(EN)

INSTRUCTION MANUAL

WARNING! BEFORE USING THE WELDING MACHINE READ THE INSTRUCTION MANUAL CAREFULLY.

1. GENERAL SAFETY CONSIDERATIONS FOR ARC WELDING

The operator should be properly trained to use the welding machine safely and should be informed about the risks related to arc welding procedures, the associated protection measures and emergency procedures.
(Please refer to the applicable standard "EN 60974-9: Arc welding equipment. Part 9: Installation and Use).

- **Avoid direct contact with the welding circuit: the no-load voltage supplied by the welding machine can be dangerous under certain circumstances.**
- **When the welding cables are being connected or checks and repairs are carried out the welding machine should be switched off and disconnected from the power supply outlet.**
- **Switch off the welding machine and disconnect it from the power supply outlet before replacing consumable torch parts.**
- **Make the electrical connections and installation according to the safety rules and legislation in force.**
- **The welding machine should be connected only and exclusively to a power source with the neutral lead connected to earth.**
- **Make sure that the power supply plug is correctly connected to the earth protection outlet.**
- **Do not use the welding machine in damp or wet places and do not weld in the rain.**
- **Do not use cables with worn insulation or loose connections.**

- **Do not weld on containers or piping that contains or has contained flammable liquid or gaseous products.**
- **Do not operate on materials cleaned with chlorinated solvents or near such substances.**
- **Do not weld on containers under pressure.**
- **Remove all flammable materials (e.g. wood, paper, rags etc.) from the working area.**
- **Provide adequate ventilation or facilities for the removal of welding fumes near the arc; a systematic approach is needed in evaluating the exposure limits for the welding fumes, which will depend on their composition, concentration and the length of exposure itself.**
- **Keep the gas bottle (if used) away from heat sources, including direct sunlight.**

- **Use adequate electrical insulation with regard to the electrode, the work piece and any (accessible) earthed metal parts in the vicinity. This is normally achieved by wearing gloves, shoes, head coverings and clothing designed for this purpose and by using insulating platforms or mats.**
- **Always protect your eyes with the relative filters, which must comply with UNI EN 169 or UNI EN 379, mounted on masks or use helmets that comply with UNI EN 175.**
  Use the relative fire-resistant clothing (compliant with UNI EN 11611) and welding gloves (compliant with UNI EN 12477) without exposing the skin to the ultraviolet and infrared rays produced by the arc; the protection must extend to other people who are near the arc by way of screens or non-reflective sheets.
- **Noise: If the daily personal noise exposure (LEPd) is equal to or higher than 85 dB(A) because of particularly intensive welding operations, suitable personal protective means must be used (Tab. 1).**

- **The flow of the welding current generates electromagnetic fields (EMF) around the welding circuit.**

Electromagnetic fields can interfere with certain medical equipment (e.g. Pace-makers, respiratory equipment, metallic prostheses etc.).
Adequate protective measures must be adopted for persons with these types of medical apparatus. For example, they must be forbidden access to the area in which welding machines are in operation.
This welding machine conforms to technical product standards for exclusive use in an industrial environment for professional purposes. It does not assure compliance with the basic limits relative to human exposure to electromagnetic fields in the domestic environment.

The operator must adopt the following procedures in order to reduce exposure to electromagnetic fields:
- **Fasten the two welding cables as close together as possible.**
- **Keep head and trunk as far away as possible from the welding circuit.**
- **Never wind welding cables around the body.**
- **Avoid welding with the body within the welding circuit. Keep both cables on the same side of the body.**
- **Connect the welding current return cable to the piece being welded, as close as possible to the welding joint.**
- **Do not weld while close to, sitting on or leaning against the welding machine (keep at least 50 cm away from it).**
- **Do not leave objects in ferromagnetic material in proximity of the welding circuit.**
- **Minimum distance d= 20 cm (Fig. I).**

- **Class A equipment:**

This welding machine conforms to technical product standards for exclusive use in an industrial environment and for professional purposes. It does not assure compliance with electromagnetic compatibility in domestic dwellings and in premises directly connected to a low-voltage power supply system feeding buildings for domestic use.

