



EN

Welding machine

Saturn 301 FKG (M1.02 / M2.20 / M2.40)

Saturn 351 FKG (M1.02 / M2.20 / M2.40)

099-004968-EW501

Observe additional system documents!

13.09.2021

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General instructions

WARNING



Read the operating instructions!

The operating instructions provide an introduction to the safe use of the products.

- Read and observe the operating instructions for all system components, especially the safety instructions and warning notices!
- Observe the accident prevention regulations and any regional regulations!
- The operating instructions must be kept at the location where the machine is operated.
- Safety and warning labels on the machine indicate any possible risks. Keep these labels clean and legible at all times.
- The machine has been constructed to state-of-the-art standards in line with any applicable regulations and industrial standards. Only trained personnel may operate, service and repair the machine.
- Technical changes due to further development in machine technology may lead to a differing welding behaviour.

In the event of queries on installation, commissioning, operation or special conditions at the installation site, or on usage, please contact your sales partner or our customer service department on +49 2680 181-0.

A list of authorised sales partners can be found at www.ewm-group.com/en/specialist-dealers.

Liability relating to the operation of this equipment is restricted solely to the function of the equipment. No other form of liability, regardless of type, shall be accepted. This exclusion of liability shall be deemed accepted by the user on commissioning the equipment.

The manufacturer is unable to monitor whether or not these instructions or the conditions and methods are observed during installation, operation, usage and maintenance of the equipment.

An incorrectly performed installation can result in material damage and injure persons as a result. For this reason, we do not accept any responsibility or liability for losses, damages or costs arising from incorrect installation, improper operation or incorrect usage and maintenance or any actions connected to this in any way.

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The content of this document has been prepared and reviewed with all reasonable care. The information provided is subject to change; errors excepted.

Data security

The user is responsible for backing up data of all changes from the factory setting. The user is liable for erased personal settings. The manufacturer does not assume any liability for this.

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2 For your safety

2.1 Notes on using these operating instructions

DANGER

Working or operating procedures which must be closely observed to prevent imminent serious and even fatal injuries.

- Safety notes include the "DANGER" keyword in the heading with a general warning symbol.
- The hazard is also highlighted using a symbol on the edge of the page.

WARNING

Working or operating procedures which must be closely observed to prevent serious and even fatal injuries.

- Safety notes include the "WARNING" keyword in the heading with a general warning symbol.
- The hazard is also highlighted using a symbol in the page margin.

CAUTION

Working or operating procedures which must be closely observed to prevent possible minor personal injury.

- The safety information includes the "CAUTION" keyword in its heading with a general warning symbol.
- The risk is explained using a symbol on the edge of the page.



Technical aspects which the user must observe to avoid material or equipment damage.

Instructions and lists detailing step-by-step actions for given situations can be recognised via bullet points, e.g.:

- Insert the welding current lead socket into the relevant socket and lock.

2.2 Explanation of icons

Symbol	Description	Symbol	Description
	Indicates technical aspects which the user must observe.		Activate and release / Tap / Tip
	Switch off machine		Release
	Switch on machine		Press and hold
			Switch
	Incorrect / Invalid		Turn
	Correct / Valid		Numerical value – adjustable
	Input		Signal light lights up in green
	Navigation		Signal light flashes green
	Output		Signal light lights up in red
	Time representation (e.g.: wait 4 s / actuate)		Signal light flashes red
	Interruption in the menu display (other setting options possible)		
	Tool not required/do not use		
	Tool required/use		

2.3 Safety instructions

WARNING



Risk of accidents due to non-compliance with the safety instructions!

Non-compliance with the safety instructions can be fatal!

- Carefully read the safety instructions in this manual!
- Observe the accident prevention regulations and any regional regulations!
- Inform persons in the working area that they must comply with the regulations!



Risk of injury from electrical voltage!

Voltages can cause potentially fatal electric shocks and burns on contact. Even low voltages can cause a shock and lead to accidents.

- Never touch live components such as welding current sockets or stick, tungsten or wire electrodes!
- Always place torches and electrode holders on an insulated surface!
- Wear the full personal protective equipment (depending on the application)!
- The machine may only be opened by qualified personnel!
- The device must not be used to defrost pipes!



Hazard when interconnecting multiple power sources!

If a number of power sources are to be connected in parallel or in series, only a technical specialist may interconnect the sources as per standard IEC 60974-9:2010: Installation and use and German Accident Prevention Regulation BVG D1 (formerly VBG 15) or country-specific regulations.

Before commencing arc welding, a test must verify that the equipment cannot exceed the maximum permitted open circuit voltage.

- Only qualified personnel may connect the machine.
- When taking individual power sources out of operation, all mains and welding current leads must be safely disconnected from the welding system as a whole. (Hazard due to reverse polarity voltage!)
- Do not interconnect welding machines with pole reversing switch (PWS series) or machines for AC welding since a minor error in operation can cause the welding voltages to be combined, which is not permitted.



Risk of injury due to radiation or heat!

Arc radiation can lead to skin and eye injuries.

Contact with hot workpieces and sparks can lead to burns.

- Use hand shield or welding helmet with the appropriate safety level (depends on the application).
- Wear dry protective clothing (e.g. hand shield, gloves, etc.) in accordance with the applicable regulations of your country.
- Persons who are not directly involved should be protected with a welding curtain or suitable safety screen against radiation and the risk of blinding!

 **WARNING****Risk of injury due to improper clothing!**

During arc welding, radiation, heat and voltage are sources of risk that cannot be avoided. The user has to be equipped with the complete personal protective equipment at all times. The protective equipment has to include:

- Respiratory protection against hazardous substances and mixtures (fumes and vapours); otherwise implement suitable measures such as extraction facilities.
- Welding helmet with proper protection against ionizing radiation (IR and UV radiation) and heat.
- Dry welding clothing (shoes, gloves and body protection) to protect against warm environments with conditions comparable to ambient temperatures of 100 °C or higher and arcing and work on live components.
- Hearing protection against harming noise.

**Explosion risk!**

Apparently harmless substances in closed containers may generate excessive pressure when heated.

- Move containers with inflammable or explosive liquids away from the working area!
- Never heat explosive liquids, dusts or gases by welding or cutting!

**Fire hazard!**

Due to the high temperatures, sparks, glowing parts and hot slag that occur during welding, there is a risk of flames.

- Be watchful of potential sources of fire in the working area!
- Do not carry any easily inflammable objects, e.g. matches or lighters.
- Ensure suitable fire extinguishers are available in the working area!
- Thoroughly remove any residue of flammable materials from the workpiece prior to starting to weld.
- Only further process workpieces after they have cooled down. Do not allow them to contact any flammable materials!

⚠ CAUTION



Smoke and gases!

Smoke and gases can lead to breathing difficulties and poisoning. In addition, solvent vapour (chlorinated hydrocarbon) may be converted into poisonous phosgene due to the ultraviolet radiation of the arc!

- Ensure that there is sufficient fresh air!
- Keep solvent vapour away from the arc beam field!
- Wear suitable breathing apparatus if appropriate!



Noise exposure!

Noise exceeding 70 dBA can cause permanent hearing damage!

- Wear suitable ear protection!
- Persons located within the working area must wear suitable ear protection!



According to IEC 60974-10, welding machines are divided into two classes of electromagnetic compatibility (the EMC class can be found in the Technical data) > see 8 chapter:



Class A machines are not intended for use in residential areas where the power supply comes from the low-voltage public mains network. When ensuring the electromagnetic compatibility of class A machines, difficulties can arise in these areas due to interference not only in the supply lines but also in the form of radiated interference.



Class B machines fulfil the EMC requirements in industrial as well as residential areas, including residential areas connected to the low-voltage public mains network.

Setting up and operating

When operating arc welding systems, in some cases, electro-magnetic interference can occur although all of the welding machines comply with the emission limits specified in the standard. The user is responsible for any interference caused by welding.

In order to **evaluate** any possible problems with electromagnetic compatibility in the surrounding area, the user must consider the following: (see also EN 60974-10 Appendix A)

- Mains, control, signal and telecommunication lines
- Radios and televisions
- Computers and other control systems
- Safety equipment
- The health of neighbouring persons, especially if they have a pacemaker or wear a hearing aid
- Calibration and measuring equipment
- The immunity to interference of other equipment in the surrounding area
- The time of day at which the welding work must be carried out

Recommendations for reducing interference emission

- Mains connection, e.g. additional mains filter or shielding with a metal tube
- Maintenance of the arc welding system
- Welding leads should be as short as possible and run closely together along the ground
- Potential equalization
- Earthing of the workpiece. In cases where it is not possible to earth the workpiece directly, it should be connected by means of suitable capacitors.
- Shielding from other equipment in the surrounding area or the entire welding system



Electromagnetic fields!

The power source may cause electrical or electromagnetic fields to be produced which could affect the correct functioning of electronic equipment such as IT or CNC devices, telecommunication lines, power cables, signal lines and pacemakers.



- Observe the maintenance instructions > see 6.2 chapter!
- Unwind welding leads completely!
- Shield devices or equipment sensitive to radiation accordingly!
- The correct functioning of pacemakers may be affected (obtain advice from a doctor if necessary).

⚠ CAUTION**Obligations of the operator!**

The respective national directives and laws must be complied with when operating the machine!

- Implementation of national legislation relating to framework directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work and associated individual guidelines.
- In particular, directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work.
- The regulations applicable to occupational safety and accident prevention in the country concerned.
- Setting up and operating the machine as per IEC 60974.-9.
- Brief the user on safety-conscious work practices on a regular basis.
- Regularly inspect the machine as per IEC 60974.-4.



The manufacturer's warranty becomes void if non-genuine parts are used!

- ***Only use system components and options (power sources, welding torches, electrode holders, remote controls, spare parts and replacement parts, etc.) from our range of products!***
- ***Only insert and lock accessory components into the relevant connection socket when the machine is switched off.***

Requirements for connection to the public mains network

High-performance machines can influence the mains quality by taking current from the mains network. For some types of machines, connection restrictions or requirements relating to the maximum possible line impedance or the necessary minimum supply capacity at the interface with the public network (Point of Common Coupling, PCC) can therefore apply. In this respect, attention is also drawn to the machines' technical data. In this case, it is the responsibility of the operator, where necessary in consultation with the mains network operator, to ensure that the machine can be connected.

2.4 Transport and installation**⚠ WARNING****Risk of injury due to improper handling of shielding gas cylinders!**

Improper handling and insufficient securing of shielding gas cylinders can cause serious injuries!

- Observe the instructions from the gas manufacturer and any relevant regulations concerning the use of compressed air!
- Do not attach any element to the shielding gas cylinder valve!
- Prevent the shielding gas cylinder from heating up.

CAUTION



Risk of accidents due to supply lines!

During transport, attached supply lines (mains leads, control cables, etc.) can cause risks, e.g. by causing connected machines to tip over and injure persons!

- Disconnect all supply lines before transport!



Risk of tipping!

There is a risk of the machine tipping over and injuring persons or being damaged itself during movement and set up. Tilt resistance is guaranteed up to an angle of 10° (according to IEC 60974-1).

- Set up and transport the machine on level, solid ground.
- Secure add-on parts using suitable equipment.



Risk of accidents due to incorrectly installed leads!

Incorrectly installed leads (mains, control and welding leads or intermediate hose packages) can present a tripping hazard.

- Lay the supply lines flat on the floor (avoid loops).
- Avoid laying the leads on passage ways.



Risk of injury from heated coolant and its connections!

The coolant used and its connection or connection points can heat up significantly during operation (water-cooled version). When opening the coolant circuit, escaping coolant may cause scalding.

- Open the coolant circuit only when the power source or cooling unit is switched off!
- Wear proper protective equipment (protective gloves)!
- Seal open connections of the hose leads with suitable plugs.



The units are designed for operation in an upright position!

Operation in non-permissible positions can cause equipment damage.

- ***Only transport and operate in an upright position!***



Accessory components and the power source itself can be damaged by incorrect connection!

- ***Only insert and lock accessory components into the relevant connection socket when the machine is switched off.***
- ***Comprehensive descriptions can be found in the operating instructions for the relevant accessory components.***
- ***Accessory components are detected automatically after the power source is switched on.***



Protective dust caps protect the connection sockets and therefore the machine against dirt and damage.

- ***The protective dust cap must be fitted if there is no accessory component being operated on that connection.***
- ***The cap must be replaced if faulty or if lost!***

3 Intended use

WARNING



Hazards due to improper usage!

The machine has been constructed to the state of the art and any regulations and standards applicable for use in industry and trade. It may only be used for the welding procedures indicated at the rating plate. Hazards may arise for persons, animals and material objects if the equipment is not used correctly. No liability is accepted for any damages arising from improper usage!

- The equipment must only be used in line with its designated purpose and by trained or expert personnel!
- Do not improperly modify or convert the equipment!

