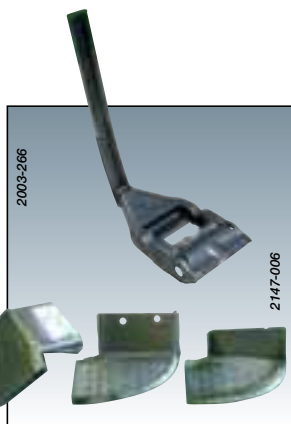
TOPTIG proves all its performance on these thin thickness carbon steel applications. No spatter guaranteed permits the painting of the cabinet directly after welding.



Stainless steel sinks

Appearance and colour of the weld bead and distortion are fundamental quality criteria for this type of production.

TOPTIG process gives both the TIG quality and the aesthetic demanded.

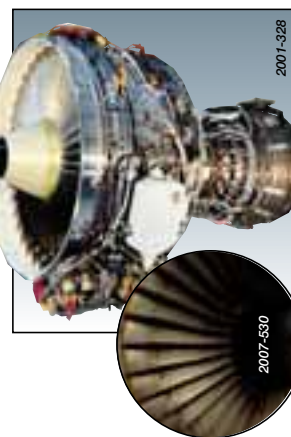


Furniture

TOPTIG process has a good acceptance of tolerance assembling which is a constraint in mass produced goods.

Nevertheless, the quality level is not sacrificed, neither the weld bead appearance.

Aeronautic and aerospace industry



Turbojet engine compressor blades or exhaust nozzle

A modern turbojet engine is composed of 40% Titanium alloys and 40% Nickel alloys on which TOPTIG gives excellent results. In manufacturing and repair, welding is a challenge to eliminate micro-fissuring, centre-line cracking or solidification cracking.



Landing gear or airplane frame parts


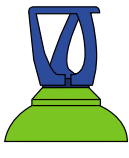


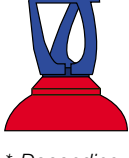

Weight reduction is a major challenge on modern airplanes. Titanium is recognized for its high strength-to-weight ratio and corrosion resistance but requires a high quality welding process TOPTIG.




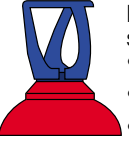



TOPTIG torch installed on a robot via an anti-collision device.

TOPTIG performance


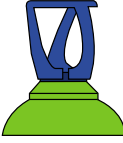

TOPTIG process is recognized for its welding quality and its flexibility and answers a wide field of industrial applications. The performance tables give indicative travel speeds with the TOPTIG process according to the material, the thickness, the joint configuration and gap, and recommends the most suitable gas. Using pulsed-synchronized wire or weaving robot trajectories allows the gap to be increased notably on thin sheets.


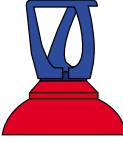

TOPTIG welding performance on carbon Steel							
Joint configuration	Gap (mm)	Operating window**				Recommended Gas EN 439	
		0.8 mm	1.0 mm	2.0 mm	3.0 mm		
Lap joint 	0	1.0 m/min.	1.2 m/min.	1.0 m/min.	0.6 m/min.	 For carbon* steel: • ARCAL 1 (Ar) / I1 • ARCAL 32 (Ar + He) / I3 • ARCAL 37 (Ar + He) / I3	
	0.5		1.0 m/min.	0.9 m/min.	0.6 m/min.		
T joint 	0	1.0 m/min.	1.2 m/min.	1.0 m/min.	0.5 m/min.		
	0.5		1.0 m/min.	0.5 m/min.	0.5 m/min.		
Corner joint 	0	0.8 m/min.	1.5 m/min.	1.2 m/min.	0.5 m/min.		 For carbon* steel: • ARCAL 10 (Ar + H ₂) / R1
	0.5		1.3 m/min.	0.9 m/min.	0.5 m/min.		
Butt joint 	0	0.8 m/min.	0.8 m/min.	0.6 m/min.	0.5 m/min.		
	0.5		0.6 m/min.	0.5 m/min.	0.4 m/min.		




