

Instruction Manual

WELD MAX

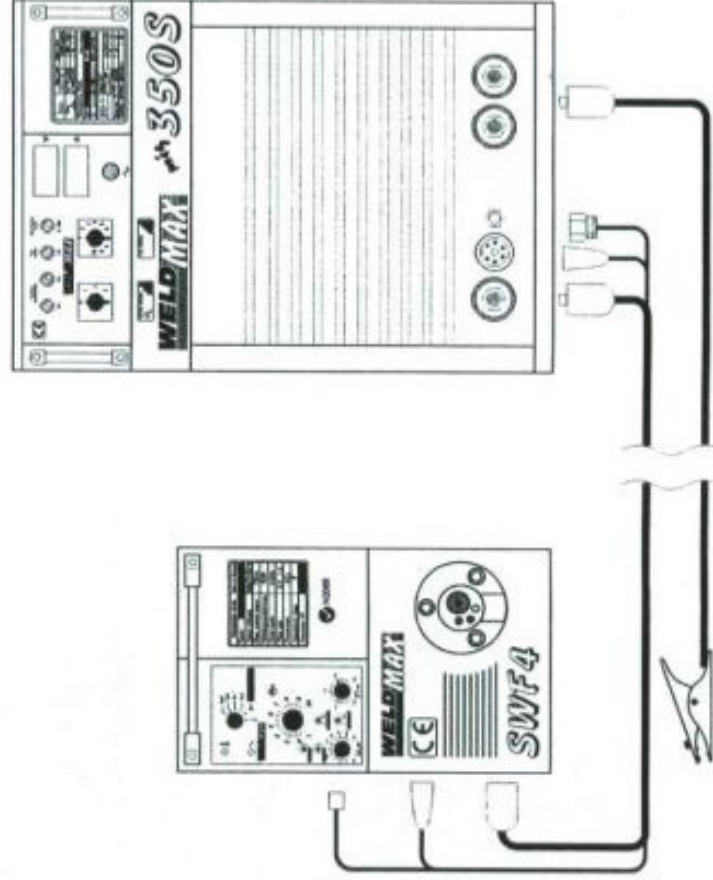
A Superior Quality Welding Product

350S

MIG/MAG Welding Power Source

SWF4

Separate Wire Feeder



Serial Number: 12030108

CE Declaration



The manufacturer: Weld-Impex Manufacturing and Trading Ltd. declares that the product conforms to

- o EN 60974-1 (*Arc welding equipment*)
- o EN 50199 (*Electromagn. compatibility*)
- o EN ISO 12100-2 (*Safety of machinery*)
- o 2006/95/EK (*Low-voltage directives*)
- o 2004/108/EK (*Electromagn. compatibility*)
- o 2006/42/EK (*Machines*)

European directives, norms and is suitable for the technical parameters in the instruction manual.

The machine has been designed according to the European norm EN 60974-1, it fulfils the (*disturbance filtering*) directions of EN 55011:1994 group "A", and it also complies with the directions of the European directive 2002/95/CE (RoHS).

Karcag, Apr. 20, 2010.
(Hungary)


.....
CSONTOS Lajos
Managing Director

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Weld-Impex Ltd. has the Quality Management System certified by ISO-9001. Its number: HU97/10906.



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Our other services:

- o Galvanization, electrostatic powder-painting
- o Screen process
- o Body ironing works (also CNC)
- o Manufacture of dry transformers
- o Manufacture of *unique* electrical equipments
- o Repairs *over* the guarantee
- o Technical supervision
- o Installing, transport, commission
- o *Leasing* of equipment (MIG, TIG, Plas)
- o *National* service network

For details, please visit our website or ask for information by telephone!

Legal Declaration

The quality certification will be handed over to the customer when purchasing. *Technical* parameters and *proper* usefulness of the equipment are warranted by the producer.

Warranty begins at installation; its period and services' list are in the *warranty* (supplement).

The manufacturer doesn't take responsibility for damages resulting any of the followings:

- o using *not according* to intended designation
- o *not complying* with labour etc. safety instructions
- o *not knowing* instruction manual
- o *not proper qualification* for the specified work (installation, welding, maintenance, etc.)
- o *lending* the machine without instruction manual, and/or to *not well* trained person.

The manufacturer reserves the rights to change *properties, technical parameters, appearance* of the product.

Built-in parts lose their warranty if damaged!



SAFETY PRECAUTIONS

for electric machines of welding/cutting industry



Present Manual should be studied thoroughly before starting any operation!

Next paragraphs provide some safety precautions and instructions how to use electric machines of welding and cutting industry in order all persons to prevent accidents, injuries etc.

As all preventing rules cannot be written because of many variations of task environment, follow the rules concerning the actual job(s) and the employer's safety practices.

Read, understand and keep industrial safety and fire protection instructions concerning to safety of all parts and equipments used (cylinder, torch, extractor, etc.).



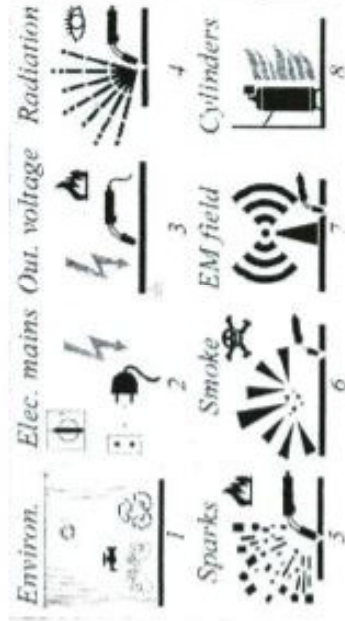
1. Dangerous features

1. Formed conditions of the machine and work are important: transport, storage, installation, operation, maintenance.
2. The machine is connected to the mains network.
3. The electrode, work-piece (or ground), and cables are under voltage (electrically live). Voltage of more electrodes can be added up on the work-piece. At plasma cutting there is 200–350 V at the torch!

At welding/cutting, the followings are produced:

4. Visible light, ultraviolet and infra-red rays, significant heat.
5. Sparks, spatter and high-energy metal drops with great temperature (800–1600 °C). These are thrown from the arc and can fly to adjacent areas (through small gaps).
6. Toxic fumes, gases and smoke generated from
 - the worked (e.g. galvanized, lead or cadmium plated) metal,
 - the gas used for work,
 - those reacting with each other (e.g. phosgene).
7. Considerable electromagnetic field (because of high-current arc and mains cable) that radiates to the environment. Its effect highly decreases with the distance. Radiation of machines with HF-ignition unit (TIG, Plas) is more bigger.

8. Cylinders using for work and nearby contain high-pressure gas.



2. Damaging effects

These dangerous features have harmful influence to the workers and also to near living beings, machine, and other equipments:

◆ General injuries

1: A not suitable made environment, a not well prepared and made working area can be dangerous (machine tipping over, its overheating, person falling down, etc.).

◆ Electric shock

2: The machine's inside is under mains voltage.
3: Machine's cables have voltage while working.

◆ Eye damaging

4: Arc ray causes eye inflammation.
5: Flying sparks can cause physical eye damaging.
6: Smoke, gas, fume can irritate the eye.

8: Cylinders' overpressure can come to the eye.