3.1 Applications

Arc welding systems for gas-shielded metal-arc welding.

It may be possible to expand the range of functions by using accessories (see the documentation in the relevant chapter).

3.2 Documents which also apply

3.2.1 Warranty

For more information refer to the "Warranty registration" brochure supplied and our information regarding warranty, maintenance and testing at www.ewm-group.com!

3.2.2 Declaration of Conformity



This product corresponds in its design and construction to the EU directives listed in the declaration. The product comes with a relevant declaration of conformity in the original.

The manufacturer recommends carrying out the safety inspection according to national and international standards and guidelines every 12 months.

3.2.3 Welding in environments with increased electrical hazards



Power sources with this marking can be used for welding in an environment with increased electrical hazard (e.g. boilers). For this purpose, appropriate national or international regulations must be followed. The power source must not be placed in the danger zone!

3.2.4 Service documents (spare parts and circuit diagrams)

WARNING



Do not carry out any unauthorised repairs or modifications!

To avoid injury and equipment damage, the unit must only be repaired or modified by specialist, skilled persons!

The warranty becomes null and void in the event of unauthorised interference.

- Appoint only skilled persons for repair work (trained service personnel)!

Original copies of the circuit diagrams are enclosed with the unit.

Spare parts can be obtained from the relevant authorised dealer.

3.2.5 Calibration/Validation

An original certificate is enclosed with the product. The manufacturer recommends calibration / validation at intervals of 12 months.

4 Machine description – quick overview

4.1 Front view / side view from the right

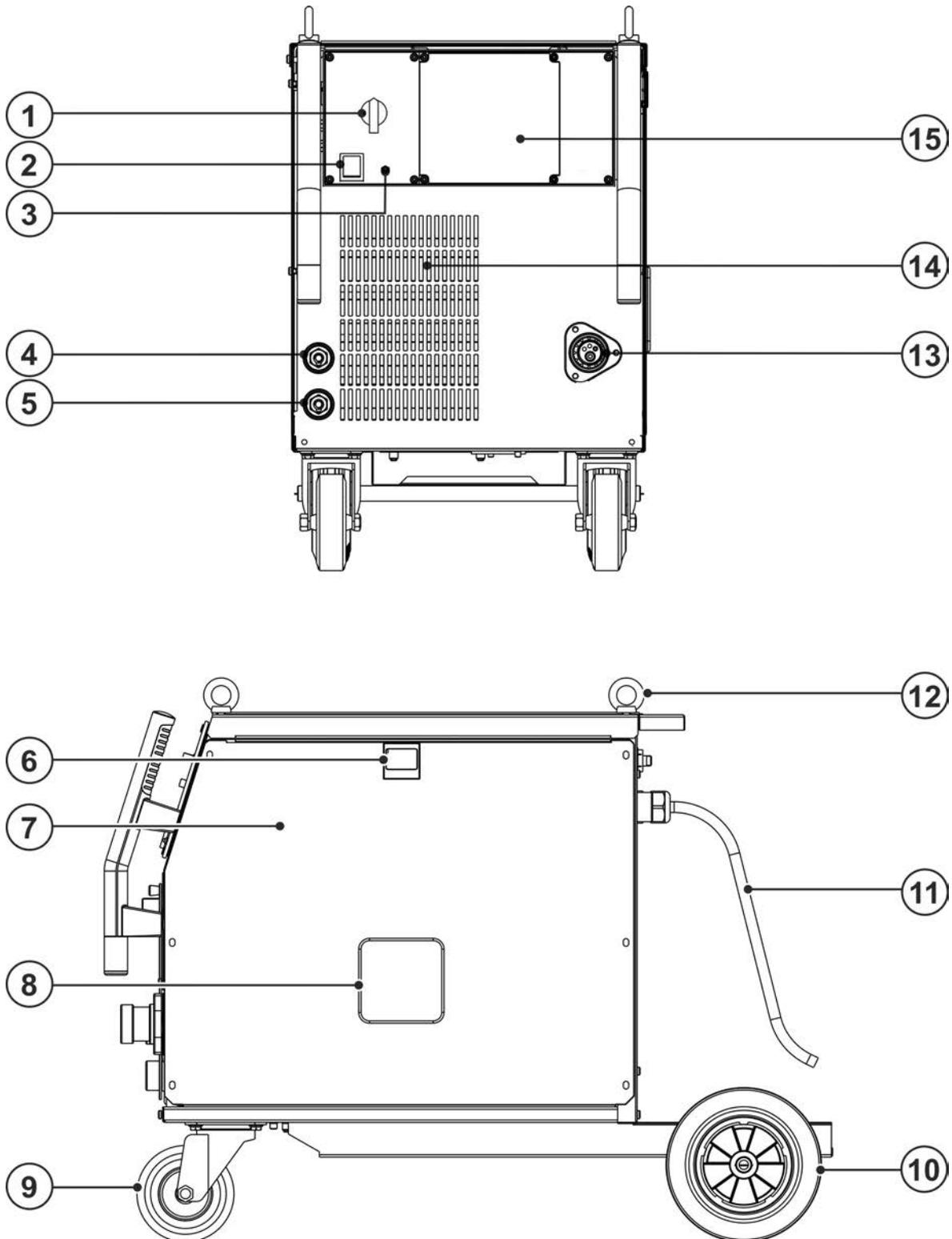


Figure 4-1

Item	Symbol	Description
1		Welding voltage step switch To set the welding voltage
2		Main Switch Switching the machine on or off.
3		Signal light, Functional error On when excess temperature detected
4		Connection socket, workpiece lead "Hard" choke tapping
5		Connection socket, workpiece lead "Medium" choke tapping
6		Slide latch, lock for the protective cap
7		Protective cap Cover for the wire feed mechanism and other operating elements. Depending on the machine series, additional stickers with information on the replacement parts and JOB lists will be located on the inside.
8		Wire spool inspection window Check wire supply
9		Wheels, guide castors
10		Wheels, fixed castors
11		Mains connection cable > see 5.1.8 chapter
12		Lifting lug > see 5.1.2 chapter
13		Welding torch connection (Euro torch connector) Welding current, shielding gas and torch trigger integrated
14		Cooling air inlet
15		Machine control > see 4.3 chapter

4.2 Rear view / interior view from the right

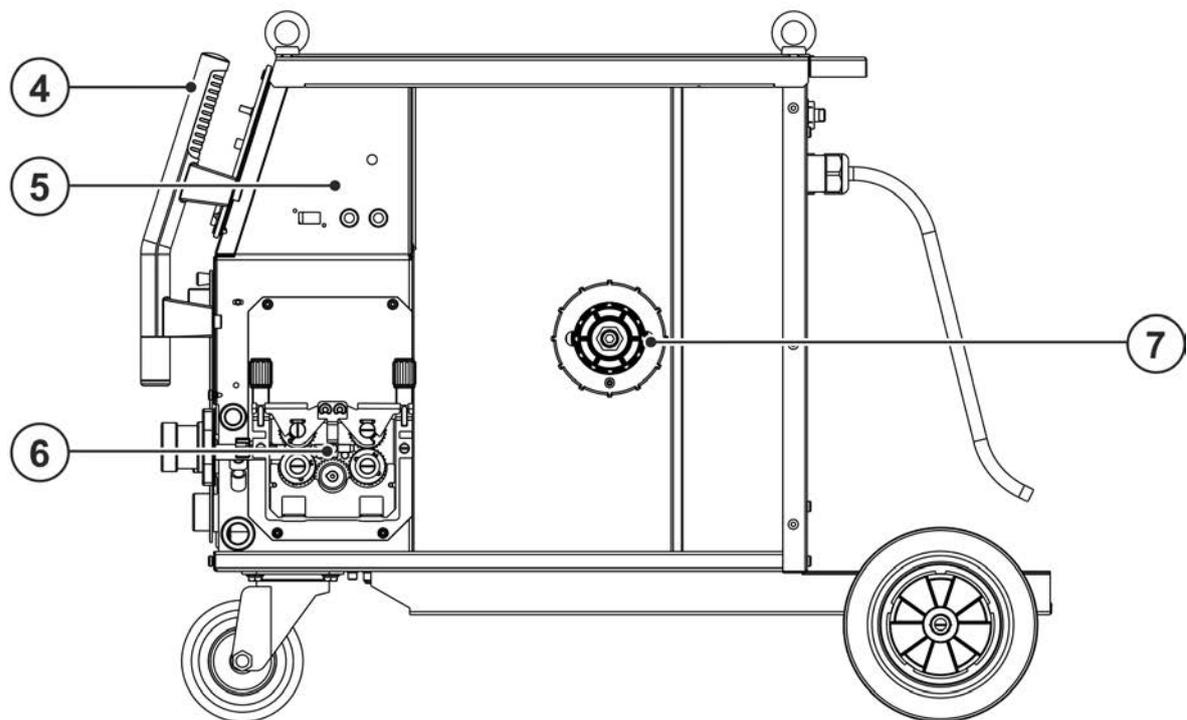
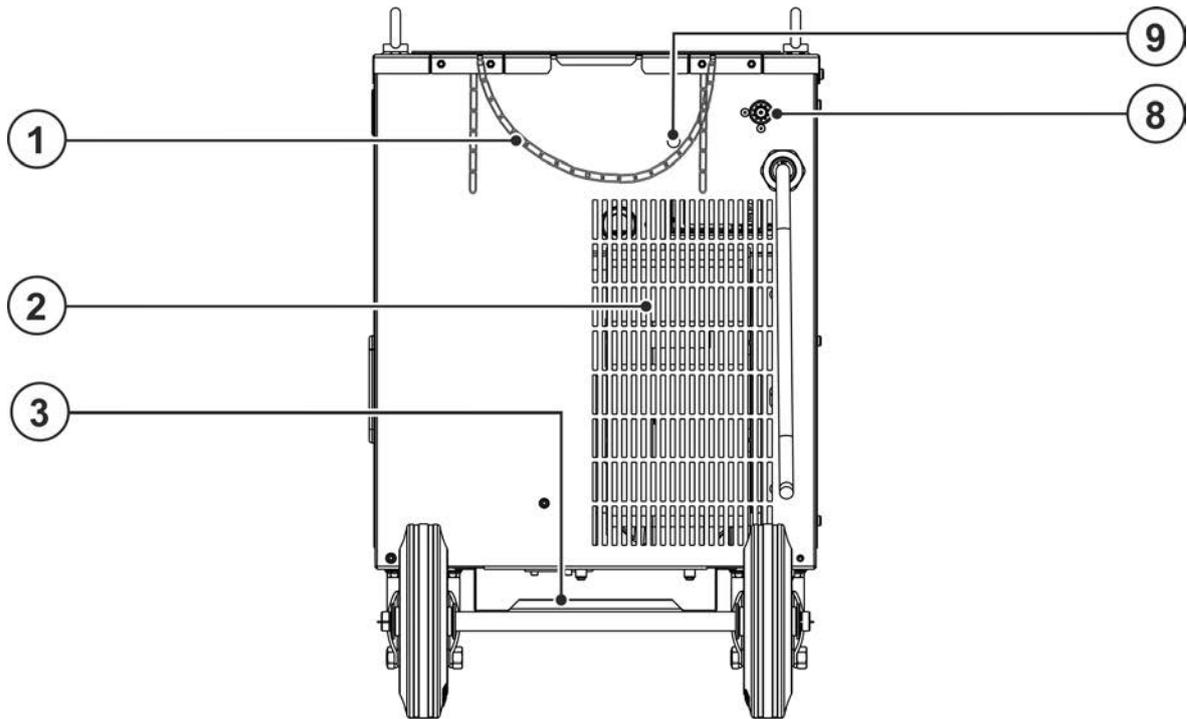


Figure 4-2

Item	Symbol	Description
1		Securing elements for shielding gas cylinder (strap/chain)
2		Cooling air outlet
3		Bracket for shielding gas cylinder
4		Carrying handle
5		Operating elements > see 4.3.1.1 chapter
6		Wire feed unit
7		Wire spool holder
8		Connection thread - G¹/₄" Shielding gas connection (inlet)
9		Key button, Automatic cutout Wire feed motor supply voltage fuse (press to reset a triggered fuse)