* Depending on cracking susceptibility.
 - yes: Ar or Ar + He
 - no: Ar or Ar + H₂

TOPTIG welding performance on stainless steel						
Joint configuration	Gap (mm)	Operating window**				Recommended Gas EN 439
		0.8 mm	1.0 mm	2.0 mm	3.0 mm	
Lap joint 	0	1.2 m/min.	1.5 m/min.	1.5 m/min.	0.9 m/min.	 For austenitic stainless steel: • ARCAL 10 (Ar + H ₂) / R1 • ARCAL 11 (Ar + He + H ₂) / R1 • ARCAL 15 (Ar + H ₂) / R1
	0.5	0.6 m/min.	1.2 m/min.	1.3 m/min.	0.8 m/min.	
	1		1.0 m/min.	1.2 m/min.		
T joint 	0	1.0 m/min.	1.0 m/min.	0.7 m/min.	0.5 m/min.	
	0.5		0.8 m/min.	0.5 m/min.	0.5 m/min.	
Corner joint 	0	1.0 m/min.	1.2 m/min.	0.8 m/min.	0.5 m/min.	
	0.5		1.0 m/min.	0.5 m/min.	0.5 m/min.	
Butt joint 	0	1.4 m/min.	1.2 m/min.	1.0 m/min.	0.5 m/min.	
	0.5	1.2 m/min.	1.0 m/min.	0.6 m/min.		

Air Liquide Welding gives its customers the benefit of its expertise whether it is for welding robots or machines, for consumables or gas. Its experience in Welding processes can help you to choose the best solution that will allow high quality production with high productivity.

TOPTIG welding performance on Titanium Superalloys (TA6V)						
Joint configuration	Gap (mm)	Operating window**				Recommended Gas EN 439
		0.8 mm	1.0 mm	2.0 mm	3.0 mm	
Butt joint 	0	1.0 m/min.	0.6 m/min.	0.4 m/min.	-	 <ul style="list-style-type: none"> • ARCAL 1 (Ar) / I1
	0.5	-	0.5 m/min.	0.4 m/min.	-	
Lap joint 	0	1.0 m/min.	0.8 m/min.	0.5 m/min.	-	
	0.5	-	-	0.4 m/min.	-	

TOPTIG welding performance on Inconel Superalloys (718)						
Joint configuration	Gap (mm)	Operating window**				Recommended Gas EN 439
		0.8 mm	1.0 mm	1.5 mm	2.0 mm	
Butt joint 	0	-	0.9 m/min.	1.1 m/min.	1.2 m/min.	 <ul style="list-style-type: none"> • ARCAL 10 (Ar + H₂) / R1 • ARCAL 11 (Ar + He + H₂) / R1 • ARCAL 15 (Ar + H₂) / R1 • ARCAL 1 (Ar) / R1 (thin sheet)
	0.5	-	0.4 m/min.	0.8 m/min.	0.9 m/min.	
Lap joint 	0	-	0.9 m/min.	1.1 m/min.	1.0 m/min.	
	0.5	-	-	0.8 m/min.	0.7 m/min.	

TOPTIG weld-brazing performance on Electro-Galvanized Coated Steel						
Joint configuration	Gap (mm)	Operating window**				Recommended Gas EN 439
		0.8 mm	1.0 mm	2.0 mm	3.0 mm	
Lap joint 	0	1.5 m/min.	1.7 m/min.	1.5 m/min.	-	 <ul style="list-style-type: none"> • ARCAL 10 (Ar + H₂) / R1 • ARCAL 10 Cu (Ar+H₂+CO₂) / M11 • ARCAL 32 (Ar + He) / I3 • ARCAL 1(Ar) / I1 (thin sheet)
	0.5	1.0 m/min.	1.2 m/min.	1.0 m/min.	-	
T joint 	0	-	1.0 m/min.	1.2 m/min.	-	
	0.5	-	0.8 m/min.	1.0 m/min.	-	

** The travel speed data indicated in the operating windows are only for information. Using weaving robot trajectories allows the gap to be increased notably on thin sheets.

