IMPORTANT SAFETY INFORMATION!!!

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE INSTALLATION, USE, OR SERVICING OF THIS UNIT. PAY CLOSE ATTENTION TO THE SAFETY RULES AND CONTACT YOUR DISTRIBUTOR IF YOU DO NOT UNDERSTAND SOME OR ALL OF THE POINTS COVERED IN THESE INSTRUCTIONS.

1 SAFETY RULES CONCERNING THE USE OF THIS WELDING MACHINE

1.1 INTRODUCTION

All people authorized to use this machine should read the following instructions manual before using or servicing this unit.

A REMINDER: YOUR SAFETY DEPENDS ON YOU!!! Always follow all safety regulations and instructions when using this machine. It is your responsibility to protect yourself and others against the risks related to the operation of this welding machine. The operator must be familiar with and observe all the safety rules regarding the safe operation and maintenance of this welding machine.

NOTHING REPLACES GOOD COMMON SENSE !!!

1.2 GENERAL PRECAUTIONS

1.2.1 Fire

Avoid causing fires due to sparks, slag, hot metal and spatter which are produced during normal welding operations.

Make sure that a suitable fire-extinguisher is located near the welding sight.

Do not weld containers (tanks or drums) containing flammable material, even when empty.

Allow the welded metal to cool down before touching it or putting it into contact with flammable material.

Do not weld structures with hollow spaces containing flammable substances.

Do not work in conditions where there are high concentrations of combustible vapours, gases, or flammable dust.

Always check the work area half an hour after welding so as to make sure that no fire has started.

Do not keep any flammable material such as lighters or matches in your pockets while using this equipment.

1.2.2 Burns

Protect your entire body by wearing fire-proof clothing. This will protect your skin against burns caused by ultraviolet radiation given off by the arc, sparks and molten slag.

The protective clothing should include: gloves, a hat, and high shoes. Your shirt collar and pocket flaps should be buttoned, and cuff-less trousers should be worn to prevent contact with sparks and molten slag.

Wear a helmet equipped with the appropriate lens shade and a clear glass cover plate. This is imperative when welding, cutting, and chipping to protect your eyes from ultra-violet arc rays and molten spatter. Replace the glass cover plate when cracked or covered with spatter etc.

Do not wear clothing spotted with oil or grease as a spark may set them on fire.

Hot metal, electrode stubs and workpieces, should never be handled without gloves.

First-aid equipment and a qualified first-aid person should always be available when welding, unless medical facilities are in the immediate vicinity, to treat flash burns of the eyes and skin burns.

Ear plugs should be worn when working in the overhead position or in confined spaces. A hard hat should be worn when others are working overhead.

Flammable hair sprays and gels should not be used by those persons intending to weld.

1.2.3 Fumes

Welding operations produce harmful fumes and metal dusts which may be hazardous to your health, therefore:

Work in well-ventilated areas.

Keep your head out of the fumes.

In closed areas, use a fume exhaust system, preferably placed under the welding area if possible.

If ventilation is inadequate, use an approved respirator set.

Clean the metal to be welded of any solvents or halogen degreasers which give rise to toxic gases. During some welding operations chlorine solvents may be decomposed by arc radiation thus creating phosgene gas.

Do not weld coated metals or those containing lead, graphite, cadmium, zink, chrome, quicksilver, or mercury unless you have an approved respirator set.

The electric arc creates ozone. Long exposures to high ozone concentrations may cause headaches, nasal, throat and eye irritation; as well as congestion and chest pains.

WARNING: NEVER USE OXYGEN FOR VENTILATION.

Gas leaks in confined spaces should be avoided. Leaked gas in large quantities can dangerously alter oxygen levels in the air surrounding the weld sight. Do not place gas cylinders in confined spaces.

DO NOT WELD where solvent vapors can be drawn into the welding shield atmosphere or where arc rays can come into contact with even minute quantities of trichloroethylene or perchloroethylene.