4.3 Machine control – Operating elements

4.3.1 Welding machine control M1.02

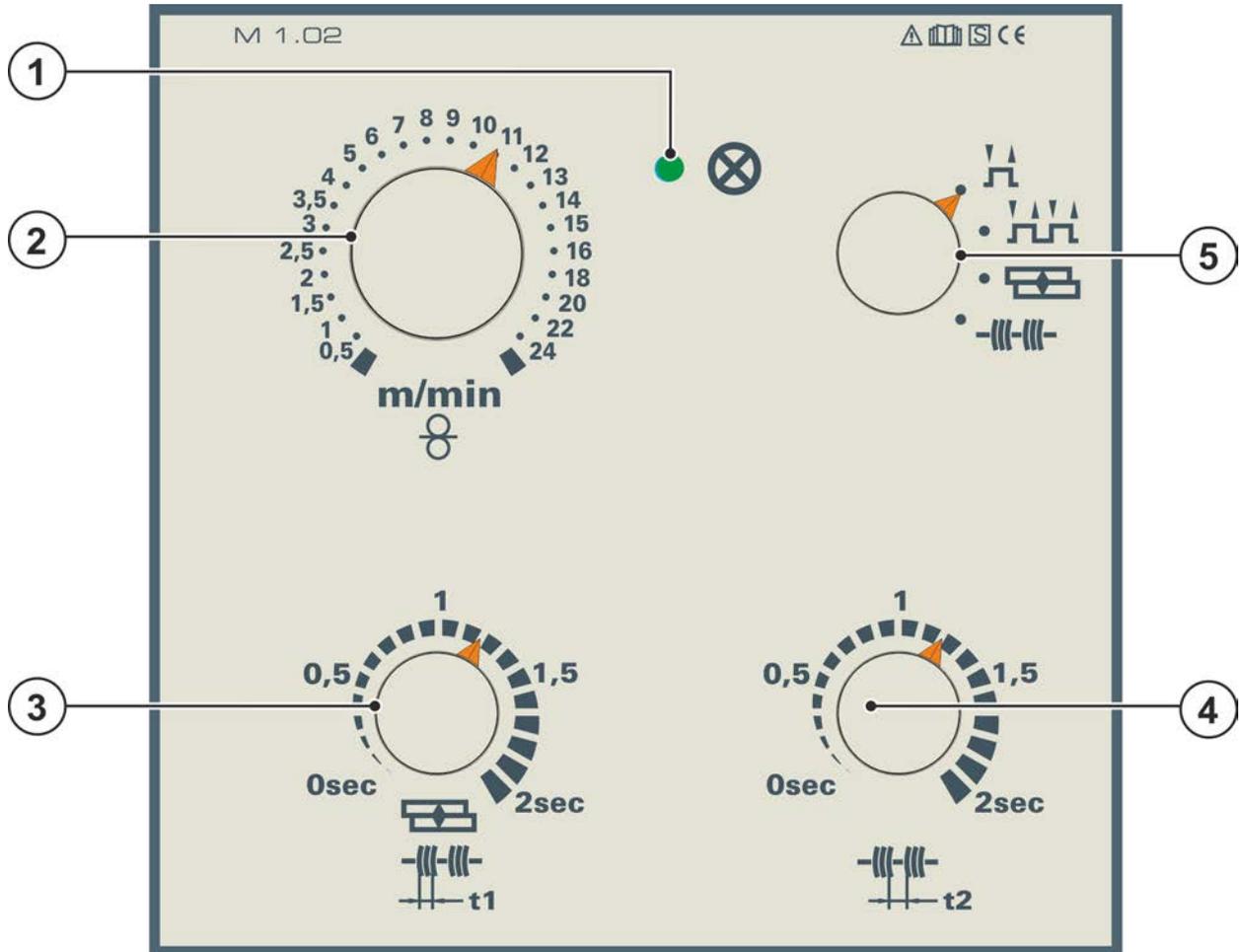


Figure 4-3

Item	Symbol	Description
1		Ready for operation signal light Signal light on when the machine is switched on and ready for operation
2		Rotary dial, Wire speed setting Infinite adjustment of the wire speed.
3		Rotary dial, Spot and interval times Infinite adjustment of the welding time (0-2s) in "Spots and interval" operating mode
4		Rotary dial, Pause time Infinite adjustment of the pause time (0-2s) in "Interval" operating mode
5		"Operating mode" selector switch Changeover between non-latched, latched, spot welding, interval

4.3.1.1 Internal operating elements

The maximum possible machine configuration is given in the text description.
If necessary, the optional connection may need to be retrofitted > see 9 chapter.

- Unlock the right-hand cover on the machine.
- Tilt the cover forwards, then remove upwards.

There are other operating elements for parameter setting on the machine.

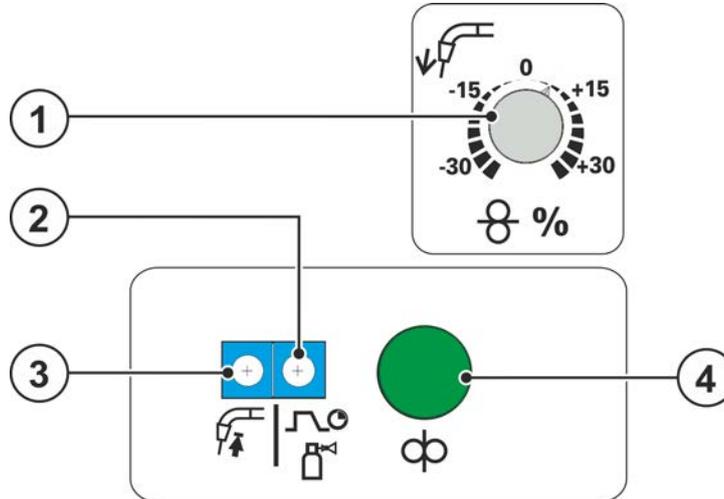


Figure 4-4

All details in percent relate to the values stored in the characteristics.

Item	Symbol	Description
1		Rotary dial, Wire creep (optional) +/- 30%
2		"Gas post-flow time" trimmer Setting range 0.2-10 s
3		Trimmer, Burn-back +/- 50%
4		Push-button, wire inching Currentless wire inching

4.3.1.2 Setting the operating point (welding output)

This control works according to the twin-knob operation principle. To set the operating point, only the wire speed and the welding voltage need to be set according to the material and the electrode diameter.

Operating element	Action	Result
		Wire speed setting
		Welding voltage setting

4.3.2 M2.20 welding machine control

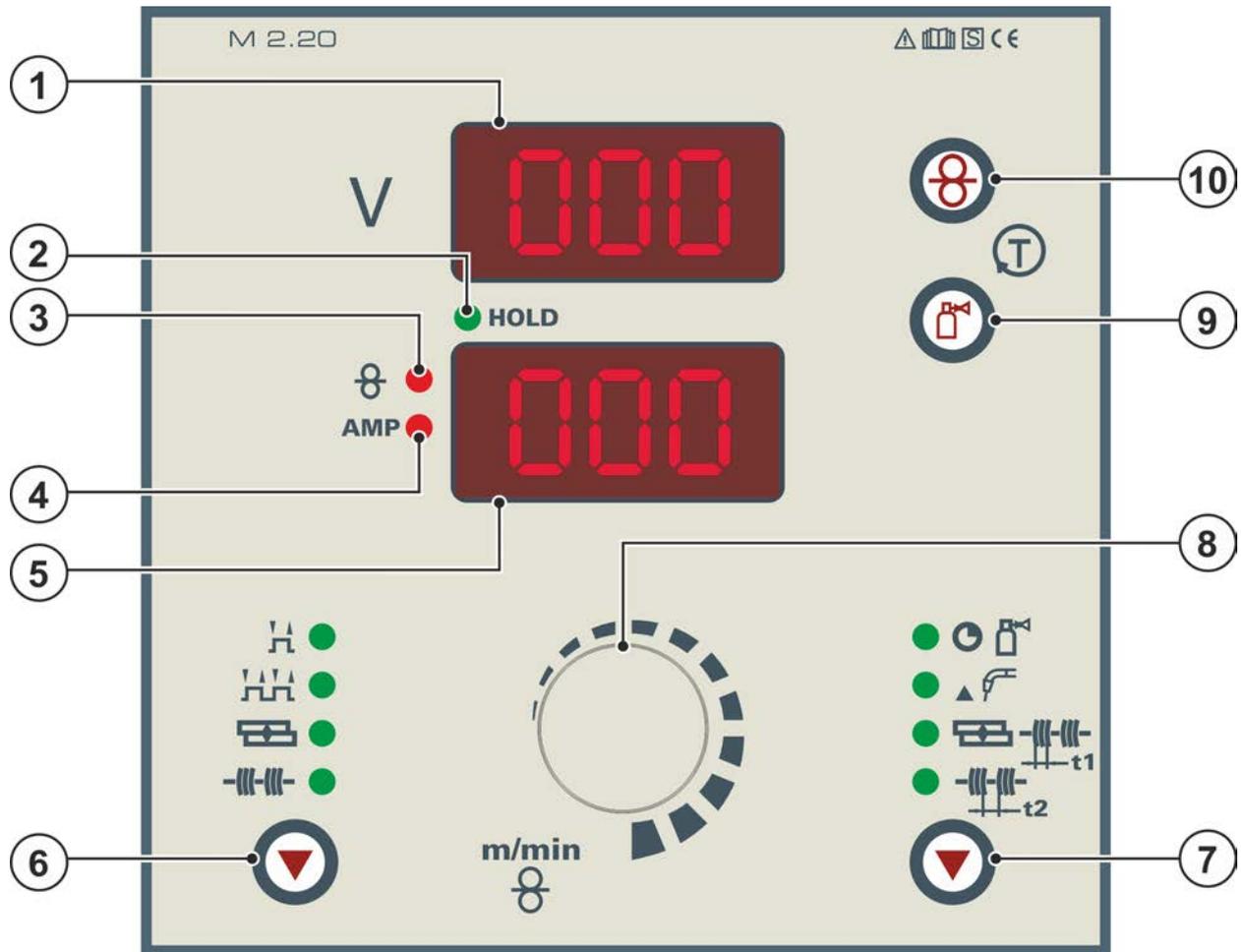


Figure 4-5

Item	Symbol	Description
1		Upper, display Displays welding voltage or person who designated the runtime parameters
2	HOLD	Signal light, HOLD Lit: Display shows the last parameters used for welding. Not lit: Display shows the setpoint values or current values during welding.
3		Signal light, Wire speed Lights when the wire speed is shown on the display.
4	AMP	Current signal light Lights when the current is shown on the display.
5		Lower display Display of wire feed speed, welding current and runtime parameters.
6		Operating mode button H----- Non-latched HH----- Latched ◀----- Spots - - - Interval
7		Sequence parameter push-button ⌚----- Gas post-flow time ▲----- Wire burn-back - - - Spot time/pulse time - - - Pulse pause

Item	Symbol	Description
8		Wire feed speed/welding parameter rotary knob Infinite adjustment of the wire feed speed/welding parameters and corresponding values
9		Gas test push-button > see 5.1.5.3 chapter
10		Wire inching push-button For potential- and gas-free inching of the wire electrode through the hose package to the welding torch.

4.3.2.1 Setting the operating point (welding output)

This control works according to the twin-knob operation principle. To set the operating point, only the wire speed and the welding voltage need to be set according to the material and the electrode diameter.

Operating element	Action	Result
		Wire speed setting
		Welding voltage setting

4.3.2.2 Setting the operating mode and runtime parameters

The parameters are pre-set in the control but can be adjusted individually.

If there is no user action within 5 seconds during the setting process, the control interrupts the process and switches back to the standard display.

Operating element	Action	Result
	n x	Select operating mode: H----- Non-latched HH----- Latched [Spot]----- Spots [Interval]----- Interval
	n x	Select welding parameter: [GnS]----- Set gas post-flow time "GnS" (0.0 s to 10.0 s) [drb]----- Set wire burn-back time "drb" (-50% to 50%) [t1]----- Spot/interval time "t1" (0.1 s to 5.0 s) [t2]----- Interval/pause "t2" (0.1 s to 2.0 s) The selected parameter is shown on the display
		Set the parameter chosen

4.3.2.3 Setting the expert parameters

The parameters are pre-set in the control but can be adjusted individually.

If there is no user action within 5 seconds during the setting process, the control interrupts the process and switches back to the standard display.

Operating element	Action	Result
	1 x	Select expert parameters. The combination of button must be pressed within 3 seconds.

	1 x 	
	2 x 	
	n x 	Select expert parameters:  Gas pre-flow time "GvS" (0 s to 10 s)  Wire creep speed "On" 0.5 – 24 m/min  Ignition time "tZn" (0 ms to 500 ms) The selected parameter is shown on the display.
		Set the parameter chosen.

4.3.2.4 Explanation of symbols

Symbol	Meaning
GnS	"GnS" - Gas post-flows
drb	"drb" - Wire burn-back
t1	"t1" - Spot time
t2	"t2" - Interval time
GvS	"GvS" - Gas pre-flows
Ein	"On" - Wire creep
tZn	"tZn" - Ignition time
tyP	"tyP" - Machine type (type table, > see 7.2 chapter)

4.3.2.5 Welding parameter ignition time "tZn" diagram

The arc striking is positively affected by the adjustable ignition time. After the arc striking, the wire feeder continues operating in wire creep speed for the set ignition time. This behaviour occurs whenever the pause time between the welding operations is at least 1.5 seconds. The ignition time can be set in the Expert menu using parameter tZn.

