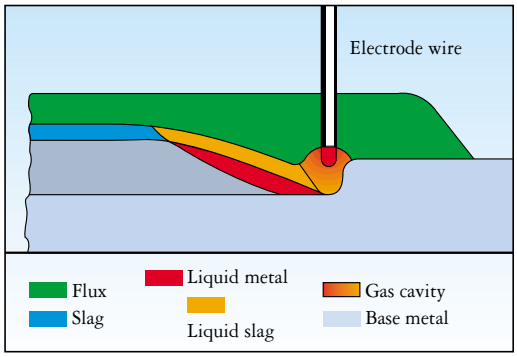
SUBMERGED ARC

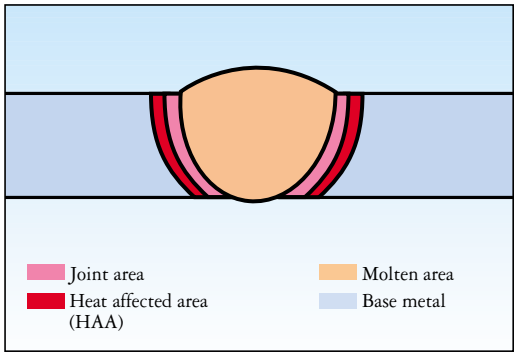
Automatic welding and hard surfacing.

AIR LIQUIDE WELDING

THEORY

The electric arc welding process in which the arc is submerged in an electrically conductive flux is mainly used by automatic welding machines. It joins the workpieces by simultaneously melting their edges and one or more electrode wires supplying filler metal. The energy required is produced by passing an electric current between electrodes and workpieces through a special medium. This medium is a slag produced by melting a powder flux in which the end of the electrode wire, the arc and the weld pool arc submerged.





In industry, the process is used only for welding and hard surfacing workpieces made from alloy or low-alloy carbon steel, stainless steel or refractory steel.

Submerged arc : automatic welding and hard surfacing process combining productivity, quality and operator comfort.

Main features

Submerged arc welding derives many advantages from its unique characteristics. They include :

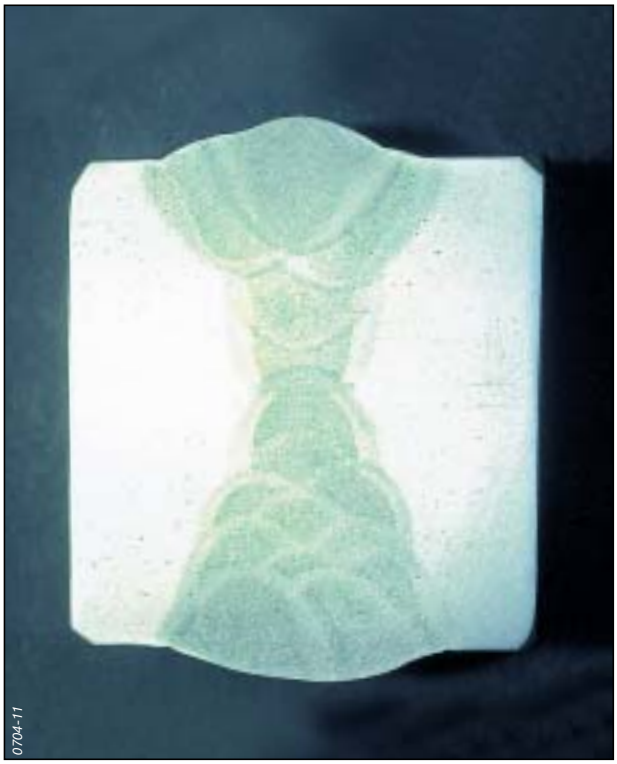
- high speed of execution due to the use of high currents in one or more electrode wires,
- low cost, the quantity of filler metal being often much lower than with other welding processes,
- high penetrating power significantly reducing or even eliminating the need for bevelling,
- little distortion,
- very good weld appearance,
- the arc is concealed, enabling the operator to work without a mask and without disturbing others nearby,
- no smoke,
- the process covers a very varied range of applications : welding of thin plate, welding of thick plate, welding of mild, alloy and stainless steel, hard surfacing and maintenance work,
- excellent compactness of welds,
- with appropriate products (wire/flux combinations), welds have excellent mechanical characteristics.