1.2.4 Explosions

Do not weld above or near containers under pressure.

Do not weld in environments containing explosive dusts, gases or vapours.

When this machine is used for MIG welding, one of the following gases or gas mixtures must be used to shield the arc: Carbon Dioxide, Argon, or Argon mixed with Oxygen. When using a shielding gas pay careful attention to the following:

A) GAS CYLINDERS

NEVER DEFACE or alter the name, number, or other markings on a cylinder. It is illegal and dangerous!

Do not use cylinders whose contents are not clearly identified.

Do not directly connect cylinder to the unit without using a pressure regulator.
1.2.6 Electric shock

Electric shocks are hazardous and potentially fatal!!
- Do not touch live electrical parts.
- Insulate yourself from the workpiece and the ground by wearing insulated gloves and clothing.
- Keep garments (gloves, shoes, hats, clothing) and body dry.
- Do not work in humid or wet areas.
- If you are welding near a body of water take precautions to ensure that the machine cannot fall into the water.
- Avoid touching or holding the workpiece by hand.
- Should you work in a dangerous area or close to one, use all possible precautions.
- Stop welding immediately if you should feel even the slightest sensation of electric shock. Do not use the machine until the problem is identified and corrected.
- Often inspect the mains input cable.
- Disconnect the power input cable from the mains supply before replacing cables or before removing the unit covers.
- Do not use the unit without protection covers.
- Always replace any damaged parts with GENUINE SPARE PARTS.
- Never disconnect any of the unit's safety devices.
- Electronic life support equipment (pacemakers) may cause disturbances. Persons wearing electronic life support equipment (pacemakers) should consult their doctor before going near any arc welding, gouging, cutting, or spot welding equipment in operation.

1.2.7 Pacemaker

Magnetic fields created by the high currents in the weld circuit can affect pacemaker operation. Persons wearing electronic life support equipment (pacemakers) should consult their doctor before going near any arc welding, gouging, cutting, or spot welding equipment in operation.

1.2.8 Noise

These power source alone do not produce noise levels exceeding 80 dB. The welding procedure, however, may produce noise levels in excess of 80 dB, in which case the machine operator must take the necessary safety precautions as prescribed by the national safety regulation.

2 GENERAL TECHNICAL DESCRIPTIONS

2.1 SPECIFICATIONS

This manual has been prepared with the intent of instructing the operator on how to install, operate, and properly maintain this electric arc welding machine. This machine is a constant voltage power source for MIG/MAG and OPEN-ARC welding. Upon receiving and unpacking the machine, make a careful inspection to ensure that there are no damaged parts. Should there be a claim for losses or damages it must be made by the purchaser directly to the shipper who handled the goods.

When requesting information about this welding machine please state the machine's part number and serial number to ensure receiving accurate information relating to your machine.

2.2 DESCRIPTION OF TECHNICAL SPECIFICATIONS

EC 974.1... This machine is manufactured according to the EN 60947.1 IEC 974 international standard.

N°. ............ Machine Serial Number which must appear on requests or inquiries concerning the machine.

Single-phase transformer-rectifier.

Flat characteristic.
3 INSTALLATION

3.1 SETUP

Place the machine in a ventilated area. Dust, dirt, or any other foreign material that might enter the machine may restrict the ventilation which could affect the machine’s performance. Keep the machine as clean as possible.

3.2 INPUT POWER CONNECTIONS

- All sections concerning the installation of this machine must be read carefully.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_0</td>
<td>Secondary no-load voltage</td>
</tr>
<tr>
<td>I_2</td>
<td>Output welding current</td>
</tr>
<tr>
<td>U_2</td>
<td>Secondary voltage with welding current I_2</td>
</tr>
<tr>
<td>U_1</td>
<td>Nominal supply voltage</td>
</tr>
<tr>
<td>X</td>
<td>Duty-Cycle Percentage</td>
</tr>
<tr>
<td>3~50/60 Hz</td>
<td>Three-phase input supply at 50 or 60 Hz</td>
</tr>
<tr>
<td>I_1</td>
<td>Input Amps absorbed corresponding to different output levels (I_2)</td>
</tr>
<tr>
<td>IP21</td>
<td>Protection class of the machine’s case</td>
</tr>
<tr>
<td>NOTE</td>
<td>This machine has also been designed to work in class 3 pollution areas (see IEC 664)</td>
</tr>
</tbody>
</table>