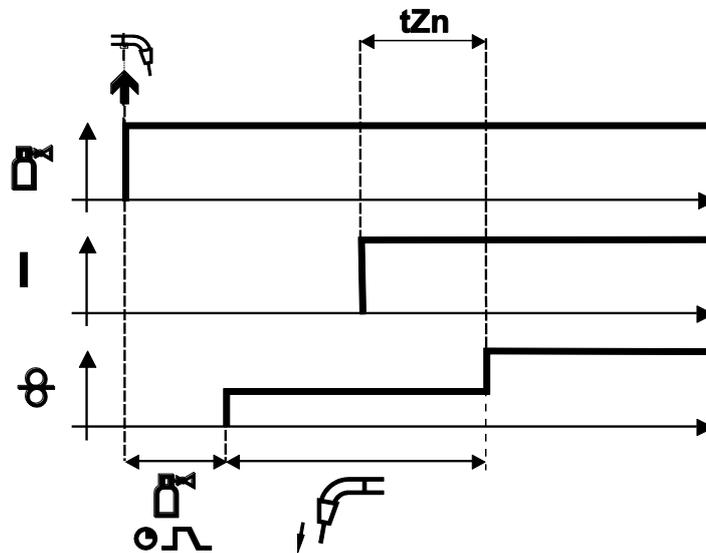


Figure 4-6

4.3.3 M2.40 welding machine control

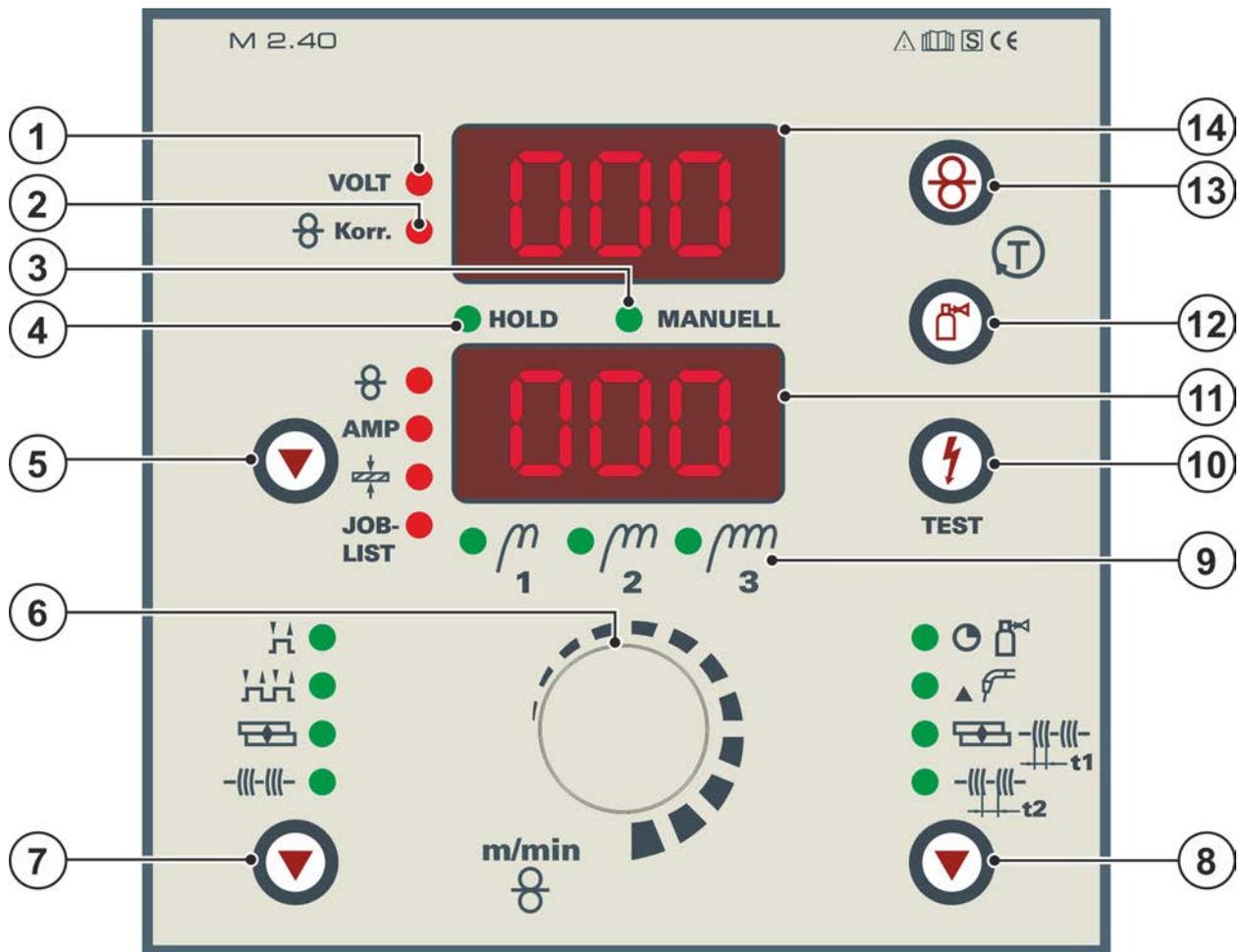


Figure 4-7

Item	Symbol	Description
1	VOLT	Signal light Voltage On when the welding voltage or open circuit voltage is displayed.
2	♀ Korr.	Signal light, Wire correction On when the correction value of the wire speed is being displayed.
3	MANUELL	Signal light, MANUAL Signal light is on when the machine is not in JOB mode. All parameter settings are carried out "manually" by the user (JOB 0).
4	HOLD	Signal light, HOLD Lit: Display shows the last parameters used for welding. Not lit: Display shows the setpoint values or current values during welding.
5	▼	Button, Welding task / operating point ♀----- Wire speed display (m/min) AMP----- Welding current display (A) ♀----- Sheet metal thickness display (mm) JOB-LIST ----- Display and select the jobs (welding tasks, selection via job list). Change the JOBS by holding down the button (approx. 3 sec), LED flashes.
6		Wire feed speed/welding parameter rotary knob Infinite adjustment of the wire feed speed/welding parameters and corresponding values

Item	Symbol	Description
7		Operating mode button ----- Non-latched ----- Latched ----- Spots ----- Interval
8		Sequence parameter push-button ----- Gas post-flow time ----- Wire burn-back ----- Spot time/pulse time ----- Pulse pause
9		Signal light, Choke tappings Depending on the machine design, there are two or three workpiece connection sockets on the welding machine (choke tappings). The machine displays the recommended workpiece connection in JOB mode (see relevant images on the connection sockets). Choke tapping 1 (hard), workpiece lead connection socket Choke tapping 2 (medium), workpiece lead connection socket Choke tapping 3 (soft), workpiece lead connection socket
10		Button, Test welding parameters > see 4.3.3.2 chapter
11		Lower display Display of wire feed speed, welding current, sheet metal thickness, JOB number and runtime parameters.
12		Push-button gas test / rinse hose package > see 5.1.5.3 chapter
13		Push-button, wire inching Potential- and gas-free inching of the wire electrode through the hose package to the welding torch > see 5.1.10.3 chapter.
14		Upper display Display of the welding voltage, correction value for the wire speed or parameter designations for runtime parameters.

4.3.3.1 Welding task selection

This microprocessor-controlled control works according to the one-dial operation principle.

Only the gas type, material type and wire electrode diameter should be set as the JOB number on the control, as well as welding output via the step switch. This defines the welding task and the system specifies the optimum wire feed speed for the required operating point after the "Test button" is pressed.

These settings are retained after the machine is switched off. After switching on again, the parameters previously set can be used to continue welding.

The user has the option to correct the wire feed speed according to the welding task or individual requirements.

The welding task setting can also be made using the two-dial operation principle, however. To do this, set the "JOB 0" (manual / no program) from the JOB list, the welding voltage on the step switch, and the wire speed on the rotary dial. Other parameters are set as described under "Using synergic mode".

Operating element	Action	Result
	X x	JOB-LIST -----Select "JOB". When the "JOB" LED lights, press and hold down the button.
	2 sec.	JOB-LIST -----"JOB" LED flashes.

The welder uses the filler material inserted and the connected shielding gas to select the JOB number according to the "JOB-LIST". The "JOB-LIST" is a sticker fixed near the wire feed drive unit.

Operating element	Action	Result
		Set JOB number (0-24).
	1 x	Confirm selection.

ewm®		JOB-LIST				094-010488-00500						
Material	Gas	Ø Wire				Job-Nr.	Material	Gas	Ø Wire			
		0,8	1,0	1,2	1,6							
		SG2/3	CO ₂ 100	1	2				3	4	CrNi	Ar98/2
G3/4 Si1	Ar82/18	5	6	7	8	AlMg	Ar100	13	14	15	16	
AlSi	Ar100	17	18	19	20	Al99	Ar100	21	22	23	24	
Manuell / no program		0										

Figure 4-8

4.3.3.2 Setting the operating point (welding output)

The operating point setting in JOB "0" (manual) is carried out as described in the chapter of the same name for control M2.4x. The following settings are therefore only intended for work in JOBS 1-24.

Operating element	Action	Result
		Select the parameter via which the welding output is to be set: ----- using the panel thickness ----- using the wire speed AMP ----- using the welding current
		Hold down the "TEST" button and at the same time set the operating point on the step switch. The display shows the required parameters and the open circuit voltage. If the "Volt" and "Wire feed correction" diodes are flashing, this indicates an error (e.g. short circuit between torch and workpiece, inductance error, etc). To correct the error, press "TEST" again.

If the operating mode has already been selected, all the necessary settings will have been activated and welding can be started.

4.3.3.3 Setting the wire correction

The wire speed (arc length) can be modified using the wire correction if required.

Operating element	Action	Result
		Set the wire correction value

4.3.3.4 Setting the operating mode and runtime parameters

The parameters are pre-set in the control but can be adjusted individually.

If there is no user action within 5 seconds during the setting process, the control interrupts the process and switches back to the standard display.

Operating element	Action	Result
		Select operating mode: ----- Non-latched ----- Latched ----- Spots ----- Interval
		Select welding parameter: ----- Set gas post-flow time "GnS" (0.0 s to 10.0 s) ----- Set wire burn-back time "drb" (-50% to 50%) ----- Spot/interval time "t1" (0.1 s to 5.0 s) ----- Interval/pause "t2" (0.1 s to 2.0 s) The selected parameter is shown on the display
		Set the parameter chosen

4.3.3.5 Setting the expert parameters

The parameters are pre-set in the control but can be adjusted individually.

If there is no user action within 5 seconds during the setting process, the control interrupts the process and switches back to the standard display.

Operating element	Action	Result
	1 x 	Select expert parameters. The combination of button must be pressed within 3 seconds.
	1 x 	
	2 x 	
    	n x 	Select expert parameters:  Gas pre-flow time "GvS" (0 s to 10 s)  Wire creep speed "On" 0.5 – 24 m/min  Ignition time "tZn" (0 ms to 500 ms) The selected parameter is shown on the display.
		Set the parameter chosen.

4.3.3.6 Explanation of symbols

Symbol	Meaning
	"GnS" - Gas post-flows
	"drb" - Wire burn-back
	"t1" - Spot time
	"t2" - Interval time
	"GvS" - Gas pre-flows
	"On" - Wire creep
	"tZn" - Ignition time
	"tyP" - Machine type (type table, > see 7.2 chapter)

4.3.3.7 Welding parameter ignition time "tZn" diagram

The arc striking is positively affected by the adjustable ignition time. After the arc striking, the wire feeder continues operating in wire creep speed for the set ignition time. This behaviour occurs whenever the pause time between the welding operations is at least 1.5 seconds. The ignition time can be set in the Expert menu using parameter tZn.

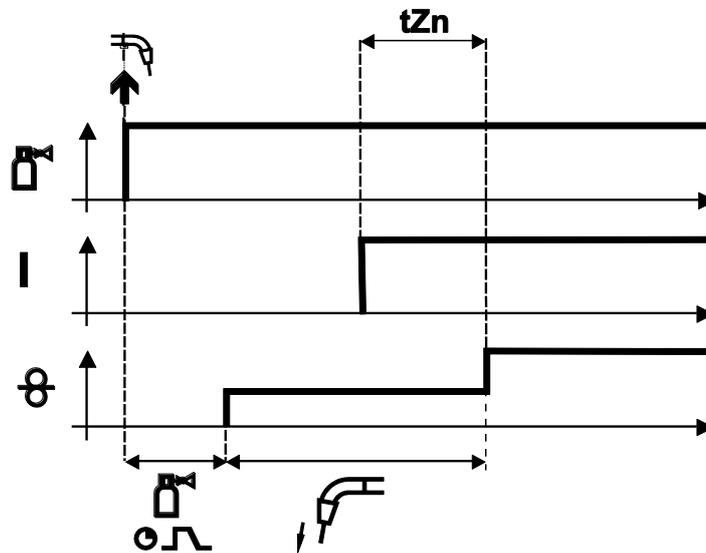


Figure 4-9

5 Design and function

WARNING



Risk of injury from electrical voltage!