Welding consumables

Air Liquide Welding offers a wide range of wires packaged on spools and also in drums for increased machine autonomy. Every industrial application can be met with the various grades of wire available in steel, stainless steel and alloys.



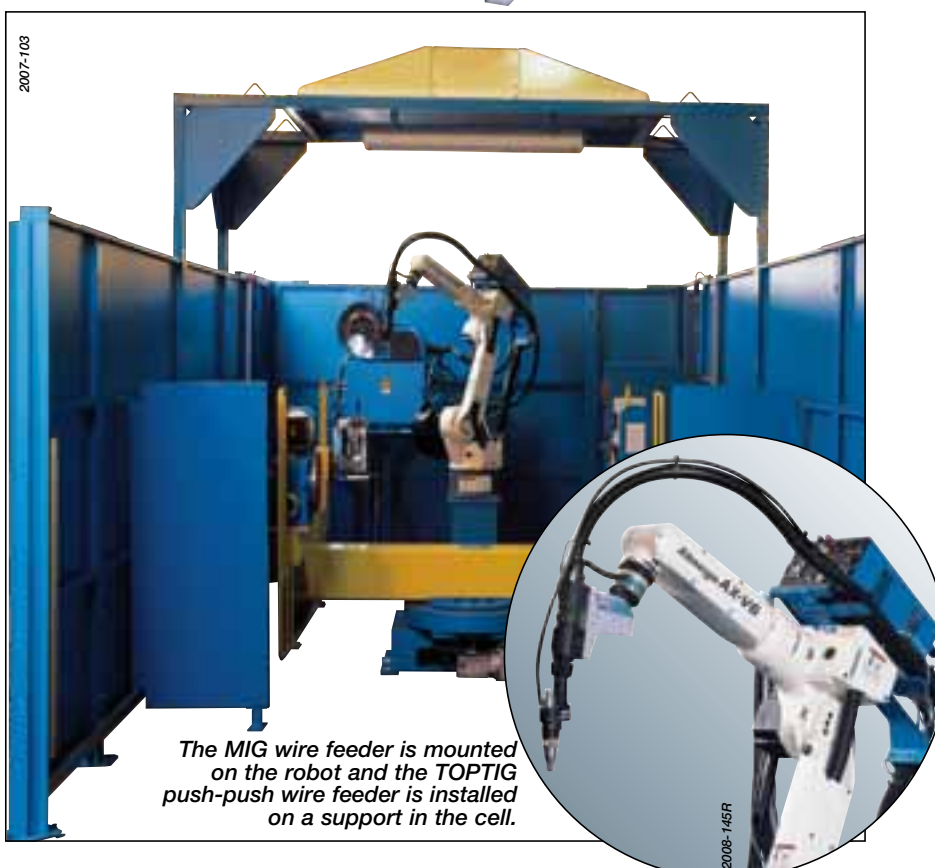
TOPTIG solutions

Air Liquide Welding has a significant experience in robotic arc welding and the TOPTIG process is an integral part of its new robotics range. Dual and Senior TOPTIG turnkey cells can be delivered within short delivery times, and Major cells or special machines are also proposed in the range. If flexibility is required, bi-process TOPTIG-MIG solutions with manual or automatic torch changing will avoid the need to invest in dedicated robots.



Dual TOPTIG platform

This Dual cell has 2 working stations (700 x 1000 mm - 100 kg) and is dedicated to small parts to be welded in a fixed position. This turnkey compact platform has a small footprint (2300 x 3200 mm) and is designed to be moved by fork-lift truck. Despite its small dimensions, this robot cell includes a TOPTIG power source and wire feeder, an automatic electrode changer, and a fume filtration system.



The MIG wire feeder is mounted on the robot and the TOPTIG push-push wire feeder is installed on a support in the cell.