◆ Hand and skin injuries

4: Heat effect of the arc ray and the overheated work-piece can burn the skin.
5: Flying sparks can reach the skin.

6: Smoke, gas, fume can irritate the skin.

◆ Breathing damage

6: Smoke etc. can displace air and breathing in can cause injury or even death.

◆ Fire and explosion danger

2: Electric fault can happen in the machine in principle.

3: Cables can overheat or a short-circuit can happen.

4: Arc ray has a great heat effect to the work-piece.

5: Sparks are of high temperature and fly far away.

6: Fumes can be hot and can stimulate burning.

8: Cylinders can contain high-pressure and fire-feeding gas (e.g. oxygen).

◆ Electromagnetic disturbances

7: EM radiation has too much energy for sensitive electrical equipments.

◆ Environmental damage

1,4,5,6: Welding/cutting and its waste materials can contaminate the surrounding soil, waters, and air. Damaging noise, light, and heat are produced.

3. The machine's transport, storage

» Must be in upright position, secured against tipping over.

» Lifted (if bigger size) by means of lift device and with the help of more personnel.

» Protected against vapour, moisture, damaging weather and mechanical effects (in dry, covered place, for good cause in its box or covered).

4. Creating working area

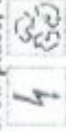
» The working area should be ...

• clean and orderly



• well-lighted and -aired (e.g. extractor fan), and of good temperature; protected from falling water, rain, and storm

• of straight, smooth floor, free from obstructions (of non-combustible material)



• screened, fenced off with safety grids (if necessary).







» In the working area or near, there not be ...

- inflammable materials (or cover them)  
- person living with pacemaker
- electrically sensitive appliances in the area of health (e.g. pacemaker), control (e.g. computer), measurement, safety (e.g. guard), radio-waves (e.g. mobile phone), etc.

» The cylinder ...



- must be in upright position, securely chained to a fixed support, and away from areas where they may be subjected to damaging physical or heat effect  
- valve protection cap should always be in its place if out of use.

» Pay attention to the following:





- Keep a fire-extinguisher, water hose, blanket, etc. readily available for immediate use.  
- Connect work clamp to the work piece close to the working area (not be complex current path). Connections must be tight.
- Ground the work to a good electrical point.
- Place the high-current cables side by side and at floor. Nobody stay close to them for a long time.
- Cables not be wound around metal or living body.  

5. Operation






- » The equipment:  
 - can be operated at a place which is suitable for safety work and well ventilated
 - changes decreasing its safety shall not be carried out
 - its electric shock prevention test must be carried out regularly as prescribed
 - must be connected to a line provided with protective grounding, circuit breaker or fuse, and possibly protection switch
 - its airing grids/slots be free
 - can be used only for the purpose that it was designed for
 - its all installation, repair and maintenance works (possibly on disconnected machine) can be performed only by qualified, trained, and competent (examined) persons, according to the labour safety provisions, electric shock protection, and local and manufacturer's regulations.

» Protect ...

- cables from any kind of damage, e.g. don't step on them and don't roll anything over them    
- low-current cables of the machine(s) by laying them in a safe location, or, if necessary, with screening
- public utilities (gas hoses and fittings, electric wires and equipments, etc.)
- air (by filter usage), soil, worked metal etc. from contamination.




6. Working



- » Don't weld/cut ... 
- with covers removed or with damaged cables  
- materials and parts under voltage (also don't touch these)








- near to inflammable or explosive materials, dust, vapours (e.g. chlorinated hydrocarbon vapours coming from cleaning or spraying operations)

• when not knowing what gases and fumes can be generated e.g. from coated metals




- in damp and dirty environment   
- tanks, drums, barrels, cylinders, containers, etc. as these are filled up with vapours (being inside in spite of "cleaning" and produced by working).







» Pay attention to the followings:

- Safe and stable working position is needed.   
- Rolls of wire feeder and the fed wire are dangerous (at MIG welding).  
- Use enough ventilation and mask or respirator.
- Keep your head and face: 
- out of the fume (avoid breathing in these) 
- away from the valve outlet when opening it.

• Wear protective clothing (isolate yourself from the work-piece): 

- oil-free, fire-resistant clothing covering all body
- dry, leather gloves with no holes 
- high shoes, hair cap, ear plugs
- safety filter glass with side shield (helmet).
- Switch off the machine when out of use (wait its cooling, also recommended pulling the mains plug out).
- Waste materials must be handled carefully, regularly.
- Keep all parts, fittings (e.g. gas hose) in well and safety condition, suitable for work, according to rules and specifications.  

» Don't do the following:

- Don't turn any switch, don't pull cables from the connector while working.   
- Never turn the torch toward anybody (and yourself).
- Don't touch the electrode: 
- to the work-piece when this is not necessary
- to parts or cylinder under voltage
- if touching also the work-piece at the same time
- to liquid (e.g. for cooling).

airing lighting shield, glasses fire-protection



fence temper. prot.cloth, mask envir. protection

bad conditions voltage smoke breath barrel, can



overheat gas leak radiation living beings wastes



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Supplements:

- Parts of the machine
- Welding tips
- Welding time diagrams
- Rules to handle parts

1. Introduction

In case of MIG/MAG welding the arc is generated between the automatic fed **welding wire** and the **work piece**, shielding in CO₂, gas or gas mixture. Its advantages:

- ◆ concentrated, small-region heat input (low warp)
- ◆ high current density and welding speed, quick melting
- ◆ wide range of welding parameters
- ◆ deep penetration, high melting rate
- ◆ easy automation
- ◆ ability to weld of thin plates, roots, etc.
- ◆ no slag on the welded seam.

The equipment consists of two connected units: the **power source** and the **small-size wire feeder** (on or max. 10 m from it).

These constitute a **compact unit** with a **gas cylinder** on it, and can be easily moved by rubber **wheels**.

Their main parts:

- ◆ Metal cabinet, wheels, cylinder holder.
- ◆ Contactor, switches, fuse, fan, auxiliary transformer.
- ◆ Main transformer, rectifier, choke, outlets.
- ◆ *Metal cabinet, wheels, wire feeding mechanism.*
- ◆ *Central adaptor, feeding motor, gas valve, electronic.*

2. Specification

Mains voltage	3×415 V, 50 Hz
Nominal mains power	15 kVA (d.c. 60%)
Max. mains current	3×21 A (d.c. 60%)
Mains fuse	3×T 25 A
Open-circuit voltage (DC)	17 – 44 V
Welding current range	40 – 335 A
Duty cycle (T _c =10 min)	60 % – 335 A 100 % – 260 A
Number of welding steps	30 (3×10)
Dimensions (w×h×l) without wheels	440 × 830 × 985 mm 440 × 660 × 985 mm
Weight (approx.)	128 kg

- Protection: IP 21
- EMC class: 2A
- cos φ: 0.7

- Insulation class: I (*earthed*)
- Thermal class: F (155 °C)
- Cooling: AF (*air forced*).