Limitations of the process

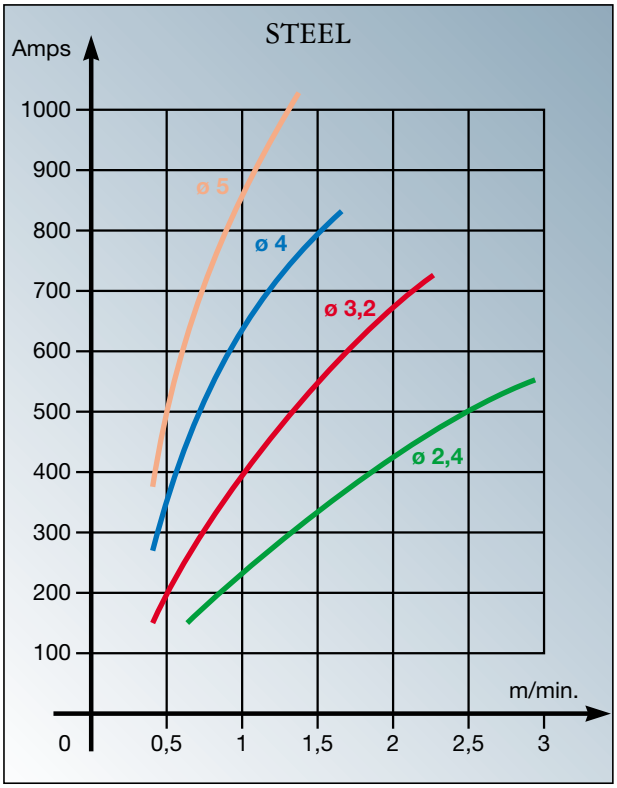
- solid flux submerged arc welding can be used only on alloy and non-alloy carbon steel, stainless and refractory steel,
- the use of a powder flux means that welds must be executed horizontally, unless special measures are taken,
- the process cannot weld plate less than 1.8 mm thick (due to its high penetration),
- it is not possible to butt joint workpieces more than 16 mm thick ; thicknesses greater than 16 mm require special preparation (bevelling).

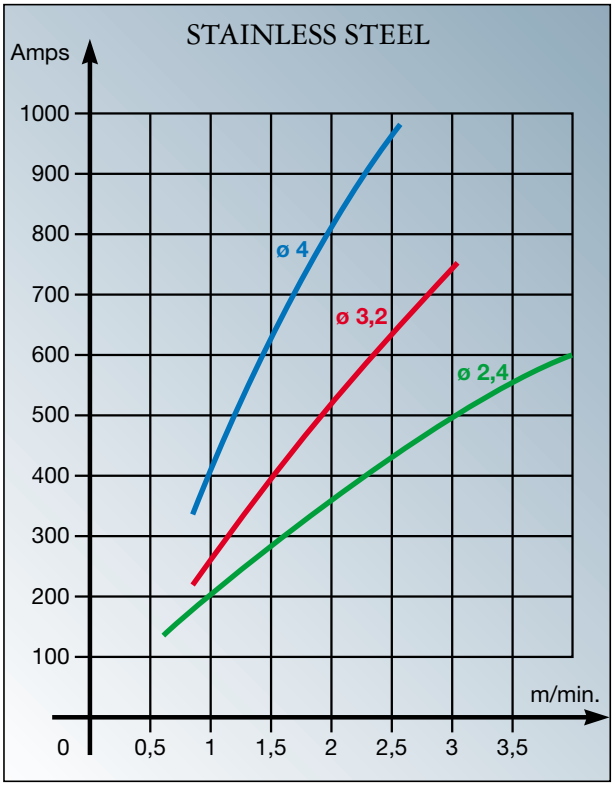
This process combines productivity, quality and operator comfort with :

- excellent weld compactness,
- good mechanical characteristics,
- high penetration,
- fast execution speed,
- good weld appearance,
- absence of spatter and smoke,
- high duty cycle.



Wire melting curves





Nozzle/workpiece distance = 7 x wire diameter

A wide range of applications

Heavy duty pressure vessels.

Shipbuilding.

All-welded structures.

Beam fabrication for steels structures.

Off-shore engineering.