3.3 OUTPUT CONNECTIONS

3.3.1 Connecting the MIG torch.

- Depending on the operating conditions, use the shortest torch possible.
- Before connecting the torch, make sure that the wire liner has a diameter large enough for the wire that is going to be used:
  - Blue coated liner Ø 1.5 for Ø 0.8-1 mm wires,
  - Red coated liner Ø 2 for Ø 1-1.2 mm wires,
  - Yellow coated liner Ø 2.5 for Ø 1.2-1.6 mm wires,
- Check that the grooves of the drive rolls 57 of the wire feed motor 58 and the torch contact tip correspond to the diameter of the wire that is going to be used.
- Connect the torch to the torch terminal 53 tightening the ring nut until it is snug.
- Check that the inlet wire guide is not touching the roll of the
wire feed assembly, but is very close.

3.3.2 Connecting the work return lead clamp.
• Connect the male end of the work return lead to one of the impedance taps on the front panel of the machine. The impedance tap designated by the \( \overline{\text{K}} \) provides the maximum amount of impedance which will produce nicely filletted weld beads. This tap is recommended when welding aluminium, stainless steel, and carbon steels of binary or ternary composition. The impedance tap designated by the \( \overline{\text{K}} \) provides the least amount of impedance and is recommended when using carbon dioxide as a shielding gas to weld carbon steels, in the upwards vertical position, of binary or ternary composition.
• After having selected the proper impedance tap, attach the work return clamp to the work to be welded.
• Make sure that the ground clamp is tightly fastened to the work return cable and periodically check that this connection remains well tightened. A loose connection can cause weld current drops or overheating of the work return lead and clamp which, in turn, creates the risk of burns from accidental contact with the work return lead.
• The weld circuit must not be placed deliberately in direct or indirect contact with the ground conductor if it is not in the work to be welded.
• If the work to be welded is attached deliberately to the ground by a protection lead, then the connection must be the most direct possible and it must be done using a lead that has a cross section that is at least equal to the cross section of the work return lead being used for the weld circuit. The protection lead must also be attached to the work at the same spot as the work return lead. To do so, a second ground clamp, fitted to the protection lead, must be attached next to the ground clamp of the work return lead.

3.3.3 Connecting the gas hose.
WARNING!! CYLINDERS CAN EXPLODE IF DAMAGED
• Keep the cylinders in an upright position by chaining them to their support.
• Keep the cylinders in a place where they cannot be damaged.
• Do not lift the machine with the cylinder on its support.
• Keep the cylinder away from the welding area and uninsulated electric circuits.
• Cylinders containing inert gas have to be equipped with a pressure reducer and a flowmeter.
• After having positioned the cylinder, connect the gas hose that comes out from the rear of machine to the pressure reducer output.
• Regulate the gas flow to 8-10 l/min.

4 DESCRIPTION OF FEATURES

4.1 FRONT PANEL DESCRIPTION
A - Status light (white color)
This light indicates that the machine is on.
B- Status light (yellow color)
When lit up, this light indicates that the thermostat has tripped, thus shutting down the machine until it has sufficiently cooled down.
C- On/Off switch
This switch turns the machine on or off.
D- Rotary weld voltage switch
This switch selects the weld voltage setting. (Step adjustment)
E- Rotary weld voltage switch
This switch allows the fine tuning of the welding voltage selected with switch \( \overline{\text{D}} \). (Step adjustment)
F- Quick connect torch terminal
The welding torch is attached to this terminal.
G- Wire feed speed control.
This knob adjusts the wire feed speed.
H- Adjustment knob
This knob sets the weld time (arc on) when spot or intermittent welding has been selected with selector \( \overline{\text{L}} \).
I- Adjustment knob
This knob sets the rest time (arc off) between two weld times (arc on) when intermittent welding has been selected with selector \( \overline{\text{L}} \).
L- Weld function selection switch
This switch selects among the following functions:

\[
\downarrow \uparrow \quad \text{Manual welding cycle (2 step):}
\]
The machine begins welding when the torch trigger is pulled and stops welding when the torch trigger is released.

\[
\downarrow \uparrow \quad \text{Manual, intermittent welding cycle (2 step):}
\]
The machine begins welding when the torch trigger is pulled. The time of the intermittent welding cycle (arc on) is set by
knob H and the rest time (arc off) is set by knob I. The machine stops welding when the torch trigger is released.

Spot welding cycle:
The machine begins welding when the torch trigger is pulled. The time of the spot weld is set by knob H. When this time has expired the machine automatically stops welding, even if the torch trigger is still being pulled. To start a new spot welding cycle, the torch trigger must be released, the torch repositioned, and the torch trigger pulled again.

Automatic welding cycle (4 step)
The machine begins welding when the torch trigger is pulled. Once welding has begun, however, the torch trigger can be released. To stop welding, the torch trigger must again be pushed and then immediately released. This function is useful when welding for long periods of time because it helps reduce operator hand fatigue due to having to keep the torch trigger constantly pulled during normal manual welding operations.

Automatic intermittent welding cycle:
Welding begins when the torch trigger is pulled and released. The welding time (arc on) and the rest time (arc off) are set by knobs H and I. Welding stops when the torch trigger is again pulled and released.

M - Impedance Taps
Connect the male end of the work return lead to one of the two impedance taps.

5. WELDING

5.1 INSTALLATION AND STARTER
• Machine installation must be done by a competent staff. All connections must correspond to the rules in force (CEI 20-10 HD 427) and must respect laws concerning accidents.
• Check that the wire diameter corresponds to that indicated on the roll and mount the wire coil.
• Connect the pipe coming out of the rear side with the cylinder flowmeter.
• Position the welding machine so as to allow free air circulation inside it and avoid that metal or any other.

5.2 THE MACHINE IS READY TO WELD
• Connect the ground terminal to the part to be welded.
• Put the switch on I.
• Extract the conic gas nozzle by rotating it clockwise.
• Unscrew the current nozzle.
• Press the torch push-button and release it only when the wire comes out.
WARNING: Keep your face away from the terminal nozzle while the wire comes out.
• Screw the current nozzle again, making sure that the hole diameter be the same as that the wire used.
• Insert the welding conic gas nozzle by rotating it clockwise.
• Open the gas cylinder and adjust flowmeter at $8 \times 10$ l/min.
WARNING: Check that the gas used is compatible with the material to be welded.

5.3 WELDING CARBON STEELS.
To weld carbon steels the following things are necessary:
1) The use of a binary shielding gas which is most commonly Argon and Carbon dioxide, in a ratio of $75-80\%$ Argon and $25-20\%$ Carbon dioxide. Some applications, however, may require a mix of three gases: Argon, Carbon dioxide ($CO_2$), and dioxide ($O_2$). These gas mixtures generate heat during welding and as a result the weld bead will be well filleted and neat in appearance. The penetration, however, will not be deep.
The use of Carbon dioxide as the shield gas results in a narrow weld bead with deep penetration but the ionization of the gas will have an influence on arc stability.
2) The use of a filler wire of the same quality as the steel to
be welded. It is recommended that high quality wires be used and that welding with rusted wires be avoided because they can give rise to defects in the weld bead. Generally, the current range within which a wire can be used is calculated in the following manner:

\[
\begin{align*}
\text{Ø of wire} & \times 100= \text{minimum number of Amperes}. \\
\text{Ø of wire} & \times 200= \text{maximum number of Amperes}.
\end{align*}
\]

Practical example: 1.2 Ø wire= 120 Amps minimum and 240 Amps maximum.