Wire feeder:

Input voltage	42&27 V, 50 Hz
Max. input power	75 VA
Duty cycle	100 % – 450 A
Wire speed range	0 – 21 m/min
Dimensions (w×h×l) without wheels	350 × 520 × 630 mm 230 × 430 × 630 mm
Weight (approx.)	24 kg

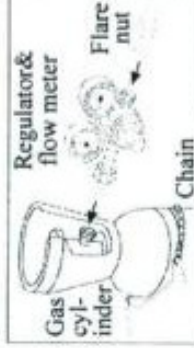
- Protection: IP 21
- Insulation class: III (*low-vol.*)
- Cooling: AN (*air natural*).

3. Installation

Safety precautions must be considered!

► Equip the **gas cylinder** with **pressure regulator** and **flow meter** according to their instruction manuals. Put the **cylinder** on its place on the machine, secure it carefully by the **chain** and mount the **flare nut** of the **gas hose** to the **regulator outlet** by a wrench. Air sealing should be checked, possible leakage must be stopped.

For **flux-cored** wire electrode, gas is **not** in use!



► In space separating from electric parts, the **reel (spool) holder** holds the **wire reel**. Push the **wire reel** onto the **holder** and **secure** against falling. Make free the **wire end** and cut it smoothly.

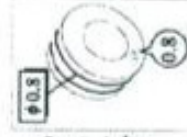
The reel's braking can be adjusted by the **bolt** located on the middle of the **holder**.

► The **feeding mechanism** serving for reliable wire feeding is mounted near to the **reel holder**. On the **feeding motor's** shaft there is a **drive roll** which drives the two **feeding rolls** in the **groove** of which the wire runs. This is provided by two **free running bearing rolls** pressed against the **feeding rolls** by the **pressure arms**. These **arms' pressure** can be adjusted by their setting screws.

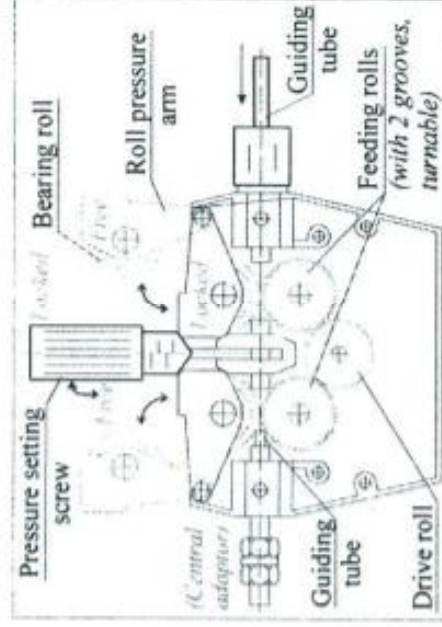
Both the **arms** and **screws** can be in two positions: locked (pressed) and free (unlocked).

The wire is guided by the **guiding tubes**.

Feeding rolls can be used for wire of **two** different diameters (size is **marked** on them); for changing the **rolls** over after **unscrewing the shaft nut** (but the **contact tip** of the torch must be changed, too).



Unlock the pressure arms and thread the welding wire through the guiding tubes, aligning it into the feeding rolls' grooves so that the wire goes 10-15 cm into the tube.

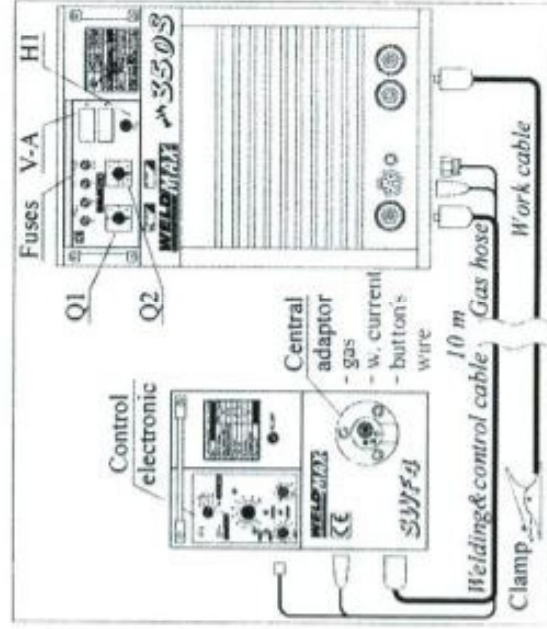


When not working in the wire reel's space, put the side cover back to protect the feeding parts against contamination.

► Connect the ...

- wire feeder to the power source by welding and control cables and gas hose (accessories, in a 10 m long protective hose);
- work cable to the other outlet (where spatter is the least in the welding current range);
- clamp of the work cable to the work piece;
- torch cable to the central adaptor of the wire feeder.

Welding cable should be connected according to the desired welding polarity (generally to the '+' outlet; it depends also on the welding method: *with* or *without* gas).



- H1: 'Power on' signalling lamp
- V-A: Volt-Ampere-meter (option)
- Q1: Mains and coarse setting switch (0-1-2-3)
- Q2: Fine setting switch (1-2-...-10).

The gas hose (to the cylinder), mains cable, and cooling fan are located at the machine's rear plate.

4. Operation

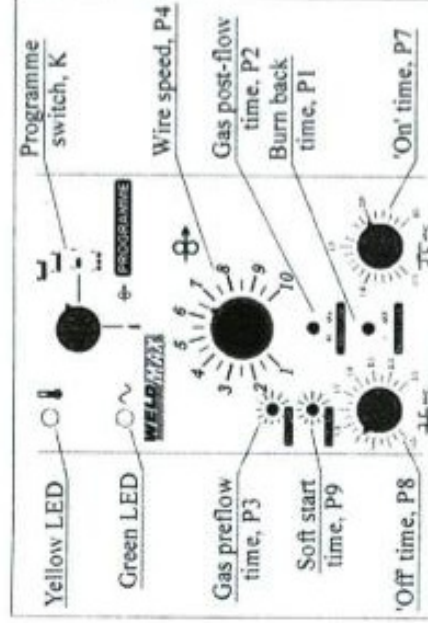
The switch marked with 0-1-2-3 serves for turning on/off the machine and coarse setting the welding voltage. The switch marked with 1-2-...-10 is for fine setting.

Some settings' welding current and no-load voltage (V):

Set	Current	Voltage	Set	Current	Voltage
1-3	40-45 A	17-18	2/7-10	135-160 A	26-28.5
4-6	50-60 A	18.5-19	3/1-3	180-210 A	29.5-32
7-10	65-80 A	19.5-21	3/4-6	220-250 A	33-36
2/1-3	90-100 A	22-23	3/7-10	260-335 A	37.5-44
2/4-6	110-125 A	23.5-25			

The power source is protected against overheating: in this case welding voltage and wire feed are automatically turned off (signalled by the yellow LED on the wire feeder). After the inside fan cools it down, welding can be continued.

The control electronic provides the feeder motor's controlled DC voltage, switches the contactor and gas valve on/off and controls the welding process.



• Welding mode (programme) selector switch (K):

- ☼(1) 4-stroke welding ☼(2) 2-stroke welding
- ☼(3) Spot welding ☼(4) Interval welding
- ☼(5) Wire threading ☼(6) Gas test.
- Green LED: signals the 'power on' state
- Yellow LED: signals overheating error
- Wire speed pot'meter (P4: 1-10, relative value)
- 'Welding on' time pot'meter (P7: 0.5-2.5 sec.)
- 'Welding off' (pause) time pot'meter (P8: 0.5-2.5 sec.)
- Wire burn back time (mini) pot'meter (P1: 0-0.5 sec.)
- Gas post-flow time (mini) pot'meter (P2: 0.1-2.5 sec.)
- Gas pre-flow time (mini) pot'meter (P3: 0-0.5 sec.)
- Soft start time (mini) pot'meter (P9: 0-0.2 sec.)