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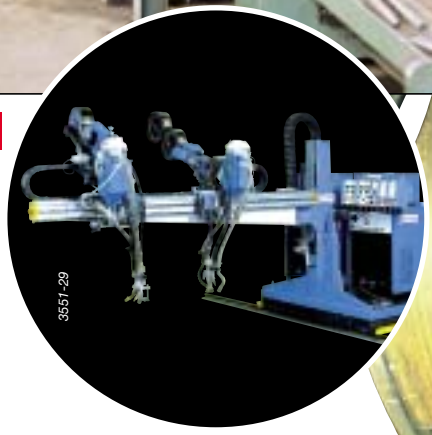

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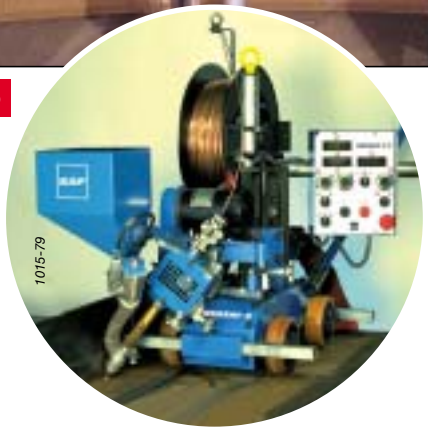

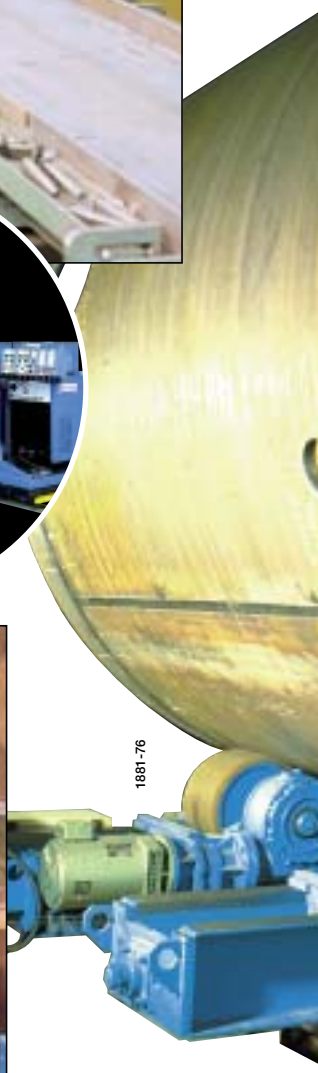

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5

1 *Welded plate beams of constant or varying cross-section can be made of lightweight materials, at lower cost, better matched to the loads applied and longer lasting than rolled sections.*

