

# Operating instructions

of the welding inverter

## **TT 350 mig/mag**

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## **1. Description**

### **1.1. Machine construction**

The welding machine TT 350MIG/MAG (hereinafter referred to as the source) is constructed as a power frequency converter (inverter).

Modern principles and knowledge in the field of semi-conductor technology and controlling electronics have been used when constructing the source. Due to that the source is characterized by:

- high power at small dimensions and low weight
- high efficiency
- quality welding characteristics
- stability of parameters independent on the electric power voltage variation

Electronic control ensures parameters stability and contains the circuits for the source protection in case of failure or overload and ensures optimal welding properties.

The source is designed as a compact mobile machine.

A massive all-metal four-pulley wire feeder with driven feeder pulleys is a standard.

On the front panel there are quick plugs for connection of the welding cables, a euro-terminal for connection of the welding torch for setting of the optimal welding parameters for the individual welding technologies, two digital measuring devices and three LEDs

The source cooling is forced with a ventilator.

### **1.2. Controls**

Positions and names of the individual controls are given in the pictures:

- pic.1 – front panel
- pic.2 – back panel
- pic.3 – feeder panel

Explanation of the individual controls is given directly at setting of the source for the selected welding processes.

### **1.3. Welding technology**

The source is determined for welding by:

- coated electrode (method MMA)
- method MIG/MAG (it is possible to use Fe wires, including stainless wires and Al-wire)
- method WIG (arc ignition is made by touching the electrode)

The source power enables to use coated electrodes in range from  $\Phi 1.6$  to  $\Phi 8$ mm and wire in range from  $\Phi 0.6$  to  $\Phi 1.2$ mm

Preparation and control of the source for individual welding technologies are described in Chapter 5.

## 2. Technical data

Input voltage/frequency		3x400V/50Hz
Output current $I_2$ (A)		
- technology MMA	X = 100%	250A
	X = 60%	300A
	X = 35%	400A
- technology MIG/MAG	X = 100%	220A
	X = 50%	270A
	X = 40%	350A
Open-circuit voltage		
- technology MMA		73V
- technology MIG/MAG		70V
Regulatory range of the welding current		5 - 350 A
Regulation of the welding current		continuous
Thermal class of isolation		F
Cover degree		IP 21
Power factor $\cos \phi_1$ at maximal current		0.9
Recommended power supply protection:		safety fuse 25 A/slow breaker 25A/C
Corresponds to standard		ČSN EN 60 974-1

Note:

X = load factor of the source at the determined ambient temperature (the ambient temperature is determined for 25°C)

X ... determines the time during which the source can be loaded by the given welding current without the thermal protection making any reactions.

This time refers to 10 minute working cycle.

## 3. Safety regulations

### 3.1. Introduction

The source is made in accordance with the present technical knowledge and safety requirements.

Nevertheless there is a danger of health or life hazard of the operator or other persons, damage or destruction of the welding machine and other material values of provider at unprofessional operation or wrong use.

Therefore the source operators must have relevant qualification and knowledge of the welding technology and must follow the instruction given in these operating instructions. It is necessary to remove immediately all failures, which can influence safe operation of the source.

### **3.2. Provider and operator duties**

The provider may allow the work with the source only to the persons, who are informed about the safety regulations, trained in the source manipulation and informed about the source operating instructions.

The person authorized to work with the source is obligated to follow all basic regulations about safety of operation, with special regard to warnings given in these operating instructions.

### **3.3. Personal protective outfit**

The source operator must have strong working shoes, which also insulate in wet environment, protective working gloves, shield with protective filter for eyes protection, suitable hardly flammable clothes and aural protectors at increased noise level.

When other persons are in the source vicinity, they must be instructed about possible danger, have the protective equipment available, possibly they must be protected with protective curtains or screens.

When some animals move within the reach of the welding workplace, it is necessary to adopt measures for their protection, the animals must be prevented from access to the welding workplace.

### **3.4. Risks resulting from the action of harmful vapours and gases**

The smoke and harmful vapours occurring during the welding are deleterious. It is necessary to exhaust them using suitable equipment and at the same time it is necessary to ensure sufficient supply of fresh air.

### **3.5. Risks resulting from flying off sparks**

It is necessary to remove all flammable objects from the source working area.

Volatile, flammable matters, whose vapours are easily inflammable, are especially dangerous.

No welding works can be carried out in the area serving for storage of gases, fuel, oils and similar matters, because also the remains of these matters represent explosion and fire risk.

Special regulations apply in area with fire and explosion risk – therefore their consistent following is necessary.