Wire speed ratio according to the P4's scale (10=100%):

Scale	W. speed	Scale	W. speed	Scale	W. speed
1	7 %	4	16 %	7	49 %
2	8 %	5	25 %	8	68 %
3	10 %	6	37 %	9	87 %

Welding modes (selected by the switch K):

☼(5) **Wire threading:** Pushing the torch button, the wire is *threaded* with ca. half speed (and soft start). Take care of torch cable to be as straight as possible in order welding wire to pass in it without difficulty.

☼(6) **Gas test:** Pushing the torch button, the *gas valve* opens, so the *gas flow* can be checked and set.

Starting welding (by pushing the torch button):

- first there is only *gas preflow* (P3);
- afterwards the *wire feed* begins (with soft start, P9), and also the *welding voltage*.

Continuing welding:

- ☼(1) **4-stroke welding:** Releasing the button, the welding *continues* till the button is pushed *again*, then the wire feed stops,
 - expiring the *burn back time* (P1), also the welding *voltage* stops,
 - when releasing the button, after expiring the *gas post-flow time* (P2), also the *gas flow* stops.

☼(2) **2-stroke welding:** Welding lasts until *releasing* the button; then a normal stop (see below) occurs.

☼(3) **Spot welding:** Expiring the *welding time* (P7), the *wire feed* stops; when *releasing* the button, the normal stop happens.

☼(4) **Interval welding:** Welding lasts for the *set time* (P7), then *pause* comes next (P8, wire feed stops); and so on (but without soft start). When *releasing* the button, the normal stop happens.

Normal stop: when releasing the button...

- the *wire feed* stops in any case,
- elapsing the *wire burn back time* (P1), the welding *voltage* ceases, then - elapsing the *gas postflow time* (P2) - the *gas flow* stops, too.

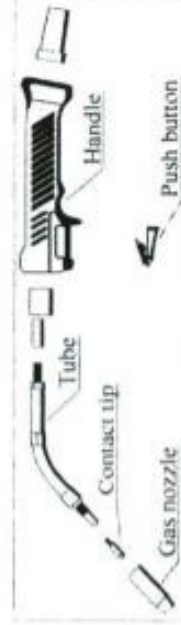
In the *Supplement*, this can be seen in a time diagram.

5. Maintenance

Safety precautions must be considered!

- **Torch:** During work apply welding spray to the gas nozzle to prevent *melted droplets* adhering to it. The contact tip is a consumable part to be changed regularly depending on its burning and erosion. The torch *liner* should be cleaned by gasoline-oil mixture and blown out with compressed air.

Factory's instructions should be authoritative.



- **Cables and hoses:** Check condition of *gas hose* and

mains and *work cables*, replace if damaged!

- **Wire feeder:** This must be checked and maintained regularly at the *drive roll* and the *guiding tube*.
- **High-current unit:** It can be necessary to remove dust from *inside* the equipment by compressed air, to check connections, and possible tighten them.

6. Trouble shooting

Safety precautions must be considered!

If the fault remains or is caused by an *unknown* reason, contact the service!

- The lamp (on the power source) is off

1. No *mains* voltage → check.
2. Faulty *switch(es)*, *mains cable* or *transformer* → replace it or contact the service.
3. Blown fuse → find the *cause* of trouble (maybe e.g. short-circuit), replace fuse and check its *rating*.

- The green LED (on the wire feeder) is off

1. Bad electric connections to the *power source* → check.
2. Faulty *control unit* → contact service.

- The yellow LED (on the wire feeder) is on

The *power source* is overheated → wait until the fan cools it down and the LED *extinguishes*.

- No welding arc

1. Faulty *torch* or its *cable* or *button* → repair or replace.
2. Loose *connection* at welding cables → tighten.
3. Worn contacts of *contactor* → replace.
4. Faulty *control unit* → contact the service.

- Bad gas flow

1. Empty *cylinder*, faulty *pressure regulator* or *flow meter* → repair or replace.
2. Leakage at gas hose or gas *valve* → stop.
3. Cylinder or regulator is *frozen* → heat up it by hot water or a gas heater.

- Weld porosity

1. Contaminated gas → replace cylinder.
2. Bad *quantity* of gas or *gas post-flow* → set correctly.

- Irregular wire feed

1. Worn or deformed wire *guide, roll* or its *groove*, loose wire reel → locate fault and repair.
2. Bad *pressure* on the roll → set correct pressure.
3. Rusty wire surface → replace it.
4. Faulty *control unit* → contact the service.

- Bad quality of weld

1. Bad *gas flow*, contaminated *surface*, improper quality of *wire* or *gas*, worn *parts* → use good quality products, maintain the machine and its parts *regularly*.
2. Size of the *drive roll* and *contact tip* don't match to the *wire* → check and replace.
 - check *welding parameters*:
 - arc voltage
 - polarity
3. → check *welding parameters*:
 - arc voltage
 - polarity

- nozzle-to-work distance • tilting the torch.
- (See *Welding tips*, in supplements.)

7. Parts list

Power source / • On the front plate:

Part	qty	Code No.
Plastic handles	2	2142240014
Fuse holders G-30 (500V)	2	2343730050
Fuses 500V/1A	2	2343730052
Fuse holders PTF-35 (250V)	2	2343730015
Fuse 250V/1A (fan)	1	2343730016
Fuse 250V/3.15A (feeder)	1	2343730049
Lamp LJ 243.051 ('power on')	1	2342340072
Bulb 48V 20 mA	1	2345210001
Switch GN 25-6720 (0-3)	1	2142330065
Switch GN 25-8407 (1-10)	1	2142330160
Welding cable's sockets CX-31	3	2142240068
6-pin socket HR 20162	1	2143730163
Gas connector 1/4"	1	2342241644

• On the rear plate:

Mains cable 4×2.5 mm ² , 5 m	1	2343630024
Mains cable's fixing clamp	1	2342240567
Gas connector 3/8" (to cylinder)	1	2342240177
Gas hose Ø9/5, 1.5 m	1	2357320008
Fan holder Ø300	1	28422411
Fan blade Ø300	1	2142240178
Fan motor VNT 34-45, 230V~	1	2142241120

• Inside:

Main transformer	T1	1	29080425
Rectifier bridge PTS-293	V1	1	2142240261
Choke	L1	1	29090264
Contacteur LC1-D32, 42V~	K1	1	2142320096
Filter unit EMC-3		1	28040623
Auxiliary transformer	T2	1	29081167

Wire feeder / • On the front plate:

Control electronic WI 3.0, 24V	A1	1	2142241669
Turning knob 2004-2 (w. speed, P4)		1	2342241701
Turning knobs 2004-3 (K,P7,P8)		3	2342241702
Standard central adaptor		1	2142240095

• On the rear plate:

Solenoid valve 42V~	Y1	1	2142241101
6-pin socket HR 20161, reverse	X2-2	1	2143730166
Welding cable's socket CX-12, rev.		1	2142240155