EXTRA PRECAUTIONS

- **WELDING OPERATIONS:**
  - **In environments with increased risk of electric shock**
  - **In confined spaces**
  - **In the presence of flammable or explosive materials**

  MUST BE evaluated in advance by an "Expert supervisor" and must always be carried out in the presence of other people trained to intervene in emergencies.
  All protective technical measures MUST be taken as provided in 7.10; A.8; A.10 of the applicable standard EN 60974-9: Arc welding equipment. Part 9: Installation and Use".
- **The operator MUST NOT BE ALLOWED to weld in raised positions unless safety platforms are used.**
- **VOLTAGE BETWEEN ELECTRODE HOLDERS OR TORCHES: working with more than one welding machine on a single piece or on pieces that are connected electrically may generate a dangerous accumulation of no-load voltage between two different electrode holders or torches, the value of which may reach double the allowed limit.**
  An expert coordinator must be designated to measuring the apparatus to determine if any risks subsist and suitable protection measures can be adopted, as foreseen by section 7.9 of the applicable standard "EN 60974-9: Arc welding equipment. Part 9: Installation and Use".

RESIDUAL RISKS

- **IMPROPER USE: it is hazardous to use the welding machine for any work other than that for which it was designed (e.g. de-icing mains water pipes).**
- **Do not use the handle to hang the welding machine.**

2. INTRODUCTION AND GENERAL DESCRIPTION

This welding machine is a power source for arc welding, made specifically for direct current (DC) .
The specific characteristics of this regulation system (INVERTER), i.e. high speed and precise regulation, mean the welding machine gives excellent results when welding both with coated electrodes (rutile, acid, basic).
Regulation with the "inverter" system at the input of the power supply

line (primary) means there is a drastic reduction in the volume of both the transformer and the levelling reactance. This allows the construction of a welding machine with extremely reduced weight and volume, enhancing its advantages of easy handling and transportation.

ACCESSORIES SUPPLIED ON REQUEST:
- MMA welding kit.
- TIG welding kit.

3. TECHNICAL DATA
DATA PLATE
The most important data regarding use and performance of the welding machine are summarised on the rating plate and have the following meaning:

Fig. A

1- Protection rating of the covering.
2- Symbol for power supply line:
1~: single phase alternating voltage;
3- Symbol **S**: indicates that welding operations may be carried out in environments with heightened risk of electric shock (e.g. very close to large metallic volumes).
4- Symbol for welding procedure provided.
5- Symbol for internal structure of the welding machine.
6- EUROPEAN standard of reference, for safety and construction of arc welding machines.
7- Manufacturer's serial number for welding machine identification (indispensable for technical assistance, requesting spare parts, discovering product origin).
8- Performance of the welding circuit:
- **U_0 :** maximum no-load voltage.
- **I_2/U_2:** current and corresponding normalised voltage that the welding machine can supply during welding
- **X :** Duty cycle: indicates the time for which the welding machine can supply the corresponding current (same column). It is expressed as %, based on a 10 minutes cycle (e.g. 60% = 6 minutes working, 4 minutes pause, and so on)**.**
If the usage factors (on the plate, referring to a 40°C environment) are exceeded, the thermal safeguard will trigger (the welding machine will remain in stand-by until its temperature returns within the allowed limits).
- **A/V-A/V:** shows the range of adjustment for the welding current (minimum-maximum) at the corresponding arc voltage.

9- Technical specifications for power supply line:
- **U_1:** Alternating voltage and power supply frequency of welding machine (allowed limit ±10%):
- **$I_{1\,max}$:** Maximum current absorbed by the line.
- **I_{1eff}:** effective current supplied.

10- ⎓ **:** Size of delayed action fuses to be used to protect the power line.
11- Symbols referring to safety regulations, whose meaning is given in chapter 1 "General safety considerations for arc welding".

Note: The data plate shown above is an example to give the meaning of the symbols and numbers; the exact values of technical data for the welding machine in your possession must be checked directly on the data plate of the welding machine itself.