### **3.6. Other necessary measures**

Welding sources are generally in the term of interference voltage designated for work in the industrial area. When it is used in the living space, special measures are necessary for elimination of the interference. Therefore the user is obligated to evaluate whether he cannot cause electromagnetic problems in vicinity at the source installation. In the first place it is necessary to consider aspect of signal and telecommunication leads, radio and television receivers and transmitters, computers,

safety equipments, health of persons in vicinity, e.g. at the cardiac stimulators use etc.

The source must be disconnected from mains by unplugging the fork of the supply cable at any manipulation with the source (change of the standing place, removing of the covers at a regular inspection...).

### **3.7. Duties of operator before beginning work**

Before beginning work with the source the operator is obligated:

- to study these operating instructions
- to check: the supply cable (the insulation must not be damaged, the cable must be firmly fixed in the source and in the fork).  
The exchange of the damaged cable must be made by a worker with a corresponding electro-technical qualification.
- the welding cables (the insulation of the cables and electrode holder must not be damaged).  
In case of damage of the insulation of the cables and electrode holder, it is necessary to change them.

### **3.8. Duties of the source provider (owner)**

The source owner is obligated:

- to familiarize with these operating instructions
- to ensure immediate removal of failures and defects reported by the source operator
- to ensure regular inspections of the source
- to ensure regular revisions of the source in terms of ČSN 33 1500 and ČSN EN 05 0630

### **3.9. Regular inspections**

The aim of the inspection is to ensure failure-free operation of the source.

The inspection term is given with regard to frequency of use and environment in which the source works.

The inspection is carried out by a person with a corresponding electro-technical qualification.

The inspection does not replace the revision!!

Prior to carrying out of the inspection, the source must be disconnected from mains by unplugging the cable fork.

The inspection consists from the following steps:

- remove the covers of the source
- clean with the pressure air
- check the position of the conductors and state of electrical connections (repair the damaged ones)
- check to fixation of the cable in the machine and in the fork
- measure continuity of perimeter of the protective conductor  
Measurement of continuity of the protective circuit:
- connect the source output PELV to protective contact of the fork of the main cable and to the farthest part of the cover where danger voltage may occur.

Using a suitable regulator, ensure that alternate current 10A flows through the created circuit.

- measure a voltage drop between “the outside protective-conductor terminal” and various parts of the cover where danger voltage may occur. Value of this voltage must not exceed 2.6 V.

All found defects must be removed before putting into operation again!!

### **3.10. Regular revisions**

The source is subject to regular revisions according to ČSN 33 1500, ČSN 05 0630 and ČSN EN 60 974-1.

The revisions are carried out by workers with a corresponding electro-technical qualification and a report on revision (see ČSN 33 1500) must be issued.

ATTENTION: If the source does not meet some of next given points in safety respect, it is necessary to put it out of operation immediately.

#### a) Inspection

Mask off the source after disconnection of the power by unplugging the power supply. Carry out a visual inspection to see whether the electric parts are not damaged (selector switches, connectors, terminal box, el. supplies, bushings etc.). Carry out the control of screw and slip connections, their possible tightening or repair. Control visually whether the mechanical parts are not released or the safe air distances and surface ways are not disturbed. **Possible defects must be removed prior to further use.**

#### b) Control of the guard wire

The guard wire must not be damaged or interrupted. Test the strength of individual interconnections on the connections and connectors by hand.

Continuity of the guard circuit is checked with the power supply of minimally 10A from the source PELV and for the period of 1 s. Checking is carried out between clamp PE and various points, which are components of the guard circuit. The guard circuit is regarded as a compact if the voltage drop is up to 2.6V at the test current 10A.

#### c) Insulation resistance

Insulation resistance is measured with the voltage 500V ss. Its value according to EN 60 974-1 must not be lower than:

Input clamps (primary) – output clamps (secondary)	5 Mohm
Input clamps (primary) – frame	2.5 Mohm
Output clamps (secondary) - frame	2.5 Mohm
Control circuit (secondary transformers for power supply of the control circuit) - frame	2.5 Mohm

#### d) Open-circuit voltage

Voltage measured on the output clamps of the machine must be in tolerance  $\pm 10\%$  to the value given on the machine label.

### **3.11. Placing and installation**

Due to the stability ensuring it is necessary to place the source on a flat and solid base. Overturning of the source in operation can cause accident of the operator or life hazard.

In the area with fire and explosion risk it is necessary to follow the special regulations. Before the source is switched on, it is necessary to check whether the other persons cannot be endangered.