• In the wire reel's space:

Wire reel (spool) holder		1	2142240076
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Wire feeder 76ZY02	MI	1	2142241704
Feeding rolls Ø40/32, Ø0.9-1.2 "V"		2	2342240742

• Others:

Handle holders		4	2142240230
11-pin PCB-connector		1	2342240179
Swivel wheels Ø65		4	2132750047
Swivel plate (bottom)		1	2142240110

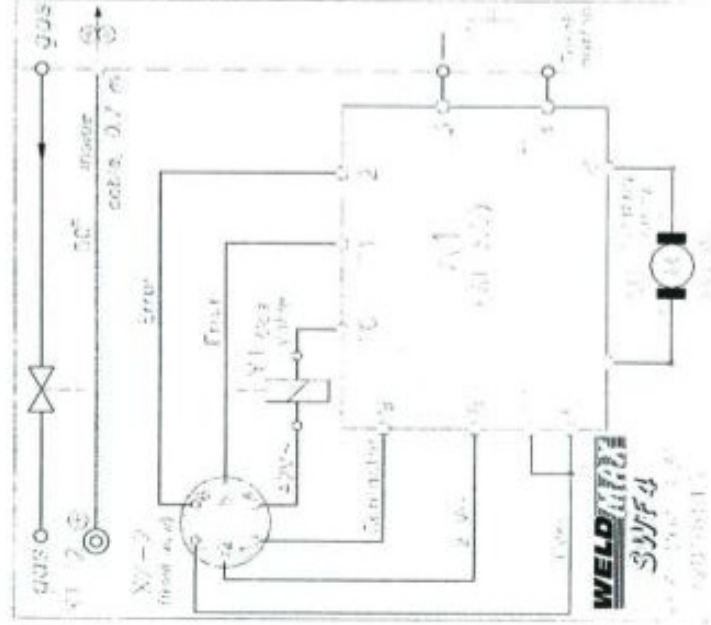
Accessories:

Work cable 35 mm ² , 10 m		1	2343630015
Work cable's plug CX-21		1	2142240154
Work clamp 350A		1	2142240072
Fuses 500V/1A	F1, F2	2	2343730052
Fuse 250V/1A (fan)	F3	1	2343730016
Fuse 250V/3.15A (feeder)	F4	1	2343730049

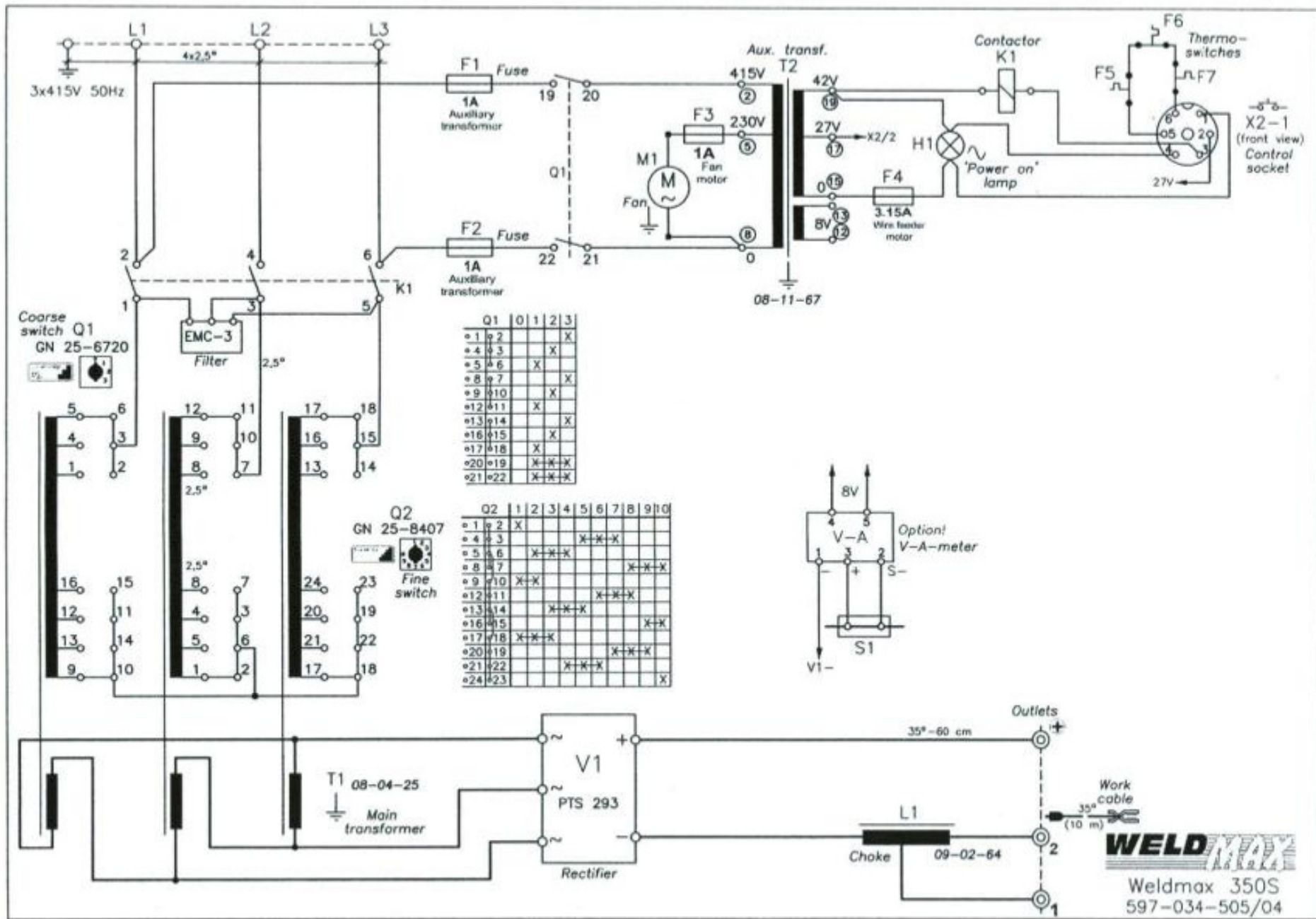
• Interconnecting cables&hose:

Gas hose Ø9/5, 10 m		1	2357320078
Gas connector 1/4" (→Power S.)		1	2342240157
Welding cable 35 mm ² , 10 m		1	2343630052
Welding cable plug CX-21 (→P. S.)		1	2142240154
Welding cable plug CX-41, reverse		1	2142240156
Control cable 6×0.75 mm ² , 10 m		1	2343630040
6-pin conn. plug HR 20103 (→P.S.)		1	2143730165
6-pin conn. plug HR 20120, reverse		1	2143730167
Protective hose 11 cm×10 m		1	2167320056