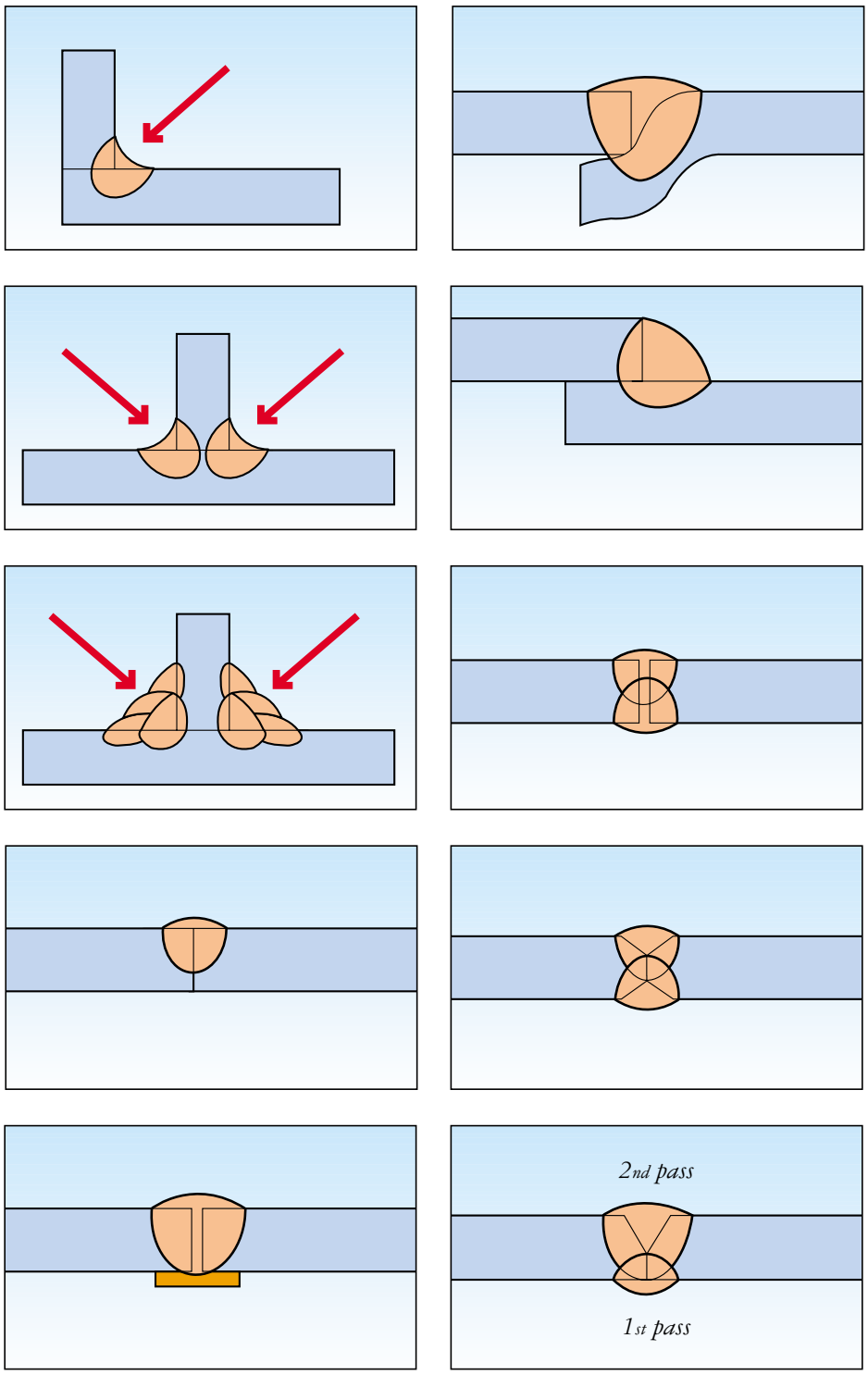
2 *Hard surfacing railroad rolling stock wheels using one electrode (single-wire) or two electrodes (twin-arc).*

3 *Single-wire welding of various all-welded structures.*

4 *Single-wire multipass welding of large cylinders (thickness ≥ 20 mm).*

5 *All types of submerged arc welding for shipbuilding (carriage-mounted equipment).*

Typical welded joints



SAF listens
to what you have
to say and then
guides
you towards
“the most
rational solution”

Automatic submerged arc welding and hard surfacing

With many years of experience in welding, and submerged arc welding in particular, SAF offers you two automatic submerged arc welding and hard surfacing installations :

- **SUBARC 3,**
- **SUBARC 5.**

A complete range of high-performance equipment using microprocessor technology to combine performance, flexibility of use and guaranteed high reliability in welding cycle management.
These installations cater for all possible modes of operation :

- direct current,
- alternating current,
- direct current + alternating current (tandem-arc).

With SUBARC 3 :

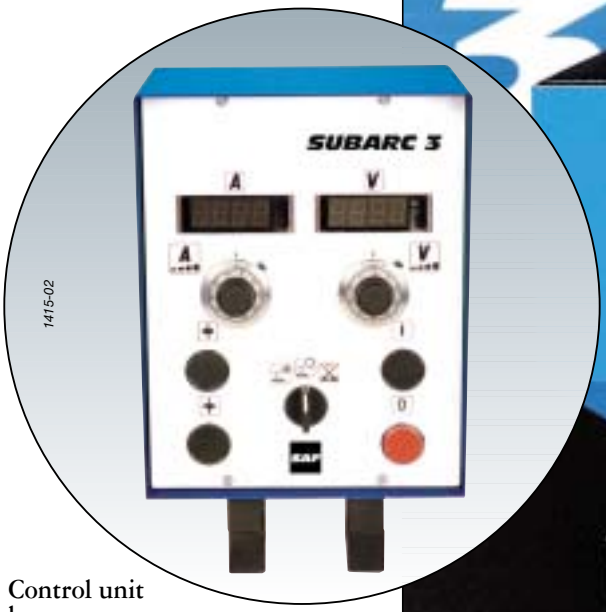
- single-wire or tandem-wire DC welding depending on power source characteristic (flat slope and drooping).