## **4. Thermal and short-circuit protection**

### **4.1. Thermal protection**

The source is equipped with a thermal protection, which protects it from damaging or destroying when exceeding the load factor (see point 2).

When the thermal protection is effective, the converter is blocked and there is neutral voltage on the source output.

This state is signalled by the yellow indicator "TEMP" on the front panel.

The cooling ventilator is also in operation at this state. Therefore do not switch the source off to allow it to cool down.

The thermal protection automatically restores the source function after cooling down and the yellow indicator TEMP is off.

### **ATTENTION!**

After the thermal protection effect, put the electrode holder on insulated place so that accidental short-circuit could not occur after restoring of the source function and thus a possible accident or damage to property could not occur.

### **4.2. Short-circuit protection**

When putting the source output into a long-term short-circuit in the MIG/MAG mode (longer than ca. 0.5 sec.), it will be blocked and on the front panel the red warning light "ERROR" will be on.

Restoration of the source function will be made by switching off the main switch and by switching it on again after ca. 1 sec. Before this it is necessary to remove the short-circuit, which caused the source blocking.

## **5. Putting into operation**

### **5.1. Preparation of the source for putting into operation**

Read the previous chapters, especially the chapter "3. Safety regulations" prior the first putting into operation.

Points 5.1.1 – 5.1.3. are valid for all welding processes for which the source is designated.

### **5.1.1. Source placing**

The source must be placed on a solid and flat base to ensure sufficient space for the cooling air supply and outlet in front of the both faces (ca. 500mm). The metal fall-out (e.g. at the grinding) must not be sucked into the machine directly.

The welding source is made with the cover IP 21, which means:

- protection against penetration of foreign matters with diameter bigger than 12 mm
- protection against vertically dripping water

With regard to the cover level, the source can be used and stored so that it would not be exposed to direct weather effects. Especially it is not allowed to use it and store it in the rain.

### **5.1.2. Welding cables**

The welding cables must have a cross-section corresponding to the current loading and must be finished with corresponding quick plugs.

The ground clamps and electrode holder must correspond to the current loading.

The welding conductors, electrode holder must not show any damage.

It is necessary to connect the ground clamp on the weldment as near to the welded place as possible.

### **5.1.3. Source connection to supply mains**

The source is constructed for connection to 5-conductor main TN-C-S with voltage 3x400V/50Hz (see point 2).

Installation of the main, plug for the source connection and its protection must correspond to the valid standards and electro-technical regulations.

## **5.2. Welding process MMA**

- connect the source to the supply mains
- switch on the main switch of the source "20"
- turn switch "9" into the position "MMA"
- connect the welding cables into the plugs "13" in polarity corresponding to the type of the electrode used
- press and release the button "5" – on A-metre "6" the segment "A" flashes
- set the required welding current by the regulator "8" – the current value is displayed by A-metre "6".

When welding A-metre measures the actual welding current. Its value stays displayed in A-metre for 3 s after finishing the welding so the operator can retrospectively control the set and actual value of the current.

### **5.2.1. Function "HOT-START"**

The function is controlled by the switch "16".

When the function "HOT-START" is switched on, the welding current is increased approximately by 50% of the set value for the period of 0.4 s at arc ignition.



This function is not recommended when welding of thin materials. Due to increase of the current, the material can be burnt up.

### **5.2.2. Use of the remote control**

If it is necessary to set amount of the welding current directly at the welding workplace, it is possible to connect the remote control "DO1" to the source.

- connect the remote control into the plug "15" on the front panel
- switch over the switch "9" into the position "REMOTE". Then the welding current is set by the potentiometer on the remote control "DO1".

Disconnection of the remote control is made by the switch "9" from the position "REMOTE" into the position "MMA" and by pulling the control connector from the source panel. Press the lever "PUSH" on the connector "REMOTE" to pull it out.

### **Attention**

If the switch "9" is in the position "REMOTE" and the remote control is disconnected from the connector "15", the source regulation is in an undefined position. This is indicated in such way that the source is fully blocked or provides little current.

### **5.3. Welding process MIG/MAG**

- switch over the switch "20" into the position "0"
- disconnect the source from the supply mains by pulling out the fork of the supply.

#### **5.3.1. Assembly of the gas bottle**

*Important: only a gas bottle with height max. 120 cm can be fixed to the source*

- put the bottle on the platform "25"
- put the bottle into the strap "19" and secure with a chain
- unscrew the protective cover of the gas bottle
- remove the sediment impurities by a short opening of the valve on the bottle (direct the opening in such way that the gas flow does not hit the operator or another person)
- screw on the pressure control valve and tight the backnut firmly
- if CO<sub>2</sub> is used, connect heating of the pressure control valve. Connect the heating cable of the pressure control valve to the connector "23" – polarity does not make any difference (heating is not necessary at flow smaller than 6 litres/min)
- interconnect the pressure control valve to the gas-fixture "22" using a hose

#### **5.3.2. Assembly of the welding torch**

Follow the instructions of the torch producer.