8. Circuit diagram (wire feeder)

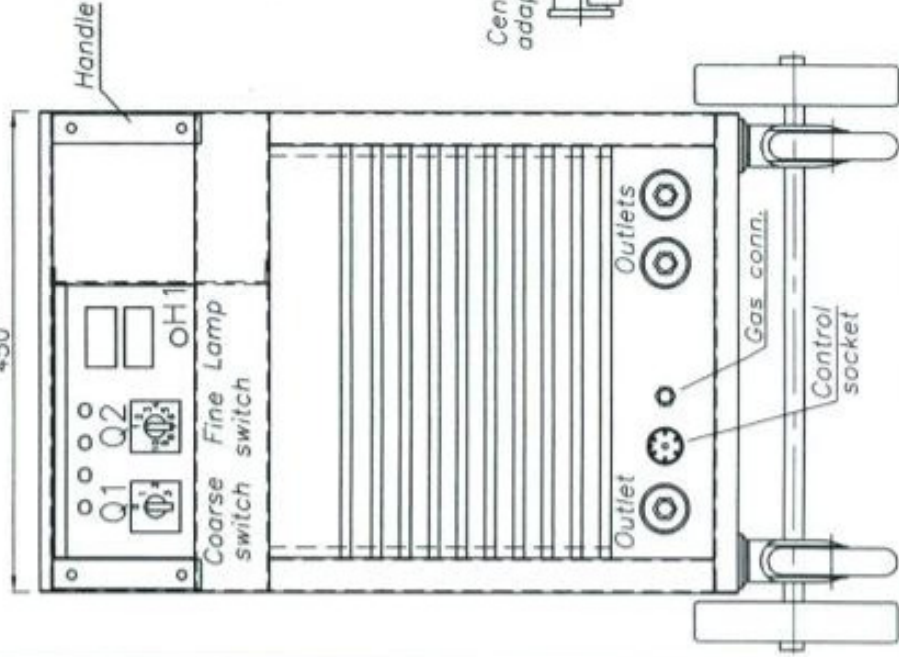
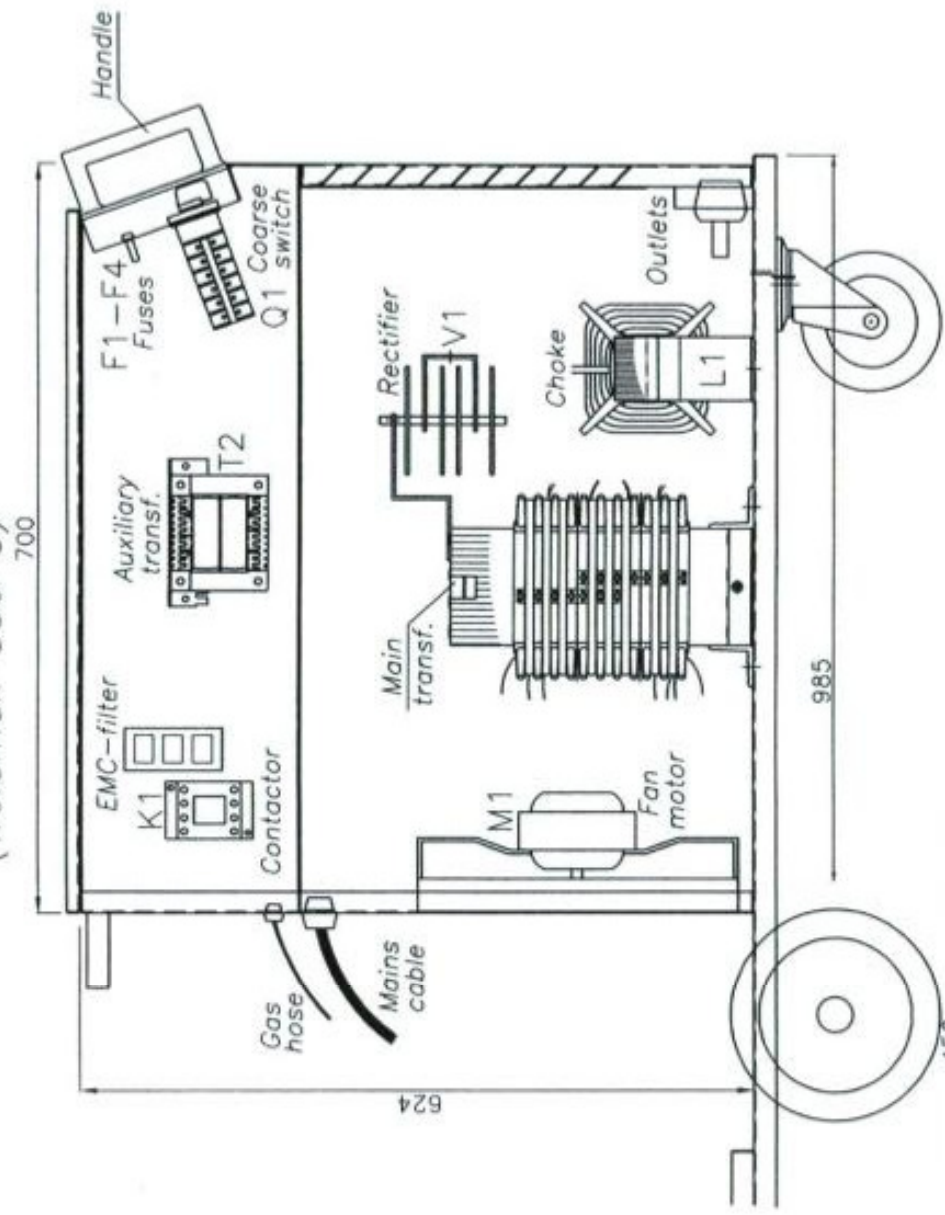


9. Circuit diagram (power source)

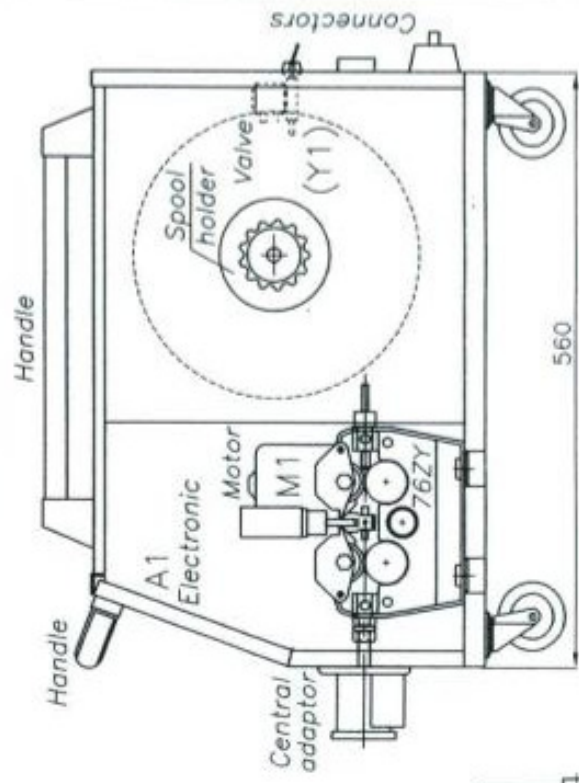


Parts of the machine

(Weldmax 350 S)



(Weldmax SWF 4)



Welding tips

The built-in main transformer of flat static characteristic provides stable welding even with hand-moved torch.

This means that e.g. the arc length increases (shifting work point), the arc voltage hardly changes but welding current and melting rate decrease: work point is restored.

1. Using gas

Properties of **argon** and **CO₂** are in the next table. Properties of **mixed gas** are between the two ones, so it is good compromise between quality and cost.