Major bi-process TOPTIG / MIG platform with automatic electrode changer

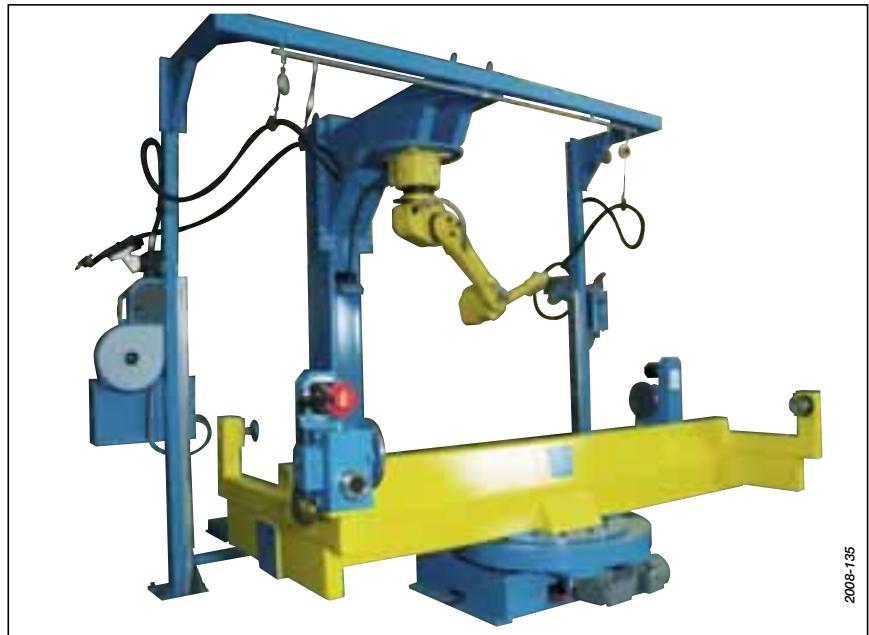
This Major cell has 2 turning working stations (1000 x 1600 mm - 250 kg) and is dedicated to parts to be welded in position with 2 robot external axes. Due to its design (5600 x 3600 mm), this platform can be moved by fork-lift truck. This bi-process platform includes a TOPTIG equipment with automatic electrode changer, a MIG DIGI@WAVE or CITOWAVE power source and is equipped with a fume filtration system. The TOPTIG automatic electrode changer allows the productivity to be significantly increased.

Air Liquide Welding has a real know-how in automatic welding notably in SAW, MIG-MAG, TIG and Plasma. These processes can be implemented on mechanized machines, on column and boom configurations or on seamer solutions. Due to its flexibility and its simplicity, the TOPTIG process can be interfaced to various machines and meets many applications that require quality welding and productivity.

Major bi-process TOPTIG / MIG platform with automatic torch changer

This Major cell with hanged robot has 2 turning working stations (1200 x 3000 mm - 500 kg) and is dedicated to parts to be welded in position with 2 robot external axes. This bi-process platform includes a TOPTIG equipment and a MIG DIGI@WAVE or CITOWAVE equipment. TOPTIG and MIG torches are changed automatically and this multipurpose configuration gives a high flexibility and productivity.

The hanged robot changes automatically the TOPTIG or the MIG torch.



TOPTIG automatic machine with 2 working stations

TOPTIG can be interfaced to an automatic machine and is particularly efficient for circular weld beads. TOPTIG power source and welding machine are synchronized in order to guarantee the quality, the shape, and the appearance of the weld bead.