- insert the correctly assembled torch into the central connector "17" (bowden cable and diameter of the mouth must correspond to the welding wire)
- tighten the mounting nut of the torch by hand

### **5.3.3. Application of the wire coil and installation of the wire electrode**

- lift off the side plate of the source
- assemble feeding pulleys for the required diameter of the wire (assembly and change of the pulleys is described in point.5.3.5.)
- unscrew the plastic backnut of the coil carrier
- put the coil with the reduction carrier on the driver so that the arresting pin of the driver would lock into the opening of the carrier reduction (keep the correct direction of unwinding of the wire)
- secure the coil by screwing of the plastic nut

**Note:** Set the brake of the coil carrier so that the coil would not move any further when the pulleys stop. Set sensitively because excessive tightening of the brake would lead to the current overloading of the feeding mechanism engine. Setting of the brake is made with a screw, which is accessible after unscrewing of the plastic backnut of the coil carrier.

- put the tension device of the feeding mechanism forward, the pressure pulleys go up automatically
- insert the wire electrode through the leading jet of the pulley mechanism into the leading tube of the torch (in length ca. 5 cm)
- check whether the wire locked into the grooves in the feeding pulleys when pressing the levers with the pressing pulleys
- tip over the tension device into a vertical position
- adjust the pressure using a screw shackle so that the wire electrode could not be deformed and good feeding could be ensured at the same time
- put a cleaning felt swab onto the wire in front of the leading bowden cable and secure it with a clamp (this measure protects the feeding mechanism and welding torch from choking with impurities stuck on the wire)
- unfold the torch hose into a straight direction if possible
- connect the main cable "18"
- switch over the power switch "20" into the position "I"
- switch over the switch "9" into the position "MIG/MAG"
- switch over the switch "14" into the position "2T"
- press the leading button "26" – the feeding mechanism leads the wire into the torch
- when the wire goes out, release the button

**!! Do not point the torch at yourself or at any other persons when applying the wire!!**

### **5.3.4. Setting of flow of the protective gas**

- press the gas blow button "21"
- set the required gas flow by the adjusting screw on the lower part of the pressure control valve
- release the button

### **5.3.5. Assembly and change of the feeding pulleys**

The feeding pulleys must be adjusted to the diameter and composition of the wire used for welding to ensure the optimal feeding of the wire electrode.

The pulleys for welding with a steel wire of diameter 0.6 to 1.2 mm are supplied with the source.

The special "U" shape pulleys are necessary for welding aluminium (they are not supplied). The change procedure:

- put the power switch into the position "0"
- lift off the side plate of the source
- put the tension device forward – the pressure pulleys go up automatically
- unscrew the plastic retaining parts of the feeding pulleys and remove the pulleys
- put on the correct pulleys according to the used welding wire (value of the wire diameter is stamped on the side of the pulley)
- screw the plastic retaining parts
- put down the pressure pulleys
- tip over the tension device into a vertical position

### **5.3.6. Preparation of the source for welding, setting of the welding parameters**

The source is prepared according to points 5.3.1. to 5.3.5

- connect the ground welding cable into the plug "-13" and connect to weldment
- switch over the power switch of the source "20" into the position "1"
- check the position of the switch "9" – "MIG/MAG", the switch "14" - "2T"
- press the button "5"
- segment at "**m/min**" – setting of the feeding speed of the wire flashes on the upper display "6"
- set the required value of the wire feeding with the control element "8"
- press the button "5"
- segment at "**V**" – setting of the arc voltage flashes on the lower display "7"
- set the required value of the voltage with the control element "8"
- start welding

Thus the basic setting of the source for welding of MIG/MAG technology is finished.

- Arc dynamic is finally adjusted by the control "10"

If further adjustment of the process parameters is necessary, it is made by repeating the procedure according to point 5.3.6.

The source is supplied with other functions to enhance the useable qualities. These will be described below.

### **5.3.7. After-blow of protective gas**

This function enables to set a delayed valve switching off after finishing the welding process. The regulation range is 1s-20s.

This function is used when it is necessary to protect the weld from oxidation or when cooling the place of the weld finish.

Regulation is made with the potentiometer "27".