Contact with live parts, e.g. power connections, can be fatal!

- Observe the safety information on the first pages of the operating instructions!
- Commissioning must be carried out by persons who are specifically trained in handling power sources!
- Connect connection or power cables while the machine is switched off!

CAUTION



Risk of injury due to moving parts!

The wire feeders are equipped with moving parts, which can trap hands, hair, clothing or tools and thus injure persons!

- Do not reach into rotating or moving parts or drive components!
- Keep casing covers or protective caps closed during operation!



Risk of injury due to welding wire escaping in an unpredictable manner!

Welding wire can be conveyed at very high speeds and, if conveyed incorrectly, may escape in an uncontrolled manner and injure persons!

- Before mains connection, set up the complete wire guide system from the wire spool to the welding torch!
- Check wire guide at regular intervals!
- Keep all casing covers or protective caps closed during operation!

Read and observe the documentation to all system and accessory components!

5.1 Transport and installation

5.1.1 Ambient conditions



The machine must not be operated in the open air and must only be set up and operated on a suitable, stable and level base!

- **The operator must ensure that the ground is non-slip and level, and provide sufficient lighting for the place of work.**
- **Safe operation of the machine must be guaranteed at all times.**



Equipment damage due to contamination!

Unusually high amounts of dust, acids, corrosive gases or substances can damage the machine (observe maintenance intervals > see 6.2 chapter).

- **Avoid large amounts of smoke, steam, oily fumes, grinding dust and corrosive ambient air!**

In operation

Temperature range of the ambient air:

- -25 °C to +40 °C (-13 °F to 104 °F)

Relative humidity:

- up to 50 % at 40 °C (104 °F)
- up to 90 % at 20 °C (68 °F)

Transport and storage

Storage in a closed room, temperature range of the ambient air:

- -30 °C to +70 °C (-22 °F to 158 °F)

Relative humidity

- up to 90 % at 20 °C (68 °F)

5.1.2 Lifting by crane

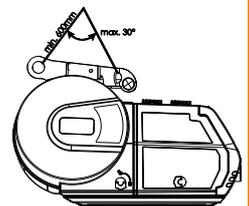
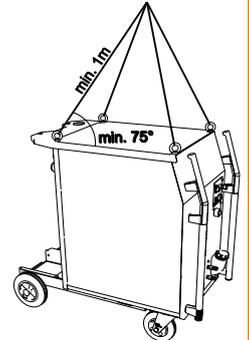
⚠ WARNING



Risk of injury during lifting by crane!

When lifting the machine by crane, persons may be severely injured by falling machines or mount-on components.

- Simultaneous lifting of system components such as power source, wire feeder or cooling unit without suitable crane components is not allowed. Each system component has to be lifted separately!
- Remove any supply leads and accessories before lifting by crane (e.g. hose package, wire spool, shielding gas cylinder, toolbox, wire feeder, remote control, etc.!)!
- Properly close and lock all casing covers and protective caps before lifting by crane!
- Use the correct number of hoisting equipment of the right size in the correct position! Observe craning principle (see figure)!
- For machines with lifting eyes: always lift all lifting eyes simultaneously!
- When using retrofitted craning frames etc.: always use at least two lifting points positioned as far apart as possible – observe option description.
- Avoid any jerky movements!
- Ensure that the load is distributed evenly! • Use chain hoists and chain slings of the same length only!
- Stay outside the danger zone underneath the machine!
- Observe the regulations regarding occupational safety and accident prevention for the respective country.



Craning principle



Risk of injury due to unsuitable lifting eye!

In case of improper use of lifting eyes or the use of unsuitable lifting eyes, persons can be seriously damaged by falling equipment or add-on components!

- The lifting eye must be completely screwed in!
- The lifting eye must be positioned flat onto and in full contact with the supporting surfaces!
- Check that the lifting eyes are securely fastened before use and check for any damage (corrosion, deformation)!
- Do not use or screw in damaged lifting eyes!
- Avoid lateral loading of the lifting eyes!

5.1.3 Machine cooling



Insufficient ventilation results in a reduction in performance and equipment damage.

- **Observe the ambient conditions!**
- **Keep the cooling air inlet and outlet clear!**
- **Observe the minimum distance of 0.5 m from obstacles!**

5.1.4 Workpiece lead, general

⚠ CAUTION



Risk of burning due to incorrect welding current connection!

If the welding current plugs (machine connections) are not locked or if the workpiece connection is contaminated (paint, corrosion), these connections and leads can heat up and cause burns when touched!

- Check welding current connections on a daily basis and lock by turning to the right when necessary.
- Clean workpiece connection thoroughly and secure properly. Do not use structural parts of the workpiece as welding current return lead!

5.1.5 Shielding gas supply (shielding gas cylinder for welding machine)

⚠ WARNING

Risk of injury due to improper handling of shielding gas cylinders! Improper handling and insufficient securing of shielding gas cylinders can cause serious injuries!

- Place shielding gas cylinder into the designated holder and secure with fastening elements (chain/belt)!
- Attach the fastening elements within the upper half of the shielding gas cylinder!
- The fastening elements must tightly enclose the shielding gas cylinder!

Risk of accidents when exceeding the maximum size of the shielding gas cylinder! The maximum size for shielding gas cylinders and the filling pressure are specified for the machine. When exceeding the limits, the cylinders may tip at an angle of up to 10 ° (according to IEC 60974-2) and people may be injured as a result.

- Use shielding gas cylinders with a maximum geometric volume of 33 l at a filling pressure of 300 bar.



An unhindered shielding gas supply from the shielding gas cylinder to the welding torch is a fundamental requirement for optimum welding results. In addition, a blocked shielding gas supply may result in the welding torch being destroyed.

- All shielding gas connections must be gas tight.**

5.1.5.1 Pressure regulator connection

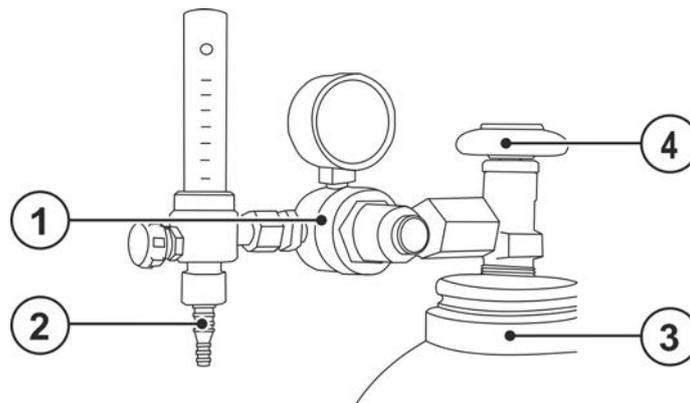


Figure 5-1

Item	Symbol	Description
1		Pressure regulator
2		Output side of the pressure regulator
3		Shielding gas cylinder
4		Cylinder valve

- Before connecting the pressure regulator to the gas cylinder, open the cylinder valve briefly to blow out any dirt.
- Tighten the pressure regulator screw connection on the gas bottle valve to be gas-tight.
- Screw the gas hose connection to the outlet side of the pressure regulator gas-tight.

5.1.5.2 Shielding gas hose connection

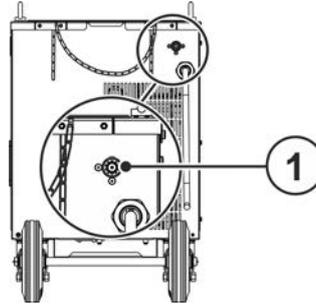


Figure 5-2

Item	Symbol	Description
1		Connection thread - G$\frac{1}{4}$" Shielding gas connection (inlet)

- Screw the gas hose connection to the shielding gas connection (inlet) on the machine gas-tight.

5.1.5.3 Setting the shielding gas volume (gas test)/rinse hose package

- Shielding gas supply as described in chapter Transport and positioning.
 - Slowly open the gas cylinder valve.
 - Open the pressure regulator.
 - Switch on the power source at the main switch.
 - Set the relevant gas quantity for the application on the pressure regulator.
 - Press the gas test key button briefly
- The shielding gas will then flow for approx. 25 sec. Pressing the key button again briefly will pause the test.

If the shielding gas setting is too low or too high, this can introduce air to the weld pool and may cause pores to form. Adjust the shielding gas quantity to suit the welding task!

Welding process	Recommended shielding gas quantity
MAG welding	Wire diameter x 11.5 = l/min
MIG brazing	Wire diameter x 11.5 = l/min
MIG welding (aluminium)	Wire diameter x 13.5 = l/min (100 % argon)

Helium-rich gas mixtures require a higher gas volume!

The table below can be used to correct the gas volume calculated where necessary:

Shielding gas	Factor
75% Ar/25% He	1.14
50% Ar/50% He	1.35
25% Ar/75% He	1.75
100% He	3.16

5.1.6 Notes on the installation of welding current leads

- Incorrectly installed welding current leads can cause faults in the arc (flickering).
- Lay the workpiece lead and hose package of power sources without HF igniter (MIG/MAG) for as long and as close as possible in parallel.
- Lay the workpiece lead and hose package of power sources with HF igniter (TIG) for as long as possible in parallel with a distance of 20 cm to avoid HF sparkover.
- Always keep a distance of at least 20 cm to leads of other power sources to avoid interferences
- Always keep leads as short as possible! For optimum welding results max. 30 m (welding lead + intermediate hose package + torch lead).

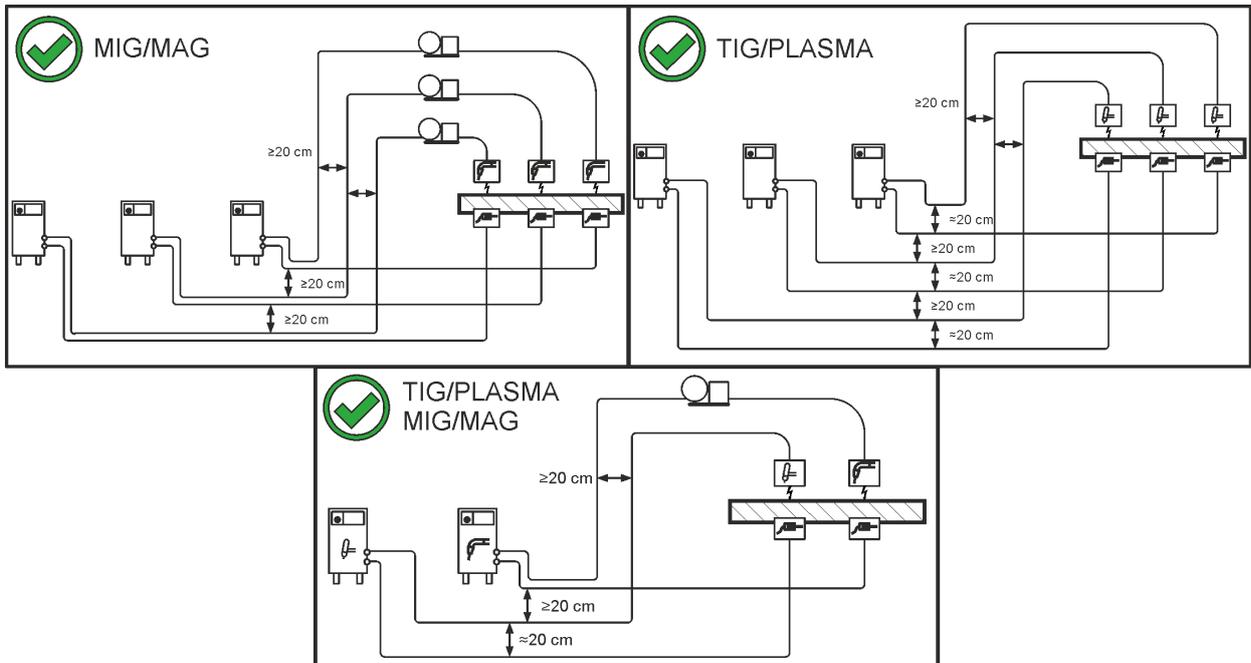


Figure 5-3

- Use an individual welding lead to the workpiece for each welding machine!