These amperages are based on the use of an Argon/CO₂ mixture as the shield gas and welding in the Short Arc transfer mode.

3) Avoid welding on rusted work pieces or work having spots of oil and grease present on the surface.

4) The use of a welding torch suitable to the welding currents that are going to be used.

5) Periodically check that the two handles making up the ground clamp are not damaged and that the welding cables (torch cable and the work return lead) do not have any cuts or burn marks that would reduce their efficiency.

### 5.4 WELDING STAINLESS STEEL

Welding stainless steels in the 300 series (the austenitic series) must be done using a shield gas mixture of predominantly Argon with a small percentage of O₂ added to stabilize the arc. The recommended mixture is AR/O₂ in the ratio of 98/2. Do not use CO₂ or AR/CO₂ mixtures as the shield gas.

Do not touch the welding wire with your bare hands. The filler metal (the wire) must be of a higher quality than the work to be welded and the weld area must be clean.

### 5.5 WELDING ALUMINIUM

The following is required for aluminium welding:

1) 100% Argon as welding protection gas.

2) A torch wire of composition suitable for the basic material to be welded.

   - For ALUMAN welding wire 3.5% silicon.
   - For ANTICORODAL welding wire 3.5% silicon.
   - For PERALUMAN welding wire 5% magnesium.
   - For ERGAL welding wire 5% magnesium.

3) A torch prepared for aluminium welding.

If you only have a torch for steel wires, the same shall be modified in the following way:

- Make sure that length of torch cable does not exceed 118 inches (it is advisable not to use longer torches).
- Remove the brass sheath-holding nut, the gas and the current nozzles, then slip the sheath off.
- Insert the teflon sheath for aluminium and ensure it protrudes from both ends.
- Screw the current nozzle so that the sheath adheres to it.
- Insert the sheath holding nipple, the O-Ring in the free end of the sheath and secure with the nut without tightening too much.
- Slip the brass tube on the sheath and ensure both into the adapter (after removing the iron tube which was fitted inside the adapter).
- Cut the sheath diagonally so that it stays as close as possible to the wire slide roller.

4) Use drive rolls that are suitable for aluminium wire. The drive rolls, when being installed, must be tightened as tight as possible.

5) Use contact tips that are suitable for aluminium wire and make sure that the diameter of the contact tip hole corresponds to the wire diameter that is going to be used.

6) Use abrasive grinders and tool brushes specifically designed for aluminium. Never use these tools on other materials.

REMEMBER that cleanliness equals quality. The wire spools must be stored in plastic bags with a dehumidifier.

### 6 WELDING DEFECTS

1- **DEFECT- Porosity** (in, or on the surface of the weld bead)

**CAUSES**
- Bad wire (rust on the surface).
- Insufficient gas shielding due to:
  - Inadequate gas flow due to a block in the gas line.
  - Defective flowmeter.
  - Gas regulator covered with frost because a gas heater was not used to heat the CO₂ shielding gas.
  - Failure of gas valve solenoid.
  - Gas nozzle plugged up with spatter.
  - Gas flow holes plugged up.
  - Air drafts in the welding area.

2- **DEFECT- Shrinkage Cracks**

**CAUSES**
- Welding wire or work to be welded dirty or rusty.
- Weld bead too small.
- Weld bead too concave.
- Too much weld bead penetration.

3- **DEFECT- Lateral cracking**

**CAUSES**
- Welding speed too fast.
- Low current and high arc voltages.

4- **DEFECT- Too much Spatter**

**CAUSES**
- Voltage too high
- Insufficient impedance
- No gas heater used for CO₂ shielding gas.

### 7 MACHINE MAINTENANCE

**Gas nozzle**. Periodically clean the nozzle of all weld spatter that may have accumulated during welding operations. If the nozzle should become distorted or oval in shape then it must be replaced.