OTHER TECHNICAL DATA
- **WELDING MACHINE:**
  - see table 1 **(TAB.1)**
  - %USE AT 20°C (if present on the top cover of the welding machine) USE AT 20°C, it gives, for each diameter (Ø ELECTRODE), the number of weldable electrodes within an interval of 10 minutes (ELECTRODES 10 MIN) at 20°C with a pause of 20 seconds for each electrode change; this datum is given also in percentage (%USE) which is the value in comparison with the maximum number of weldable electrodes.
- **ELECTRODE HOLDER CLAMP: see table 2 (TAB.2)**

The weight of the welding machine is given in the table 1 (TAB.1)

4. DESCRIPTION OF THE WELDING MACHINE
The unit is comprised of power modules which have been developed on a specially printed circuit designed to maximise reliability and reduce maintainance.

Fig. B

1- Power supply input (1~), rectifier group and balancing capacitors.
2- Transistors and drivers switching bridge (IGBT).
It turns the mains rectified voltage into high frequency alternate voltage and permits power regulation according to the current/voltage of the weld to be done.
3- High frequency transformer: the primary windings are fed by the voltage converted by Block 2, it has the function of adapting voltage and current to the values required by the arc welding procedure and, simultaneously, isolates the welding circuit from the mains.
4- Secondary rectifier bridge with inductance: this changes the alternate voltage/current supplied by the secondary windings into continuous current/voltage at a low wave-length.
5- Electronic and regulation board: this instantly checks the value of the welding current against that selected by the user, it modulates the commands of the IGBT drivers, which control Regulation. Determines the dynamic response of the current while the electrode melts (instantaneous short circuits), and supervises the safety systems.

CONTROL, ADJUSTMENT AND CONNECTION DEVICES WELDING MACHINE

at the front:

Fig. C

1- Encoder (1) selection and adjustment of the welding parameters; it enables adjustment even during welding.
Operating modes and parameters:
- First function on short press of encoder (1):
In MMA selection and setting of ARC "Arc Force" HOT "Hot Start" and I_2 "output current".
- Second function on prolonged press of encoder (1):
After prolonged pressing, selection takes place via encoder (1) among MMA, MMA VRD and TIG LIFT cyclically with flashing indication on the display (2) of the mode.
To exit this adjustment procedure, encoder pressing is necessary.

Hot Start (on display "HOt"):
Adjustment parameter of the initial overcurrent (adjustment 0-100%); the display shows the percentage increase as to the value of the pre-selected welding current. This adjustment facilitates the electric arc strike.
Arc Force (on display "Arc"):
Adjustment parameter of the dynamic overcurrent (adjustment 0-100%); the display shows the percentage increase as to the value of the pre-selected welding current. This setting improves welding fluidity and prevents the electrode from sticking to the metal piece.
VRD (on display "VRD"):
Reduction device of the loadless output voltage (on-off selection) with indication on the display (2). The VRD device is enabled if the "VRD" icon appears on the display, the device is not active without the icon.
This device increases operator safety when the welding machine is on but not in the welding mode.
RESET PARAMETERS:
For this specific function, you can access it keeping the encoder (1) pressed during start-up of the welding machine (with main switch closure).
Switching on and keeping the encoder selection (1) pressed, the Reset mode activates and RES OFF is displayed, rotating the encoder (1) you alternatively select ON / OFF.
You can exit this selection/setting by prolonged pressing the encoder selection (1), confirming selection of Reset and therefore with start-up of the board.
Instead, with a single, short press of the encoder selection (1), you enter the setting menu of the current ranges where you can set the current reduction class (CL1 high current, CL2 low current), rotating the encoder (1) you alternatively select CL1/CL2.
To confirm and start the board, prolonged press the encoder selection (1).

2- Display:
:
It indicates output voltage on quick couplings (3) and (4).

Alarm icon " ALARM ": normally off, when on it indicates the welding machine is blocked (the machine remains on without supplying power) due to intervention of one of the following guards:
- **Protection against line overvoltage:** the voltage is outside the range +/- 15% compared to the plate value. Alarm on display **"AL.3"**.
- **Protection against line undervoltage:** the voltage is outside the range +/- 15% compared to the plate value. Alarm on display **"AL.4"**.