TOPTIG equipment

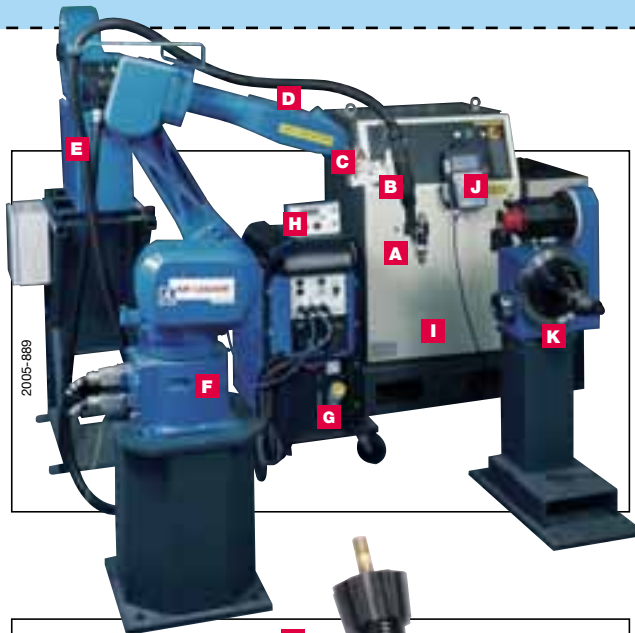


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To optimise the TOPTIG process, the torch is interfaced to a push-push high-quality wire feeder which guarantees the precision of the wire feeding. In order to prevent damage in case of a trajectory error, the torch is installed via an anti-collision device. Depending on the application and the welding current, an air-cooled or water-cooled torch nozzle, the size of the electrode and the appropriate wear parts can be chosen.

TOPTIG Installation

- A** TOPTIG torch
- B** Torch support
- C** Anti-collision device
- D** Harness L 5 m
- E** Wire feeder with spool support
- F** Welding robot



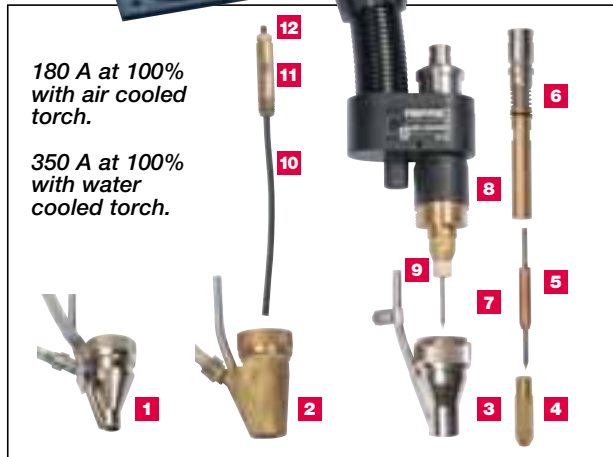
- G** TOPTIG 220 DC power source
- H** Remote control
- I** Robot bay
- J** Robot teach pendant
- K** Tooling

TOPTIG push-push wire feeder

The complete push-push wire feeder system includes the spool support with slave feeding equipment, the electronic card driver, the 5 m harness, the anti-collision device, the torch support and the master head micro-motor.

180 A at 100%
with air cooled
torch.

350 A at 100%
with water
cooled torch.



TOPTIG torch accessories

- 1** Small water-cooled nozzle
- 2** Water-cooled nozzle
- 3** Standard air-cooled nozzle
- 4** Electrode screw
- 5** Electrode clamp
- 6** Electrode holder
- 7** Electrode
- 8** Torch body
- 9** Insulating part
- 10** Sheath
- 11** Wire guide
- 12** Sheath clamp

TOPTIG torch	To order
TOPTIG torch	W 000 236 883
Electrode holder	W 000 236 884
Insulating cap	W 000 237 307
Electrode tool	W 000 236 882
Wire guide tool	W 000 237 326
Ext. sheath 2.2 int. L 10 m	W 000 266 066

Standard air-cooled nozzle	To order
Air-cooled nozzle	W 000 263 430

Heavy duty water-cooled nozzle	To order
Water-cooled nozzle	W 000 263 431
PVC hose 4 x 8	08000279
Male tip hose D4	Z00366502
Autolink water-cooled device only for TOPTIG 220 power source	W 000 260 761

Wire feeder system	To order
Wire feeder with 5 m harness	W 000 050 037

Clamp and electrodes	To order
Tungsten welding electrodes D 2.4	92579190
Electrode clamp 2.4 mm	W 000 236 885
Tungsten welding electrodes D 3.2	92579191
Electrode clamp 3.2 mm	W 000 236 886
Tungsten welding electrodes D 4	92579192
Electrode clamp 4.0 mm	W 000 236 887