**Contact tip**. A good contact between the contact tip and the wire ensures a stable arc and optimal current output. Therefore, following steps must be followed:

A) The contact tip hole must be kept free of dirt or oxidation.
B) After lengthy welds, spatter can easily accumulate on the contact tip and prevent the wire from being fed. The contact tip must be cleaned regularly and if necessary it must be replaced.
C) The contact tip must always be screwed tightly on to the body of the torch. The thermal cycles which the torch undergoes during operation may loosen the contact tip which, in turn, may cause the torch body and nozzle to overheat or cause unsteady wire feed.

**The Wire Liner** is an important part that must often be checked since, during normal operations, the wire can deposit copper dust or tiny metal shavings in the lining.
Periodically clean the liner and the gas line with a jet of dry, compressed air. Wire liners are exposed to continual wear and therefore they must be replaced after a certain period of time.

**Wire feed motor.** Periodically clean the wire feed assembly and the drive rolls from any rust or metal shavings due to the feeding of the wire. A periodic check of all the components of the wire feed assembly, spool holder 10, drive rolls 57, wire liner , and the contact tip is recommended.

### 8 TROUBLESHOOTING

**WARNING!** In section 4 of this instructions manual, the protection fuses and the protection that they provide for the parts of the machine (auxiliary transformer, wire feed motor, fan motor, etc) were described. If one of these components fails to function because of a blown fuse, replace the fuse, after having identified the problem that caused the fuse to blow.

The machine is equipped with a thermostat that shuts the machine down when the power source overheats. After the thermostat intervenes, let the power source cool down for several minutes before resuming welding operations.

The troubleshooting table lists troubles, causes and remedies for those troubles that occur most commonly.

**Note:** All repair work must be done by qualified personnel.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited electric output</td>
<td>A phase is missing</td>
<td>Check the three phases of the feed line and/or the remove control switch contacts</td>
</tr>
<tr>
<td></td>
<td>A line fuse is burnt</td>
<td>replace it</td>
</tr>
<tr>
<td></td>
<td>Wrong connection on the</td>
<td>Check the terminal board connections by following the plate scheme</td>
</tr>
<tr>
<td></td>
<td>voltage changer terminal board</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The rectifier diode/s is/are</td>
<td>Replace the rectifier</td>
</tr>
<tr>
<td></td>
<td>burnt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loose torch or ground connections</td>
<td>Tighten all connections</td>
</tr>
<tr>
<td></td>
<td>Welding regulation commutator has</td>
<td>Change the commutator</td>
</tr>
<tr>
<td></td>
<td>an uncertain contact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transformer wire interrupted on the</td>
<td>Unscrew the commutator contact, remove the wire insulation and put it under the contact</td>
</tr>
<tr>
<td></td>
<td>commutator</td>
<td></td>
</tr>
<tr>
<td>Welding with several metal projections</td>
<td>Wrong adjustment of the welding</td>
<td>Look for correct parameters by means of welding voltage commutators and of wire speed adjusting potentiometer</td>
</tr>
<tr>
<td></td>
<td>parameters</td>
<td></td>
</tr>
<tr>
<td>Wire advancing improperly</td>
<td>Uncorrect sheath diam. See point 3.3.1</td>
<td></td>
</tr>
<tr>
<td>Unfficient ground connections</td>
<td>Check the connection efficiency</td>
<td></td>
</tr>
<tr>
<td>Wire not advancing or advancing</td>
<td>Wire roller with too wide groove</td>
<td>Replace roller</td>
</tr>
<tr>
<td>improperly</td>
<td>Obstructed or clogged sheath</td>
<td>Extract it and clean</td>
</tr>
<tr>
<td></td>
<td>Loose Wire pressing roller</td>
<td>Tighten it</td>
</tr>
<tr>
<td></td>
<td>Coil reel friction</td>
<td>Loosen and</td>
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