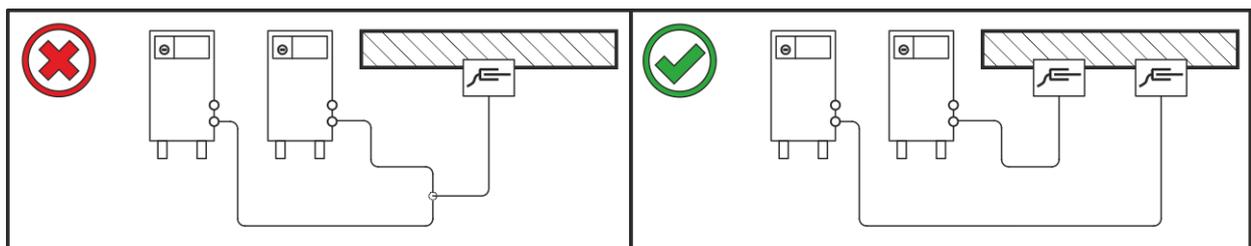


Figure 5-4

- Fully unroll welding current leads, torch hose packages and intermediate hose packages. Avoid loops!
- Always keep leads as short as possible!

Lay any excess cable lengths in meanders.

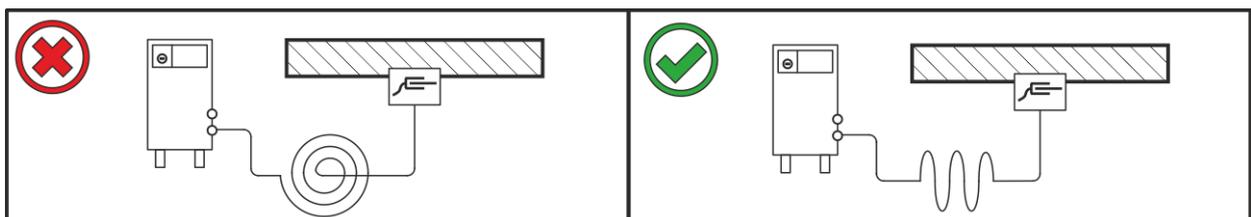


Figure 5-5

5.1.7 Stray welding currents

⚠ WARNING



Risk of injury due to stray welding currents!

Stray welding currents can destroy protective earth conductors, damage machines and electronic devices and cause overheating of components, leading to fire.

- Check that all welding current connections are firmly secured and electrical connections are in perfect condition.
- Set up, attach or suspend all conductive power source components such as casing, transport vehicles and crane frames so they are insulated.
- Do not place any other electronic devices such as drills or angle grinders on the power source, transport vehicle or crane frames unless they are insulated.
- Always put welding torches and electrode holders on an insulated surface when they are not in use.

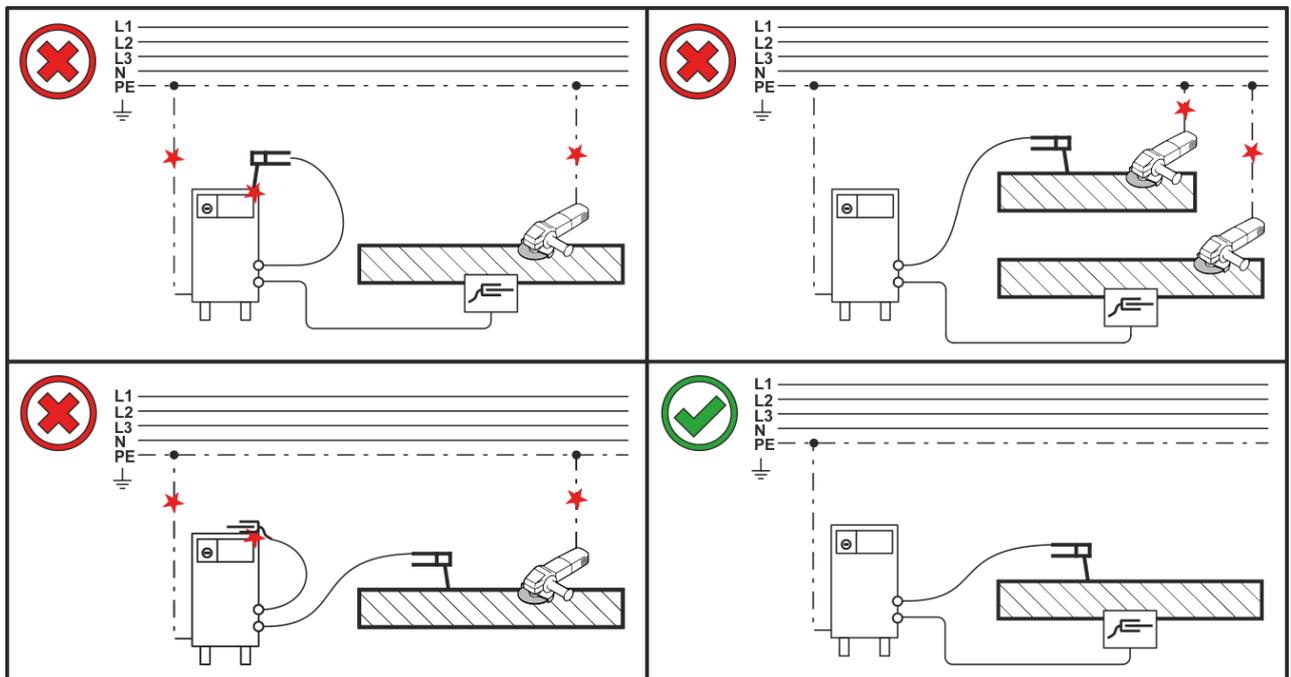


Figure 5-6

5.1.8 Mains connection

DANGER



Hazards caused by improper mains connection!

An improper mains connection can cause injuries or damage property!

- The connection (mains plug or cable), the repair or voltage adjustment of the device must be carried out by a qualified electrician in accordance with the respective local laws or national regulations!
- The mains voltage indicated on the rating plate must match the supply voltage.
- Only operate machine using a socket that has correctly fitted protective earth.
- Mains plug, socket and lead must be checked by a qualified electrician on a regular basis!
- When operating the generator, always ensure it is earthed as stipulated in the operating instructions. The network created must be suitable for operating machines according to protection class I.

5.1.8.1 Mains configuration

The machine may be connected to:

- a three-phase system with four conductors and an earthed neutral conductor
- a three-phase system with three conductors of which any one can be earthed, e.g. the outer conductor

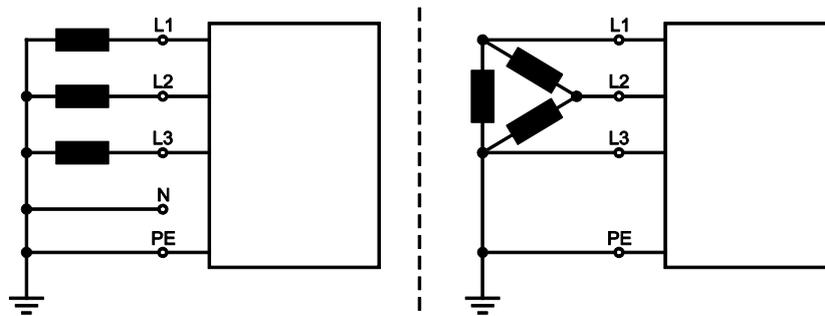


Figure 5-7

Legend

Item	Designation	Colour code
L1	Outer conductor 1	brown
L2	Outer conductor 2	black
L3	Outer conductor 3	grey
N	Neutral conductor	blue
PE	Protective conductor	green-yellow

- Insert mains plug of the switched-off machine into the appropriate socket.

5.1.9 Welding torch and workpiece line connection

Prepare welding torch according to the welding task in hand (see operating instructions for the torch).

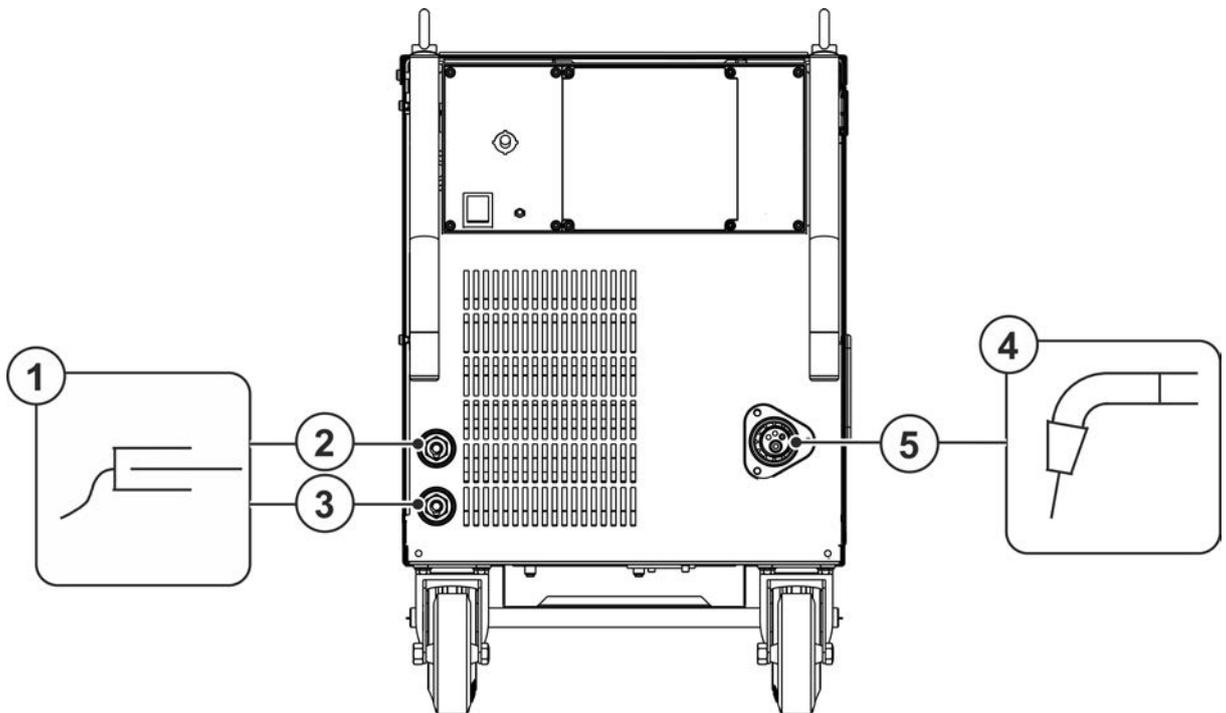


Figure 5-8

Item	Symbol	Description
1		Workpiece
2		Connection socket, workpiece lead "Hard" choke tapping
3		Connection socket, workpiece lead "Medium" choke tapping
4		Welding torch
5		Welding torch connection (Euro torch connector) Welding current, shielding gas and torch trigger integrated

- Insert central plug of the welding torch into the central connector and screw together with crown nut.
- Insert cable plug on the workpiece lead into the connection socket for workpiece lead 1 or 2 (depending on the application or shielding gas used) and lock by turning to the right.

5.1.10 Wire feed

⚠ CAUTION



Risk of injury due to moving parts!

The wire feeders are equipped with moving parts, which can trap hands, hair, clothing or tools and thus injure persons!

- Do not reach into rotating or moving parts or drive components!
- Keep casing covers or protective caps closed during operation!



Risk of injury due to welding wire escaping in an unpredictable manner!

Welding wire can be conveyed at very high speeds and, if conveyed incorrectly, may escape in an uncontrolled manner and injure persons!

- Before mains connection, set up the complete wire guide system from the wire spool to the welding torch!
- Check wire guide at regular intervals!
- Keep all casing covers or protective caps closed during operation!

5.1.10.1 Inserting the wire spool

⚠ CAUTION



Risk of injury due to incorrectly secured wire spool.

If the wire spool is not secured properly, it may come loose from the wire spool support and fall to the ground, causing damage to the machine and injuries.

- Make sure to correctly fasten the wire spool to the wire spool support.
- Before you start working, always check the wire spool is securely fastened.

Standard D300 wire spool holder can be used. Adapters are required when using standardised basket coils (DIN 8559) > see 9 chapter.

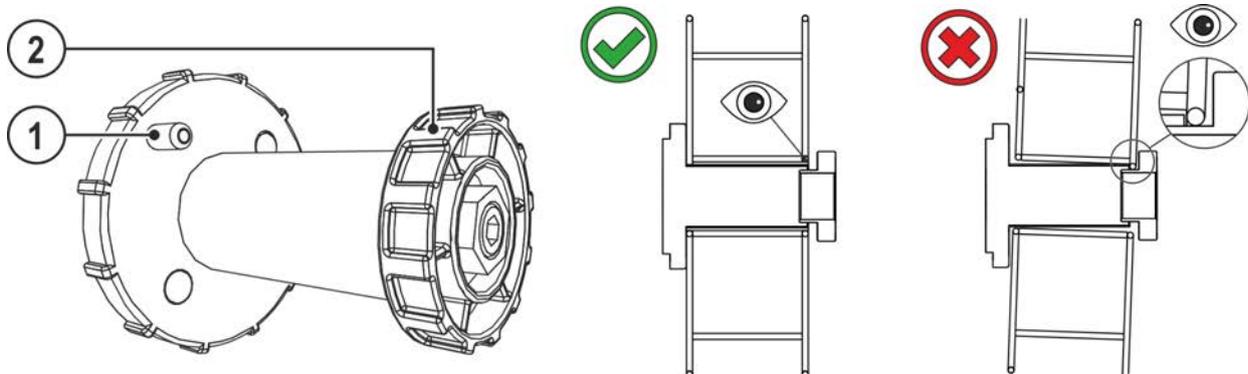


Figure 5-9

Item	Symbol	Description
1		Carrier pin For fixing the wire spool
2		Knurled nut For fixing the wire spool

- Unlock and open protective flap.
- Loosen knurled nut from spool holder.
- Fix welding wire reel onto the spool holder so that the carrier pin locks into the spool bore.
- Fasten wire spool using knurled nut.