Property	Ar	CO ₂
Width of seam	wide	narrow
Height of seam	flat	big
Depth of penetration	small	deep
Dimensions of bath	big	small
Current of welding torch	low	big
Danger of contact tip burning	frequent	rare
Spatter	low	strong
Danger of porosity	-	middle
Weldability of structural steels	less	good
Pulse arc welding	excellent	not poss.
Dipping arc welding	adequate	excellent
Weldability of Cr-Ni steels	good (+O ₂)	condition-ally
Weldability of Al and alloys	possible	not poss.
Costs	very high	low

It can be seen that only un- or low alloyed steels are practical to weld with **CO₂**.

It is worth considering offers of gas manufacturers!
Flux-cored wire *doesn't* need any gas!

Typical values of gas consumption (litres/min):

Wire	Gas cons.	Wire	Gas cons.
Ø 0.8 mm	8 – 12	Ø 1.2 mm	10 – 15
Ø 1.0 mm	10 – 12	Ø 1.4 mm	12 – 16

2. Welding properties

Welding **unalloyed steel** (in case of butt joint, 82% Ar+18% CO₂ gas):

Thickness	Wire dia.	Current	Voltage	W. speed
mm	mm	A	V	m/min
1.0	Ø 0.8	70	17	3.6
1.5	Ø 0.8	90	18	4.9
2.0	Ø 0.8	120	20	7.2
3.0	Ø 0.8	130	21	8.0
4.0	Ø 1.0	130	21	4.5
5.0	Ø 1.0	130	21	4.5
6 – 9	Ø 1.0	130 – 200	21 – 25	4.5 – 8.3
10 – 20	Ø 1.2	135 – 300	21 – 30	3.0 – 9.6

Aluminium and alloys (SG-AlSi5 wire and Ar gas):

Thickness	Wire dia.	Current	Voltage	W. speed
mm	mm	A	V	m/min
1.0	Ø 0.8	70	17	7.3
1.5	Ø 0.8	70	17	7.3
2 – 3	Ø 0.8	90	18	9.7
4.0	Ø 1.2	130	20	5.5
5.0	Ø 1.2	160	22	6.9
6.0	Ø 1.2	180	23	8.0

Copper and alloys (Ar gas):

Thickness	Wire dia.	Current	Voltage	W. speed
mm	mm	A	V	m/min
3.0	Ø 0.8	175	23	10.9
5.0	Ø 1.2	210	25	6.0

3. Welding parameters

It is very important welding parameters properly to set to the welding process.

• Welding current

Wire feed speed determines the welding current which assures uniform melting. Welding current is set by the wire feed speed.

• Arc voltage

Too high: wider and longer weld, lower penetration depth, higher spatter and burning alloying elements - in turn good appearance of seam surface.

Too low: narrow and deep weld, poor appearance of seam surface, bulgy fillet weld.

• Wire stickout

Too long: reduction of welding current (melting rate), bad gas shielding, strong spatter.

Too short: contact tip can be melted, and the wire can burn back.

Recommended values (according to welding current):

A	50	100	150	200	250	300	350	400
mm	5	6	8	10	12	14	17	20

• Polarity

Unusual polarity can be used only for piling welding, but arc burns irregularly and spatter is stronger.

• Gas nozzle-to-work distance

Too big: bad gas shielding.

Too small: difficult visible welding bath, easier melting gas nozzle, to which melted metal droplets can adhere. Recommended value approx. 10-12 mm (15 mm over 350 A).

• Tilting the torch

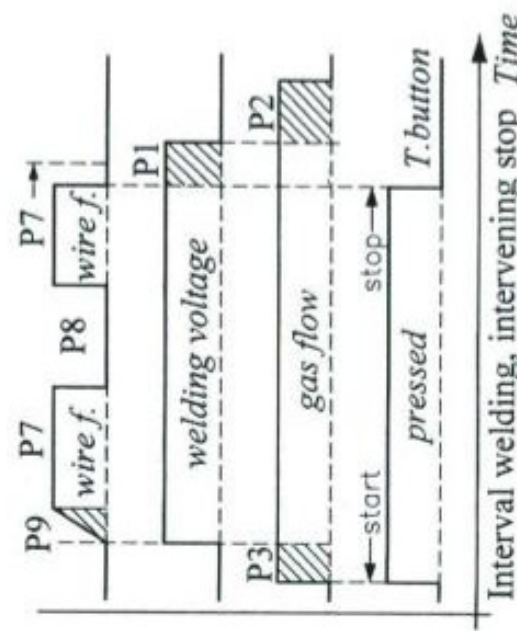
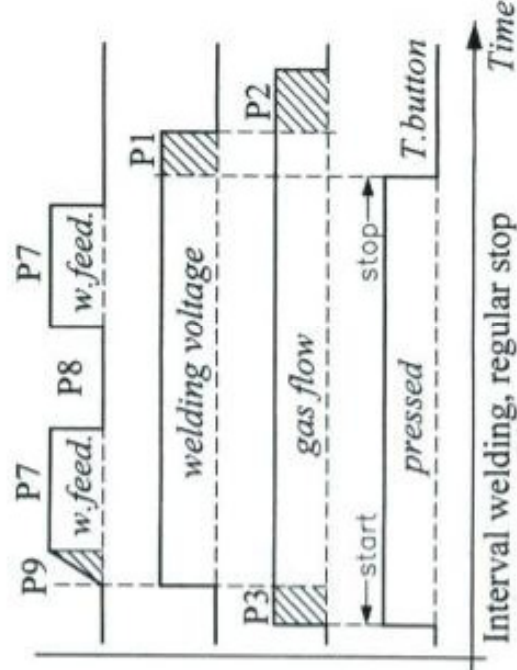
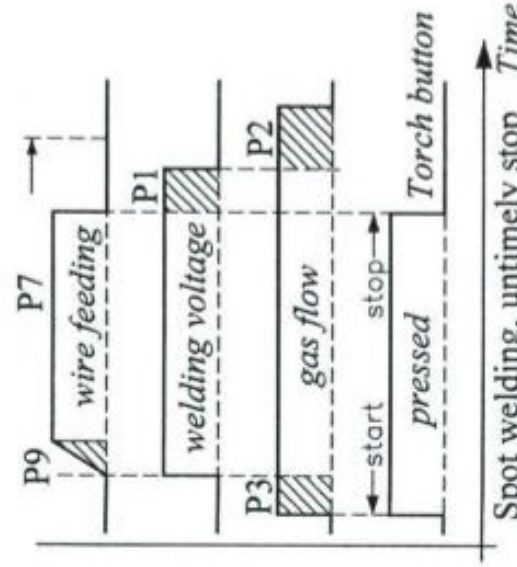
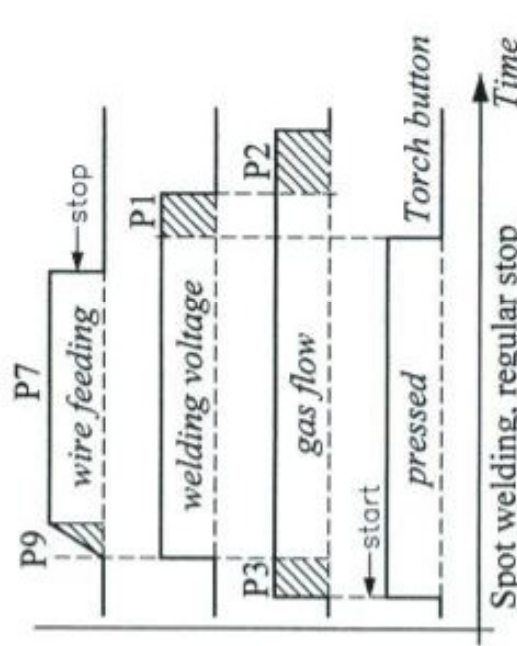
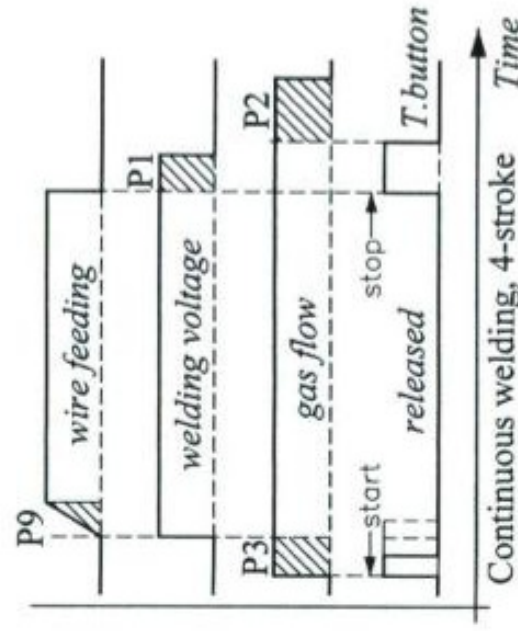
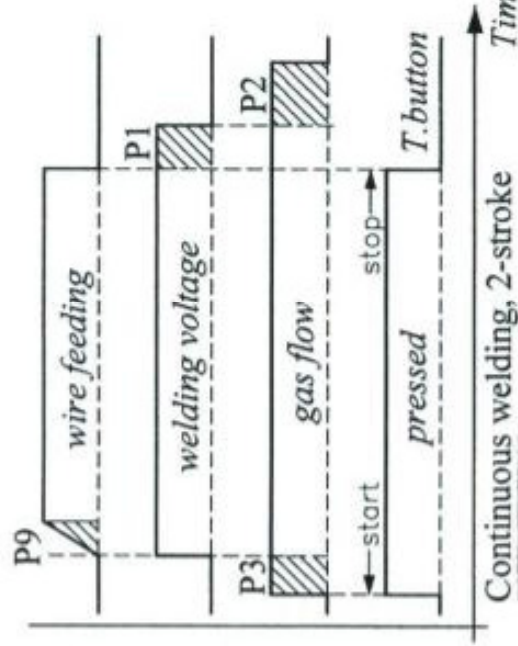
In the direction of travel (pulling): higher penetration depth, narrow and high seam; good gas shielding, well visible welding bath.