ATTENTION: Exceeding the upper limit, stated above, will seriously damage the device.
- **ANTI STICK protection:** the electrode is stuck to the material to

weld, you can remove it manually.
Resetting to normal is automatic.

- **Alarm icon "** ALARM **" + thermal protection icon "** **":** an excess temperature has been reached inside the welding machine. Resetting to normal operation is automatic. Alarm on display **"AL.2"**.

3- **Negative (-) quick coupling** for connecting the welding cable.
4- **Positive (+) quick coupling** for connecting the welding cable.

Back panel

Fig. D

1- Mains cable with E.E.C. 2p plug + (⏚).
(For the "DUAL VOLTAGE AUTOMATIC" model the cable has no plug).
2- General luminous switch O/OFF - I/ON.

5. INSTALLATION

WARNING! CARRY OUT ALL INSTALLATION OPERATIONS AND ELECTRICAL CONNECTIONS WITH THE WELDING MACHINE COMPLETELY SWITCHED OFF AND DISCONNECTED FROM THE POWER SUPPLY OUTLET.
THE ELECTRICAL CONNECTIONS MUST BE MADE ONLY AND EXCLUSIVELY BY AUTHORISED OR QUALIFIED PERSONNEL.

PREPARATION

Unpack the welding machine, assemble the separate parts contained in the package.

Assembling the return cable-clamp
Fig. E

Assembling the welding cable-electrode holder clamp
Fig. F

HOW TO LIFT THE WELDING MACHINE

All the welding machines described in this manual must be lifted using the handle.

POSITION OF THE WELDING MACHINE

Choose the place to install the welding machine so that the cooling air inlets and outlets are not obstructed (forced circulation by fan, if present); at the same time make sure that conductive dusts, corrosive vapours, humidity etc. will not be sucked into the machine.
Leave at least 250mm free space around the welding machine.

WARNING! Position the welding machine on a flat surface with sufficient carrying capacity for its weight, to prevent it from tipping or moving hazardously.

CONNECTION TO THE MAIN POWER SUPPLY

- Before making any electrical connection, make sure the rating data of the welding machine correspond to the mains voltage and frequency available at the place of installation.
- The welding machine should only be connected to a power supply system with the neutral conductor connected to earth.
- To ensure protection against indirect contact use residual current devices of the following types:
  - Type A ( ) for single phase machines;
  - Type B ( ) for 3-phase machines.
- To comply with the requirements of the EN 61000-3-11 (Flicker) standard we recommend connecting the welding machine to interface points of the power supply that have an impedance of less than:
  Zmax = 0.17 ohm (200A).
- the welding machine does not fall within the requisites of IEC/EN 61000-3-12 standard.
  Should it be connected to a public mains system, it is the installer's responsibility to verify that the welding machine itself is suitable for connecting to it (if necessary, consult the distribution network company).
- Unless otherwise specified (MPGE), the welding machines are compatible with power generating sets for voltage oscillations up to ± 15%.
  For correct use, the power generating set must be brought to steady conditions before being able to connect the inverter.

- **PLUG AND OUTLET:**
  - **The 230V model** is fitted at the factory with a power supply cable and normalised plug, (2P + T) 16A/250V .
    It can therefore be connected to a mains outlet fitted with fuses or an automatic circuit-breaker; the special earth terminal should be connected to the earth conductor (yellow-green) of the power supply line.
    Table **(TAB.1)** shows the recommended delayed fuse sizes in amps, chosen according to the max. nominal current supplied by the welding machine, and the nominal voltage of the main power supply.
  - **For welding machines without a plug (115/230V models),** connect a normalised plug (2P + T) - having sufficient capacity- to the power cable and prepare a mains outlet fitted with fuses or an automatic circuit-breaker; the special earth terminal should be connected to the earth conductor (yellow-green) of the power supply line. Table **(TAB. 1)** shows the recommended delayed fuse sizes in amps, chosen according to the max. nominal current supplied by the welding machine, and the nominal voltage of the main power supply.

WARNING! Failure to observe the above rules will make the (Class 1) safety system installed by the manufacturer ineffective with consequent serious risks to persons (e.g. electric shock) and objects (e.g. fire).