With SUBARC 5 :

- single-wire or tandem-wire DC welding depending on power source characteristic (flat slope and drooping),
- single-wire AC welding with drooping characteristic power source,
- DC single-wire + AC tandem-arc welding.

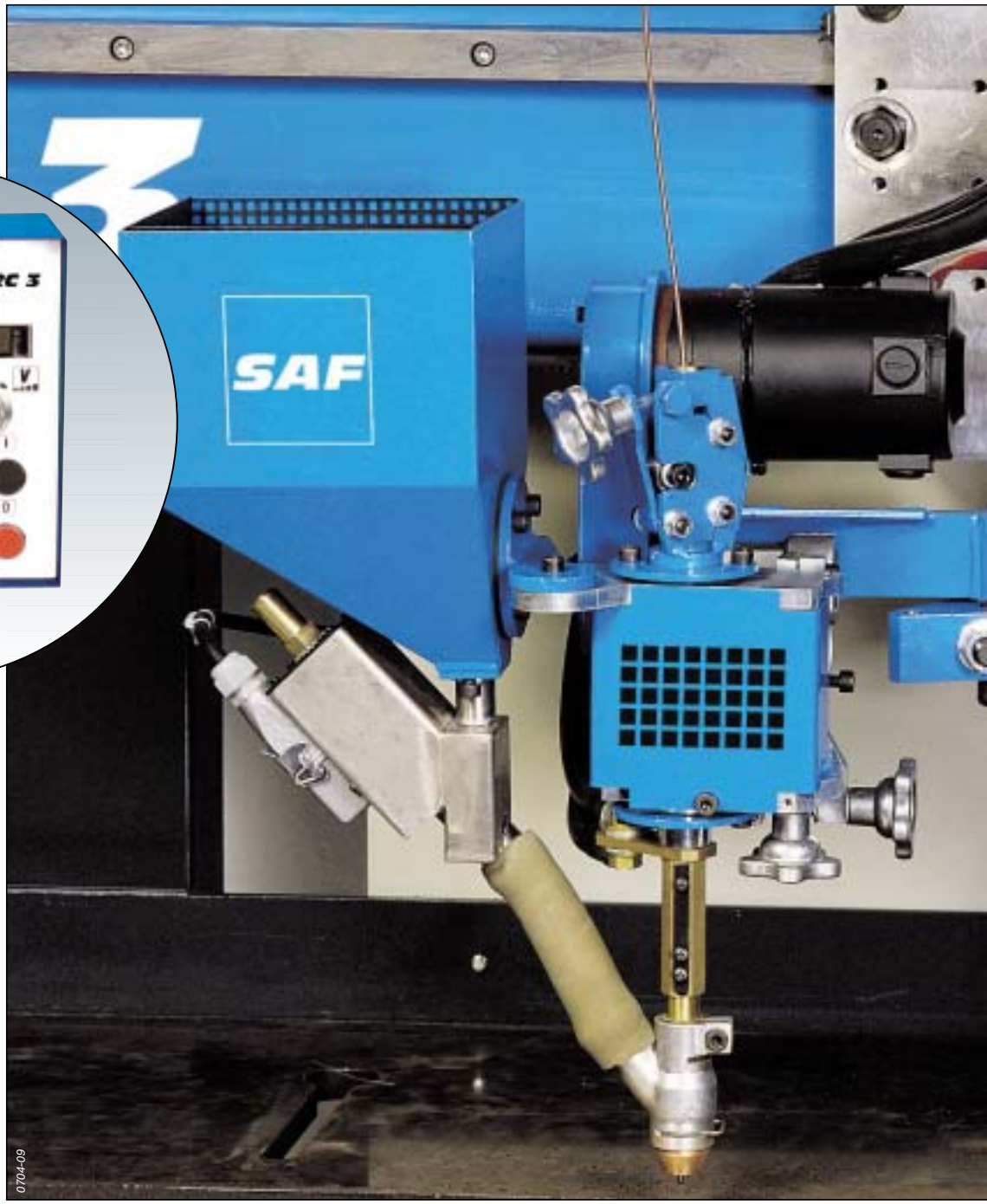
SUBARC 3

A compact installation for DC welding or hard surfacing depending on power characteristics (flat or drooping), combining the optimum operating point with great flexibility in terms of electrical parameters at all settings.