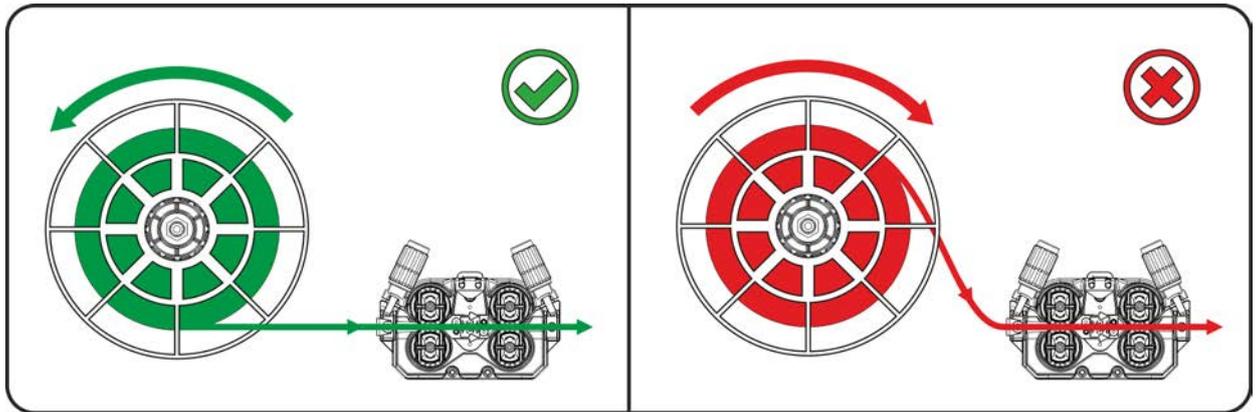


Figure 5-10

Observe the unwinding direction of the wire spool.

5.1.10.2 Changing the wire feed rollers

Poor welding results due to faulty wire feeding! Wire feed rolls must be suitable for the diameter of the wire and the material.

- Check the label of the rolls whether they fit the wire diameter. If necessary, turn or change!
- Use V-groove rolls for steel wires and other hard wires.
- Use driven rolls with U-groove for aluminium wires and other soft, alloyed wires.
- Use driven rolls with knurled U-groove for flux cored wires.
- Slide new drive rollers into place so that the diameter of the wire used is visible on the drive roller.
- Screw the drive rollers in place with knurled screws.

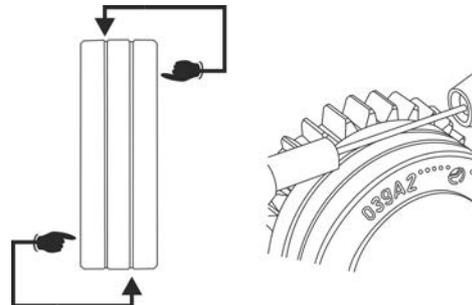


Figure 5-11

5.1.10.3 Inching the wire electrode

⚠ CAUTION



Risk of injury due to welding wire escaping from the welding torch!
The welding wire can escape from the welding torch at high speed and cause bodily injury including injuries to the face and eyes!

- Never direct the welding torch towards your own body or towards other persons!

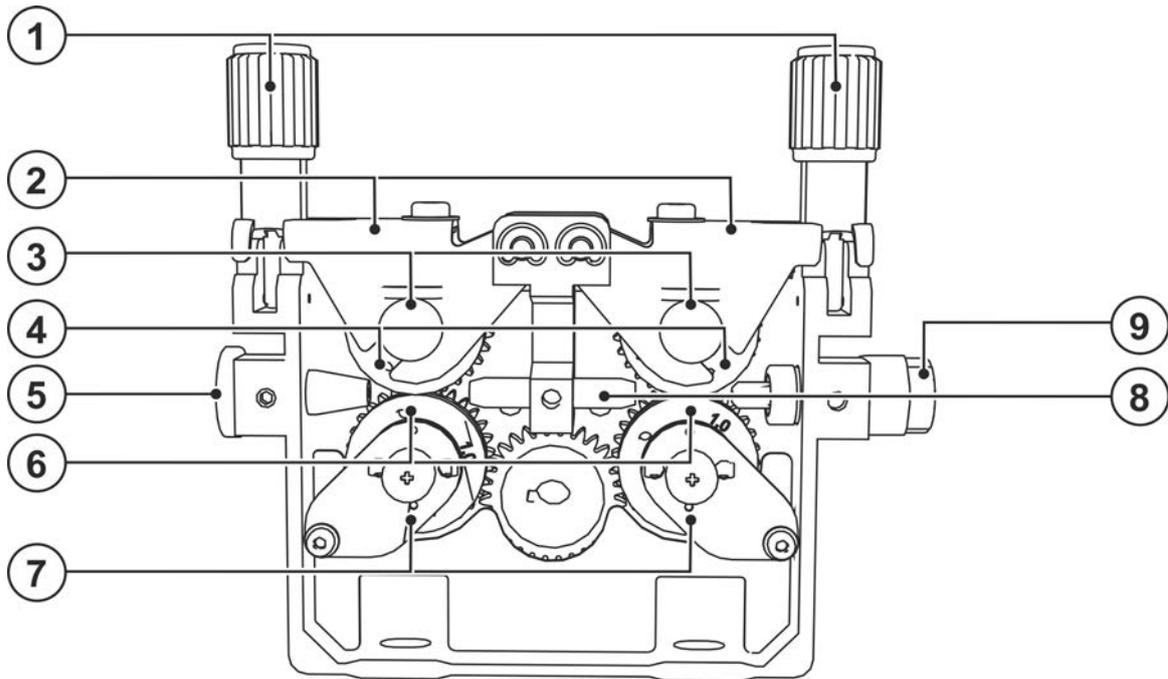


Figure 5-12

Item	Symbol	Description
1		Feed roll tensioner Fixing the clamping unit and setting the pressure.
2		Clamping unit
3		Knurled screw
4		Pressure roller
5		Wire feed nipple
6		Drive roller
7		"Undetachable" knurled screws
8		Guide tube
9		Wire return nipple

- Extend and lay out the torch hose package.
- Unfasten pressure units and fold out (clamping units and pressure rollers will automatically flip upwards).
- Unwind welding wire carefully from the wire spool and insert through the wire inlet nipple over the drive roller grooves and the guide pipe into the capillary tube and Teflon core using guide pipe.
- Press the clamping element with the pressure roller back downwards and fold the wire units back up again (wire electrode should be in the groove on the drive roller).
- Set the contact pressure with the adjusting nuts of the pressure unit.



Incorrect contact pressure will cause extensive wear of the wire feed rollers!

- ***With the adjusting nuts of the pressure units set the contact pressure so that the wire electrode is conveyed but will still slip through if the wire spool jams.***
- ***Set the contact pressure of the front rollers (in wire feed direction) to a higher value!***
- Press the wire inching button until the wire electrode projects out of the welding torch.

5.1.10.4 Spool brake setting

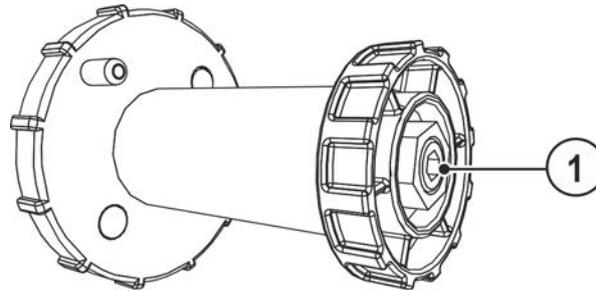


Figure 5-13

Item	Symbol	Description
1		Allen screw Securing the wire spool retainer and adjustment of the spool brake

- Tighten the Allen screw (8 mm) in the clockwise direction to increase the braking effect.

Tighten the spool brake until the wire spool no longer turns when the wire feed motor stops but without it jamming during operation!

5.1.11 Operating modes (functional sequences)

There are optimum pre-sets for welding parameters such as gas pre-flow and burn back, etc. for numerous applications (although these can also be changed if required).

5.1.11.1 Explanation of signs and functions

Symbol	Meaning
	Press torch trigger
	Release torch trigger
	Tap torch trigger (press briefly and release)
	Shielding gas flowing
I	Welding output
	Wire electrode is being conveyed
	Wire creep
	Wire burn-back
	Gas pre-flows
	Gas post-flows
	Non-latched
	Latched
t	Time
t1	Spot time
t2	Interval pause
tZn	Ignition time

5.1.11.2 Automatic cut-out

The welding machine ends the ignition process or the welding process with an

- Ignition fault (no welding current flows within 5 s after the start signal).
- Arc interruption (arc is interrupted for longer than 2 s).

5.1.11.3 Non-latched mode

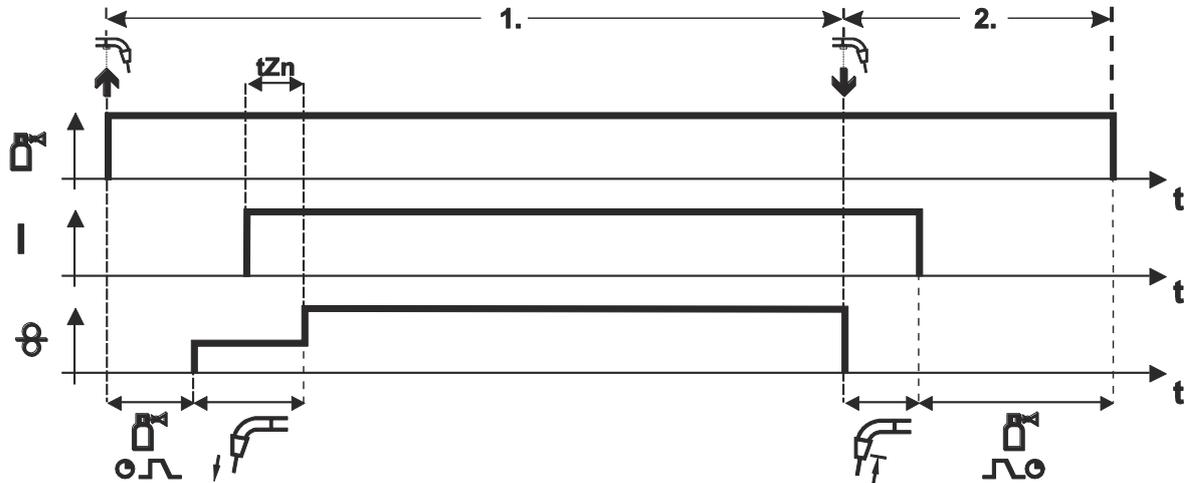


Figure 5-14

Step 1

- Press and hold torch trigger.
- Shielding gas is expelled (gas pre-flows).
- Wire feed motor runs at "creep speed".
- Arc ignites after the wire electrode makes contact with the workpiece; welding current flows.
- Changeover to the pre-selected wire speed after the set ignition time (t_{zn}).

Step 2

- Release torch trigger.
- WF motor stops.
- Arc is extinguished after the pre-selected wire burn-back time elapses.
- Gas post-flow time elapses.