CONNECTION OF THE WELDING CABLES

WARNING! BEFORE MAKING THE FOLLOWING CONNECTIONS MAKE SURE THE WELDING MACHINE IS SWITCHED OFF AND DISCONNECTED FROM THE POWER SUPPLY OUTLET.
Table **(TAB. 1)** gives the recommended values for the welding cables (in mm^2) depending on the maximum current supplied by the welding machine.

MMA WELDING

Almost all coated electrodes are connected to the positive pole (+) of the power source; as an exception to the negative pole (-) for acid coated electrodes.

WELDING OPERATIONS WITH DIRECT CURRENT

Connecting the electrode-holder clamp welding cable
On the end take a special terminal that is used to close the uncovered part of the electrode.
This cable is connected to the terminal with the symbol (+).

Connecting the welding current return cable
This is connected to the piece being welded or to the metal bench supporting it, as close as possible to the join being made.
This cable is connected to the terminal with the symbol (-).

Warnings:
- Turn the welding cable connectors right down into the quick connections (if present), to ensure a perfect electrical contact; otherwise the connectors themselves will overheat, resulting in their rapid deterioration and loss of efficiency.
- The welding cables should be as short as possible.
- Do not use metal structures which are not part of the workpiece to substitute the return cable of the welding current: this could jeopardise safety and result in poor welding.

6. MMA WELDING: PROCESS DESCRIPTION

- It is indispensable to refer to the electrode manufacturer's instructions regarding the correct polarity and the optimal welding current (generally, these instructions are outlined on the packaging of the electrodes).
- Welding current is regulated to suit the diameter of the electrode being used and the type of soldering to be performed; an example of the currents used for the various electrode diameters can be seen below:

Ø Electrode (mm)	Welding current (A)	
	min.	max.
1.6	25	50
2	40	80
2.5	60	110
3.2	80	160
4	120	200

- Remember that for the same diameter electrode, high levels of current will be used for flat welding, whilst lower current levels will be used for vertical or overhead welding.
- The mechanical characteristics of the welded joint are determined by the intensity of the selected current and also other welding parameters such as the length of the arc, the operating speed and position, the diameter and quality of the electrodes (to ensure correct conservation, use special packaging or containers to store and protect the electrodes against humidity).

Procedure:
- Keeping the mask IN FRONT OF YOUR FACE, rub the tip of the electrode on the piece to be welded, moving as if striking a match; this is the most correct method for igniting the arc.
  ATTENTION: DO NOT TAP the electrode against the workpiece, which could damage the coating and make arc striking difficult.
- As soon as the arc has struck, try to keep the electrode at a distance from the workpiece that is equivalent to the diameter of the electrode being used, and keep this distance as constant as possible while welding; remember that the electrode angle while moving forward must be approx. 20-30 degrees **(Fig. G)**.
- At the end of the welding seam, take the electrode end slightly back as to the forward direction, above the crater to fill it, then quickly lift the electrode from the weld pool to switch off the arc.

ASPECTS OF THE WELDING SEAM
Fig. H

TIG WELDING: PROCESS DESCRIPTION
TIG welding is a welding procedure that takes advantage of the heat produced by the electric arc which is struck, and maintained, between an infusible electrode (Tungsten) and the piece to weld. The Tungsten electrode is supported by a torch suitable for transmission of the welding current and protecting the electrode itself and the welding bath from atmospheric oxidation through an inert gas flow (normally Argon: Ar 99.5%) which exits the ceramic nozzle **(FIG. L)**.
TIG DC welding is suitable for all types of low-alloy and high carbon steel, and heavy metals such as copper, nickel, titanium and their alloys.
An electrode with 2% Cerium (grey band) is normally used for TIG DC welding with electrode at the (-) pole.
The tungsten electrode must be axially sharpened using a grinding wheel, see **FIG. M**; make sure the tip is perfectly concentric to prevent arc deviation. The electrode must be ground along its length. This operation must be repeated periodically according to the use and wear state of the electrode, or when the electrode itself has been accidentally contaminated, oxidised or used incorrectly.
For the welding to be good, the exact diameter of the electrode must be used with the exact current, see table **(TAB. 3)**.
The electrode normally projects from the ceramic nozzle by 2-3 mm, but can reach 8 mm for welding edges.
The weld is created by the edges that melt. Filler metal is not needed when welding suitably prepared thin material (up to about 1 mm) **(FIG. N)**.
A greater thickness requires rods made from the same material as the basic material and with a suitable diameter, with edges that have been suitably prepared **(FIG. O)**. For welding to be successful, the pieces must be carefully cleaned and free from oxide, grease, oil, solvent, etc.