Control unit box

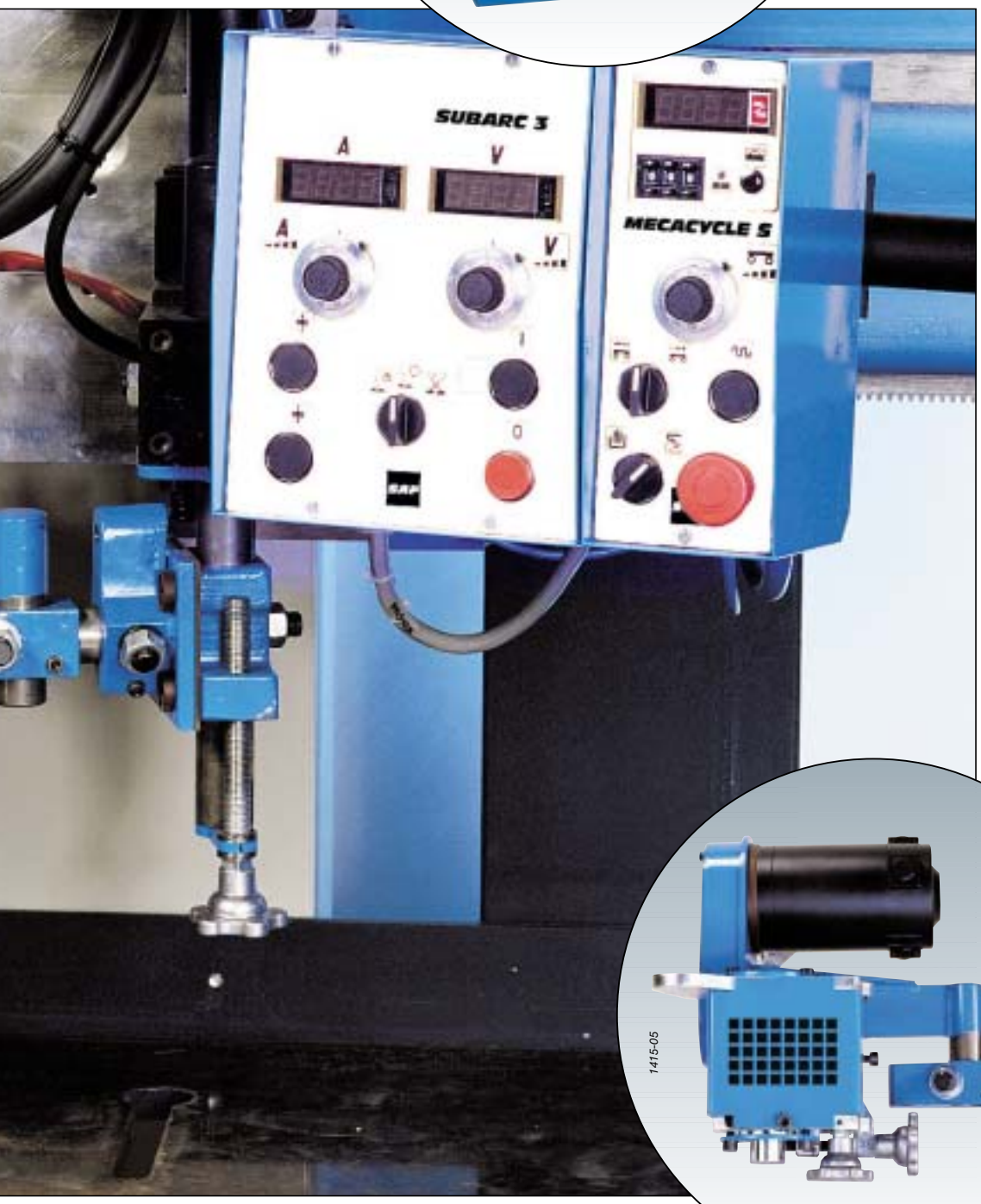
- Rugged and user friendly controls (containing no sensitive electronics, the control console can be located near the welding point).
- Ten-turn potentiometers for precise adjustment of current and voltage parameters.
- Storage and read-out on digital displays of welding current and voltage.



Installation including the single-movement MECACYCLE S welding head assembly drive module (9120-9817) .

Power unit box

- The controls for configuring the installation are all on the front panel of the power module.
- Cycle timing controls (crater fill, burn-off control, etc) raising of the wire after arc extinction, etc).
- Fixes to the top of the power source away from "sensitive" areas of the installation (near the arc).