Wire feeder	To order
Wire guide 0.8 mm L 30 mm	W 000 267 694
Roller DV-04 steel 0.8 mm	W 000 260 942
Roller MEP steel 0.8 mm	W 000 260 944
Wire guide 1.0 mm L 30 mm	W 000 267 695
Roller DV-04 steel 1.0 mm	W 000 263 425
Roller MEP steel 1.0 mm	W 000 263 426
Wire guide 1.2 mm L 30 mm	W 000 267 696
Roller DV-04 steel 1.2 mm	W 000 260 943
Roller MEP steel 1.2 mm	W 000 260 945

TOPTIG process is interfaced as standard to a TOPTIG 220 power source, and the NERTAMATIC 450 is the heavy duty solution that supplies higher current. The electrode changer driven automatically avoids any manual intervention when replacing the electrode, thus improving the productivity of the installation. The distance between the torch and the work piece can be automatically managed with the AVC option.

TOPTIG 220 DC



TOPTIG 220 DC supplies 220 A at 100% duty cycle with flat or pulsed current. It can drive a constant or pulsed wire feeding which is synchronized with the welding current. The RC-JOB permits a complete welding cycle to be programmed. Programs selection and chaining is done by analog signals.

NERTAMATIC 450



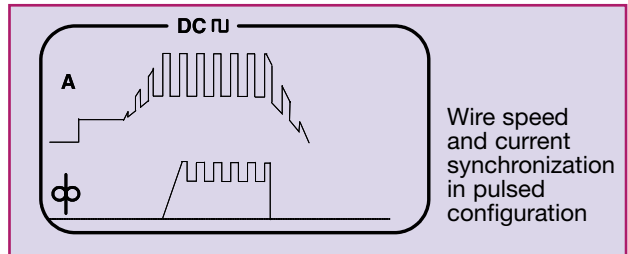
NERTAMATIC 450 supplies 450 A at 100% duty cycle with flat or pulsed current. It can drive a constant or pulsed wire feeding which is synchronized with the welding current. The console permits a complete welding cycle to be programmed. Program selection is done by binary code, and program chaining by pulse.

Programs selection

In robotized welding, it is recommended to attribute a welding program to each weld bead. That permits independent adjustment of the parameters which guarantees a better welding quality. TOPTIG 220DC and NERTAMATIC 450 can store 100 welding programs and can also chain several programs for the same weld bead.

Electrode changer

Especially designed for TOPTIG, the electrode changer permits an improvement to the global productivity of the installation. The electrode changing cycle lasts 20s, and this system avoids any manual intervention during production, and allows the electrodes, to be sharpened off-line.



PATENTED



6 electrodes cylinder for the electrode changer

Power source TOPTIG 220 DC	To order
TOPTIG 220 power source	W 000 237 633
TOPTIG 220 RC-JOB	W 000 055 077
TOPTIG harness L 5 m	W 000 257 596
Synchro pulse wire option	W 000 267 812
Power source N450 robot DC	To order
N450 DC robot pack	W 000 270 262
REFRISAF GR5 mono 230 V/50 Hz	93577300
FREEZCOOL	W 000 010 168
TOPTIG Factory control	To order
TOPTIG factory control	W 000 260 434
TOPTIG electrode changer	To order
TOPTIG electrode changer	W 000 260 742
TOPTIG electrode holder (5 pi.)	W 000 236 884
Electrode clamp 3.2 mm (5 pi.)	W 000 236 886
Electrode clamp 4.0 mm (5 pi.)	W 000 236 887
Torch adjustment gauge	To order
Torch adjustment gauge	W 000 263 139
Tungsten electrodes sharpening device	To order
Sharpening TIG tungsten electrodes	W 000 011 035
Option sharpening for 4.0, 4.8 electrodes sharpening TIG red head	W 000 011 037

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