Procedure (LIFT strike)
- Use the knob to adjust the welding current to the required rate; adjust this value during welding to adapt to the actual heat transfer required.
- Make sure the gas is flowing correctly.
  The arc ignites through contact, distancing the tungsten electrode from the workpiece. This strike mode causes less electric-irradiated disturbances and reduces tungsten inclusions and electrode wear to a minimum, rest the tip of the electrode on the piece, with light pressure and lift the electrode by 2-3mm with a few seconds delay, thereby obtaining arc strike. Initially, the welding machine supplies current I_{BASE} and after a few seconds, the welding current set will be supplied.
- Quickly lift the electrode from the workpiece to interrupt welding.

7. MAINTENANCE

WARNING! BEFORE CARRYING OUT MAINTENANCE OPERATIONS MAKE SURE THE WELDING MACHINE IS SWITCHED OFF AND DISCONNECTED FROM THE MAIN POWER SUPPLY.

EXTRAORDINARY MAINTENANCE
EXTRAORDINARY MAINTENANCE MUST ONLY BE CARRIED OUT BY TECHNICIANS WHO ARE EXPERT OR QUALIFIED IN THE ELECTRIC-MECHANICAL FIELD, AND IN FULL RESPECT OF THE IEC/EN 60974-4 TECHNICAL DIRECTIVE.

WARNING! BEFORE REMOVING THE WELDING MACHINE PANELS AND WORKING INSIDE THE MACHINE MAKE SURE THE WELDING MACHINE IS SWITCHED OFF AND DISCONNECTED FROM THE MAIN POWER SUPPLY OUTLET.

If checks are made inside the welding machine while it is live, this may cause serious electric shock due to direct contact with live parts and/or injury due to direct contact with moving parts.
- Inspect the welding machine regularly, with a frequency depending on use and the dustiness of the environment, and remove the dust deposited on the transformer, reactance and rectifier using a jet of dry compressed air (max. 10bar).
- Do not direct the jet of compressed air on the electronic boards; these can be cleaned with a very soft brush or suitable solvents.
- At the same time make sure the electrical connections are tight and check the wiring for damage to the insulation.
- At the end of these operations re-assemble the panels of the welding machine and screw the fastening screws right down.
- Never, ever carry out welding operations while the welding machine is open.
- After having carried out maintenance or repairs, restore the connections and wiring as they were before, making sure they do not come into contact with moving parts or parts that can reach high temperatures. Tie all the wires as they were before, being careful to keep the high voltage connections of the primary transformer separate from the low voltage ones of the secondary transformer.
  Use all the original washers and screws when closing the casing.

8. TROUBLESHOOTING
IN CASE OF UNSATISFACTORY FUNCTIONING, BEFORE SERVICING MACHINE OR REQUESTING ASSISTANCE, CARRY OUT THE FOLLOWING CHECK:
- Check that the welding current, which is regulated by the potentiometer with a graduated amp scale, is correct for the diamter and electrode type in use.
- Check that when general switch is ON the relative lamp is ON. If this is not the case then the problem is located on the mains (cables, plugs, outlets, fuses, etc.)
- Check that the yellow led (ie. thermal protection interruption- either over or undervoltage or short circuit) is not lit.
- Check that the nominal intermittance ratio is correct. In case there is a thermal protection interruption, wait for the machine to cool down, check that the fan is working properly.
- Check the mains voltage: if the value is too high or too low the welding machine will be stopped.
- Check that there is no short-circuit at the output of the machine: if this is the case eliminate the incovenience.
- Check that all connections of the welding circuit are correct, particularly that the work clamp is well attached to the workpiece, with no interferring material or surface-coverings (ie. Paint).
- Protective gas must be of appropriate type (Argon 99.5%) and quantity.