DEVIMATIC D X 3
wire feed unit
MOTOR/GEARBOX

- A simple, rugged and very compact mechanical assembly that is easy to configure to suit your application.
- Low-voltage (42 V) motor and wire feed unit cover guarantee total operator safety.

SUBARC 5

For the most demanding users, a compact welding and hard surfacing installation offering :
• SUBMERGED ARC welding :
- direct current : flat or drooping power source characteristics
- alternating current : drooping power source characteristic
• MIG/MAG welding (spray-arc transfert)
SUBARC 5 allows accurate presetting and preselection of the actual welding current and voltage parameters for excellent arc striking every time.

Control unit box

- Rugged, simple and user friendly controls.
- Digital read-out of three parameters : current, voltage and wire speed.
- Presetting of voltage and welding current.
- Storage and read-out on digital displays of welding current and voltage.
- Wire/workpiece short-circuit detection and display in manual wire feeding mode minimizes mechanical stresses on wire feed head supports.

Installation completed with the movement + cycle MECACYCLE M drive module (9120-9805) for moving the welding head assembly in a predefined cycle.

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Power unit box

- All the controls for configuring the installation are accessible on the front panel of the power module.
- Full control of all welding cycle time-delays.
- Welding process selector (SUBMERGED ARC or MIG/MAG).
- Fixes to the top of the power source away from "sensitive" areas of the installation (near the arc).

DEVIMATIC D X 5 wire feed unit motor/gearbox

- A tachogenerator driven by the wire feed motor guarantees very accurate welding control.
- A simple and rugged mechanical assembly that is easy to configure to suit your application.
- Fine adjustments for all degrees of freedom in rotation allow easy adjustment of the point at which the wire impinges on the workpiece.

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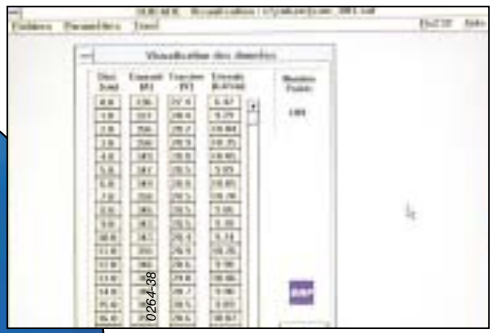
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Software for analysis and recording of welding parameters (option).

The installation can be completed by software for the analysis and recording of the welding parameters (current, voltage). This software is compatible with all PC's equipped with a minimum of WINDOWS 3.1.
A screen display of the weld pass permits visualisation of the upper and lower parameter limits together with the other welding variable (wire & flux types, wire and welding speeds etc...).
Two screen displays for the visualisation of the parameters are available;
The first provides the trace of both current and voltage for each weld pass, the second provides a display of the welding data: current, voltage and energy for each measurement point.
After welding it is possible to print these recorded parameters.
(QA fabrication traceability).

STARMATIC
power sources

- *Rugged,*
- *reliable,*
- *proof against aggressive industrial environments,*
- *fan cooled,*
- *fitted with thermal cut-out,*
- *easy to move using crane or forklift,*
- *quick connection to the core of the installation by simple and accessible connectors,*
- *remote controlled.*

Designation

STARMATIC 650 DC
STARMATIC* 1003 DC
STARMATIC* 1303 DC
STARMATIC 1003 AC/DC

Four power ratings are available for two different operating modes: DC or AC

- *AC/DC operation:*
  remote controllable thyristor based power sources:
  STARMATIC 1003 AC/DC:
  1000 A duty cycle at 100 %.

- *DC operation:*
  remote controllable thyristor based power sources:
  - STARMATIC 650 DC:
    650 A duty cycle at 100 %.
  - STARMATIC 1003 DC:
    1000 A duty cycle at 100 %.
  - STARMATIC 1303 DC:
    1300 A duty cycle at 100 %.