### **5.3.8. Burnback of the wire**

This function ensures that after finishing the welding the wire always burns out to the same length. The condition is that after releasing the torch button, the welder keeps the arc until its spontaneous extinction.

The function is controlled with the potentiometer "28".

### **5.3.9. Process of "tack welding"**

It is switched on and set with the potentiometer "11". This function ensures that the welding process always takes the same time.

- set the required time of welding with the potentiometer "11"
- switch "14" is in position "2T"
- start the welding process with the torch button – after the set time the process finishes automatically
- the process is repeated by releasing and new pressing of the torch button

The switch of the potentiometer "11" must be switched off (position "0") for use of the continuous mode of the welding.

### **5.3.10. Process of cyclic welding**

It is switched on and set with the potentiometer "11" and "12".

- set the time of the arc burning with the potentiometer "11"
- set the time of the arc burning interruption with the potentiometer "12"
- start the welding process with the torch button – when the arc burning is interrupted, move the torch into a new place of the weld. The process is repeated automatically.

The switches of the potentiometer "11" and "12" must be switched off (position "0") for use of the continuous mode of the welding.

### **5.3.11. Welding mode "4T"**

This mode is used for long welds. Benefit of such mode is that after starting the welding process it is not necessary to keep the torch button pressed.

Activation of "4T" function

- switch over the switch "14" into the position "4T"
- press the torch button for longer period (about 1s) and then release – thus the welding process starts

- after finishing – press the torch button for longer period (about 1s) and then release

### **5.3.12. Entering of the welding parameters MIG/MAG into memory**

This function is good in case that welding of a few same products is repeated.

The welding parameters are optimised on the given product and then they are entered into the machine memory.

The parameters are accessed from memory at repeating production of the given part by which use of the same condition during welding is ensured.

- switch over the switch of the welding procedures “9” into the position MIG
- press the button “4” PROG – Pxx is displayed on the lower display (number of the last free position in memory)
- press the button “4” PROG for longer period until the displays flash (thus the set data of the feeding speed and voltage volume are entered into the given memory cell) – it is possible to enter up to 15 programs
- return to the position of the parameter setting by a brief pressing of the button “4” PROG

### **5.3.13. Accessing the welding parameters MIG/MAG from memory**

- switch over the switch of the welding procedures “9” into the position PROG MIG
- briefly press the button “4” PROG
- Pxx is displayed on the lower display
- list the number of the program whose parameters we want to weld using the button “5”
- wait for short time until the parameters are displayed
- start welding

## **5.4. Welding WIG (TIG)**

### **5.4.1. Preparation of the source**

- switch over the switch “20” into the position “0”
- disconnect the source from the supply mains by pulling out the cable fork from the plug
- switch over the switch of the welding procedures “9” into the position ”WIG”
- connect the ground cable into the plug “13+”
- connect the assembled welding torch for WIG technology into the plug “13-“
- connect the protective gas hose to the torch
- switch over the switch ”16 – HOT-START“ into the position “0”
- open the gas valve with a control element on the torch
- set the required protective gas flow by the control element of the pressure control valve
- close the gas valve on the torch
- connect the source to the supply mains
- switch on the source with the switch “20”

### **5.4.2. Welding**

- press the button "5" – the segment "A" of the display "6" flashes
- set the required welding current with the control "8"
- start the protective gas with the control on the torch
- start welding by touching W-electrode to the weldment
- welding is finished by taking away the electrode from the weldment

Note: in this case it is convenient to use the remote control (see Chapter 5.2.2.). It is possible to carry out the start at lower current and when finishing welding it is possible to lower the current. Thus the W-electrode is saved.

## **6. Maintenance**

It is necessary to carry out a regular maintenance of the source, welding cables and torch to ensure trouble-free operation.

Prior to every maintenance it is necessary to disconnect the source from mains by unplugging the fork of the cable from the plug.

### **6.1. Everyday control**

This activity is carried out by the source operator. It is checked:

- state of the main cable
- state of the welding cables and torch
- cleanness of the source

### **6.2. Regular special inspections**

The control is made by a worker determined by the source owner for this activity. The worker must have a corresponding electro-technical qualification.

When inspecting the worker follows the requirements EN ČSN 05 0630.

- remove the upper cover of the source and blow settled impurities out with dry compressed air depending on the way of use and place where the source works, but twice a year at least
- turn to a special service or producer to remove all possible failures

### **6.3. Regular revisions**

When doing this activity, proceed according to point 3.10. Chapter.3

## **7. Disposal**

The source does not contain any special or dangerous wastes. Therefore it is possible to use the metal and plastic parts for recycling, the rest can be dumped when finishing the service life.