In the opposite (pushing): fusion defects, lower penetration depth, wide and flat seam (but good for thin plates and roots).

Welding time diagrams

- ∅ P3: Gas pre-flow time (0-0.5 s)
- ∅ P9: Soft start time (0-0.2 s)
- ⊙ P1: Wire burn-back time (0-0.5 s)
- ⊙ P2: Gas post-flow time (0-2.5 s)

- ⊙ P7: Welding time (0.5-2.5 s)
- ⊙ P8: Pause time (0.5-2.5 s)



Rules to handle parts

for electric machines of welding/cutting industry



Also this manual should be studied **thoroughly!**

In the welding and cutting industry, not only the machine but its parts need *special* handling. In the following, some rules are given how to

- ♦ install,
 - ♦ operate (handle, use),
 - ♦ maintain (change),
 - ♦ cancel etc.
- the machine's parts, fittings, accessories.

Manufacturer's instructions of individual parts etc., and the Safety Precautions (pages 3, 4) must be considered, too!

• Generally:

- ♦ The inside of the machine (and any parts) can be touched only by an expert.
- ♦ If there can be seen damage, cracking etc. on any parts, or their work can be perceived as *unstable*, than it must be checked whether the work can be continued with safety;
- ♦ on an unsafe machine, the fault must be repaired, or if it is not instantly immediately, the machine should be marked as "*cannot be used*" or "*out of work*".

• Handle:

- ♦ serves only to move the machine;
- ♦ don't lift the machine by it.

But in case of a *low-weight* machine (separate *wire feeder* or *inverter*), it is possible to lift it by the handle:

- » by hand,
- » close to the floor (<0.5 m),
- » without wire spool (in case of MIG),
- » without torch and cables connected,
- » for a short time (only to move it place to place).

If it is still needed to *hang* the machine, contact the supplier!

• Cables and theirs connectors, switches:

- ♦ are under voltage (electric shock hazard);
- ♦ become warm (burning injury hazard);
- ♦ danger of arc flash (fire hazard);
- ♦ by holding these, never pull the machine.

• Cables:

- ♦ connect in and out them only if machine turned off;
- ♦ must always be changed in full length (it is forbidden to lengthen, to repair partially).

• Gas connectors and hoses:

- ♦ high gas pressure and
- ♦ high gas flow are in the system;

- ♦ if gas escape, environmental pollution (mainly CO₂).

• Water connectors and hoses (if water cooled):

- ♦ water pressure and
- ♦ high water flow are in the system;
- ♦ if not using *antifreeze*, damage may be in case of frost;
- ♦ if leakage, hot (and possibly contaminated) water can go out to the *environment*.

• Wheels:

- ♦ serve for moving on horizontal, stable, smooth floor;
- ♦ the machine may overturn in spite of the low centre of gravity;
- ♦ in spite of large weight, the machine may move, so be *fixed* if possible;
- ♦ take into consideration pulling and overturning effect *of the cables*;
- ♦ at transport, loading to car, etc., the machine must be handled according to its *weight*: practical to use pallet and it's recommended to work with more people and lift machine(s). It must be fixed also on the pallet against overturn and movement!

• Torch:

- ♦ sharp-end wire moves in it and comes out from it, relatively quickly (in case of MIG);
- ♦ gas of high pressure and speed flows out of it;
- ♦ warms up significantly;
- ♦ in case of water cooled version, *hot*, flowing water is in it;
- ♦ as the worker is in (direct) contact with it for longest time, take care particularly to its *damage-free* condition!

• Airing grids:

- ♦ serve hot air to flow in and out (don't be anybody and anything in its way);
- ♦ small particles can get into the air flow;
- ♦ don't insert anything into the openings (electric shock, limb and burning injury can occur).

• Inside parts:

- ♦ are under voltage (hazard of electric shock, generating arc);
- ♦ warm up (burning injury hazard);
- ♦ theirs voltage and temperature can be kept temporarily (*after* turn-off);
- ♦ there may be moving parts inside them (e.g. contactor, wire feeder in case of MIG);
- ♦ there may be rotating parts inside them (e.g. fan, water pump, wire feeder's cogwheel in case of MIG).

• Environmental protection:

- ♦ all parts, accessories, (dismounted part after change) etc. are dangerous waste, don't handle them as household waste;
- ♦ badly working part may cause radio disturbance;
- ♦ good condition/operation of the parts serves also environmental protection.