STARMATIC 1003 AC/DC
Nr 9114-0620

STARMATIC 650 DC
Nr 9114-0768

STARMATIC 1003 DC
Nr 9114-0630

Technical specifications

Duty cycle at 100 %	Primary power supply*	Primary current at 100 % duty cycle (400 V supply)	Power at 100 % duty cycle	External-static Characteristics flat	drooping	Protection	Insulation	Weight
650 A under 44 V	230-400-440 V 50-60 Hz three-phase	73 A	34,5 kVA	■	■	IP 21	H	247 kg
1000 A under 44 V	400-440 V 50-60 Hz three-phase	95 A	65,8 kVA	■	■	IP 23	H	394 kg
1300 A under 44 V	400-440 V 50-60 Hz three-phase	145 A	99 kVA	■	■	IP 23	H	483 kg
1000 A under 44 V	400 V 50 Hz three-phase	143 A	98 kVA	■	■	IP 21	H	540 kg

**230 V three-phase, 50 or 60 Hz power supply for STARMATIC 1003 DC, 1003 AC/DC and 1303 DC available to order.*

STARMATIC 1303 DC
Nr 9114-0640

Tools

Wire lead-in

The straight and curved wire lead-ins are fitted with nozzles which have unusually high resistance to wear, giving them a long service life. Their shape and dimensions cover virtually all applications without special adaptations. They can be equipped with straight or curved extensions.

Straight wire lead-in

single-wire with shoe

Nr 9111-0454

twin-wire

Nr 9111-0457

Curved wire lead-in 35°

single-wire

Nr 9111-0456

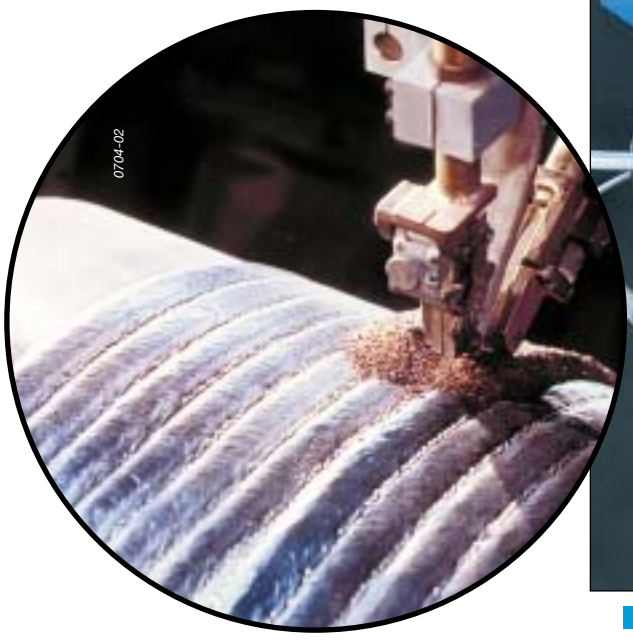
twin-wire

Nr 9111-0458

Flux recovery equipment

A compact unit which reduces significantly manual refilling of the flux feed hopper using a venturé powered by compressed air (5 to 7 bar).

Nr 9109-5145



Optional extras

6 programs control unit

Allows memorisation
for 6 different setting
(current, voltage
and welding speed).
Very practical for fabrications
requiring multi-pass welds.

Nr 9109-5375

Spot light guidance device

The light spot device
projects an illuminated
cross ahead
of the electrode wire.
This shows the point
of impact of the electrode
wire relative to the joint
on the workpiece.

Nr 9111-3052

Steel strip head

Allows feeding of steel strip
from 25 to 80 mm wide,
for hard surfacing
of various workpieces.

Nr 9111-0474

Proportionnal
SENSORTRACK

Traditional operation

Allows the welding head to follow
a joint trajectory thanks
to a seam-tracking finger which runs
on the workpiece. Its control function
provides a correction speed slaved
to the amount of deformation
of the sensing finger.
This technology provides an excellent
seam-following function
(without disruption of the welding arc)
on joints having both large
and rapid variation.

Characteristics

- For use with welding processes
  MIG-MAG or Submerged Arc
  in both internal and external angles
  with plates for fillet, or, butt welding
  with edge bevel.
- Minimum plate thickness = 5 mm
  without tacks.
- A modular system which provides
  both for mono-axis or bi-directional
  tracking without limitation
  of axis travel.
- Option which ignores the presence
  of tacks during welding
  and automatically stops the sensing
  function and the end of the workpiece.
- Electrical supply
  = 42V - 10A - 50/60 Hz.
- Maximum displacement speed
  of motorised axis = 3 m/min.
- Maximum tracking speed = 1 m/min.
- Sensing precision = ± 0.2 mm.
- External control possible for full
  automatic operation (by automate).

Imagine what your performance could be

AIR LIQUIDE WELDING

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