5.1.11.4 Latched mode

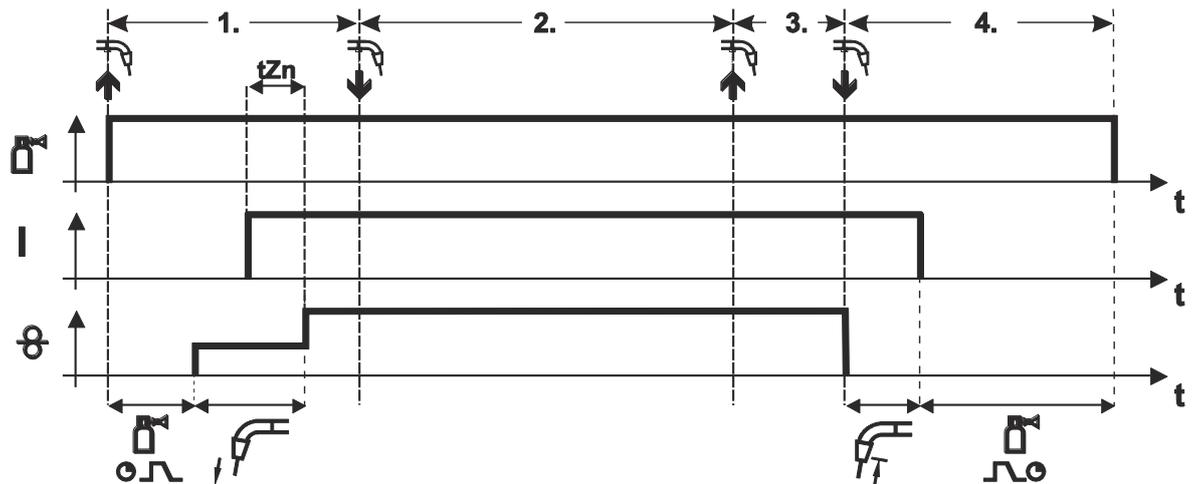


Figure 5-15

Step 1

- Press and hold torch trigger.
- Shielding gas is expelled (gas pre-flows).
- Wire feed motor runs at "creep speed".
- Arc ignites when the wire electrode makes contact with the workpiece; welding current flows.
- Changeover to the pre-selected wire speed after the set ignition time (t_{Zn}).

Step 2

- Release torch trigger (no effect).

Step 3

- Press torch trigger (no effect).

Step 4

- Release torch trigger.
- WF motor stops.
- Arc is extinguished after the pre-selected wire burn-back time elapses.
- Gas post-flow time elapses.

5.1.11.5 Spot welding

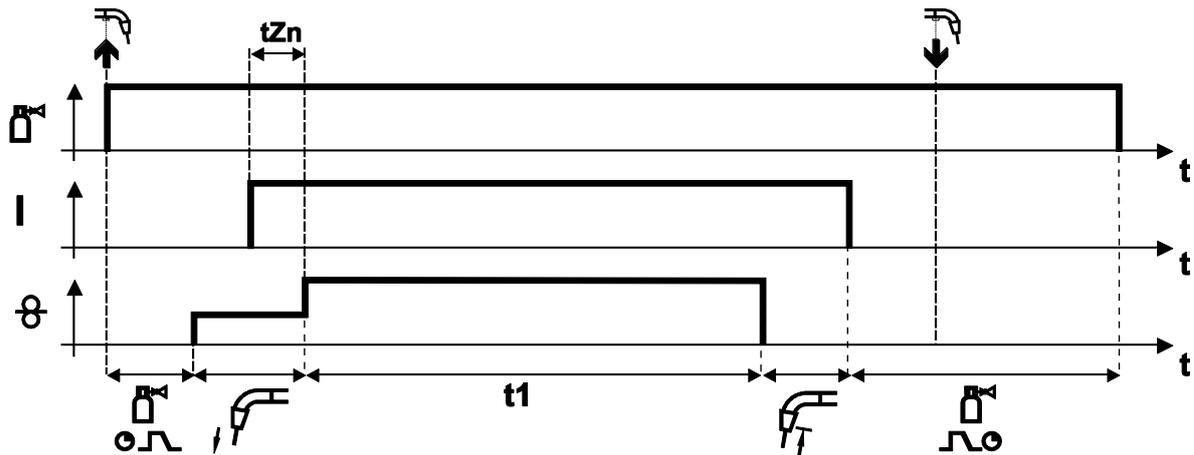


Figure 5-16

1. Start

- Press and hold torch trigger.
- Shielding gas is expelled (gas pre-flows).
- Wire feed motor runs at "creep speed".
- Arc ignites after the wire electrode makes contact with the workpiece; welding current flows.
- Changeover to the pre-selected wire speed after the set ignition time (t_{Zn}).
- The WF stops after the set spot welding time elapses.
- Arc is extinguished after the pre-selected wire burn-back time elapses.
- Gas post-flow time elapses.

2. End

- Release torch trigger.

When the torch trigger is released, the welding process is also interrupted even before the spot time elapses. With fast tacking (time between two welding process under approx. 1.5 seconds) the gas pre-flow, the creep process and also the ignition time (t_{Zn}) are not required.

5.1.11.6 Interval

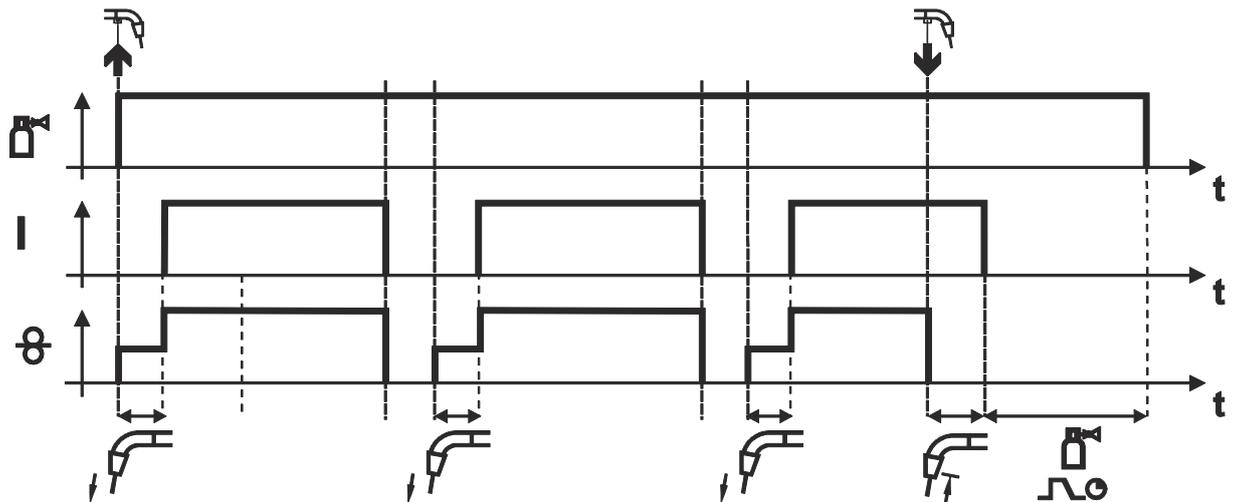


Figure 5-17

1. Start

- Press and hold torch trigger.
- Shielding gas is expelled (gas pre-flows).
- Wire-feed motor runs at "creep-start speed".
- Arc ignites after the wire electrode makes contact with the workpiece; welding current flows.
- Changeover to the pre-selected wire speed after the set ignition time (t_{Zn}).
- The wire feed stops after the pulse time expires.
- Arc is extinguished after the wire burn-back time elapses.
- The process is repeated after the pause time elapses.

2. End

- Release torch trigger.
- Wire feed stops.
- Arc is extinguished after the wire burn-back time elapses.
- Gas post-flow time elapses.

When the torch trigger is released, the welding process is also interrupted even before the spot time elapses. With fast tacking (time between two welding process under approx. 1.5 seconds) the gas pre-flow, the creep process and also the ignition time (t_{Zn}) are not required.

6 Maintenance, care and disposal

6.1 General

DANGER



Risk of injury due to electrical voltage after switching off!

Working on an open machine can lead to fatal injuries!

Capacitors are loaded with electrical voltage during operation. Voltage remains present for up to four minutes after the mains plug is removed.

1. Switch off machine.
2. Remove the mains plug.
3. Wait for at least 4 minutes until the capacitors have discharged!

WARNING



Incorrect maintenance, testing and repair!

Maintenance, testing and repair of the machine may only be carried out by skilled and qualified personnel. A qualified person is one who, because of his or her training, knowledge and experience, is able to recognise the dangers that can occur while testing welding power sources as well as possible subsequent damage, and who is able to implement the required safety procedures.

Observe the maintenance instructions > see 6.2 chapter.

- In the event that the provisions of one of the below-stated tests are not met, the machine must not be operated again until it has been repaired and a new test has been carried out!

Repair and maintenance work may only be performed by qualified authorised personnel; otherwise the right to claim under warranty is void. In all service matters, always consult the dealer who supplied the machine. Return deliveries of defective equipment subject to warranty may only be made through your dealer. When replacing parts, use only original spare parts. When ordering spare parts, please quote the machine type, serial number and item number of the machine, as well as the type designation and item number of the spare part.

Under the specified ambient conditions and normal working conditions this machine is essentially maintenance-free and requires just a minimum of care.

Contamination of the machine may impair service life and duty cycle. The cleaning intervals depend on the ambient conditions and the resulting contamination of the machine. The minimum interval is every six months.

6.1.1 Cleaning

- Clean the outer surfaces with a moist cloth (no aggressive cleaning agents).
- Purge the machine venting channel and cooling fins (if present) with oil- and water-free compressed air. Compressed air may overspeed and destroy the machine fans. Never direct the compressed air directly at the machine fans. Mechanically block the fans, if required.
- Check the coolant for contaminants and replace, if necessary.

6.1.2 Dirt filter

When using a dirt filter, the cooling air throughput is reduced and the duty cycle of the machine is reduced as a result. The duty cycle decreases with the increasing contamination of the filter. The dirt filter must be removed at regular intervals and cleaned by blowing out with compressed air (depending on the level of soiling).

6.2 Maintenance work, intervals

6.2.1 Daily maintenance tasks

Visual inspection

- Mains supply lead and its strain relief
- Gas cylinder securing elements
- Check hose package and power connections for exterior damage and replace or have repaired by specialist staff as necessary!
- Gas tubes and their switching equipment (solenoid valve)
- Check that all connections and wearing parts are hand-tight and tighten if necessary.
- Check correct mounting of the wire spool.
- Wheels and their securing elements
- Transport elements (strap, lifting lugs, handle)
- Other, general condition

Functional test

- Operating, message, safety and adjustment devices (Functional test)
- Welding current cables (check that they are fitted correctly and secured)
- Gas tubes and their switching equipment (solenoid valve)
- Gas cylinder securing elements
- Check correct mounting of the wire spool.
- Check that all screw and plug connections and replaceable parts are secured correctly, tighten if necessary.
- Remove any spatter.
- Clean the wire feed rollers on a regular basis (depending on the degree of soiling).

6.2.2 Monthly maintenance tasks

Visual inspection

- Casing damage (front, rear and side walls)
- Wheels and their securing elements
- Transport elements (strap, lifting lugs, handle)
- Check coolant tubes and their connections for impurities

Functional test

- Selector switches, command devices, emergency stop devices, voltage reducing devices, message and control lamps
- Check wire guide elements (wire feed roll holder, wire feed nipple, wire guide tube) for tight fit. Recommendation for replacing the wire feed roll holder (eFeed) after 2000 hours of operation, see replacement parts).
- Check coolant tubes and their connections for impurities
- Check and clean the welding torch. Deposits in the torch can cause short circuits and have a negative impact on the welding result, ultimately causing damage to the torch.

6.2.3 Annual test (inspection and testing during operation)

A periodic test according to IEC 60974-4 "Periodic inspection and test" has to be carried out. In addition to the regulations on testing given here, the relevant local laws and regulations must also be observed.

For more information refer to the "Warranty registration" brochure supplied and our information regarding warranty, maintenance and testing at www.ewm-group.com!

6.3 Disposing of equipment



Proper disposal!

The machine contains valuable raw materials, which should be recycled, and electronic components, which must be disposed of.

- **Do not dispose of in household waste!**
- **Observe the local regulations regarding disposal!**
- According to European provisions (Directive 2012/19/EU on Waste of Electrical and Electronic Equipment), used electric and electronic equipment may no longer be placed in unsorted municipal waste. It must be collected separately. The symbol depicting a waste container on wheels indicates that the equipment must be collected separately.
This machine has to be disposed of, or recycled, in accordance with the waste separation systems in use.
- According to German law (law governing the distribution, taking back and environmentally correct disposal of electric and electronic equipment (ElektroG)), used machines are to be placed in a collection system separate from unsorted municipal waste. The public waste management utilities (communities) have created collection points at which used equipment from private households can be disposed of free of charge.
- Information about returning used equipment or about collections can be obtained from the respective municipal administration office.
- In addition to this, returns are also possible throughout Europe via EWM sales partners.

7 Rectifying faults

All products are subject to rigorous production checks and final checks. If, despite this, something fails to work at any time, please check the product using the following flowchart. If none of the fault rectification procedures described leads to the correct functioning of the product, please inform your authorised dealer.

7.1 Checklist for rectifying faults

The correct machine equipment for the material and process gas in use is a fundamental requirement for perfect operation!

Legend	Symbol	Description
	↗	Fault/Cause
	✘	Remedy

Collective interference signal light illuminates

- ↗ Excess temperature, welding machine
 - ✘ Allow the machine to cool down whilst still switched on
- ↗ Welding current monitoring device triggered (stray welding currents flowing across the protective earth). The error must be reset by switching the machine off and on again.
 - ✘ Welding wire is touching electrically conductive casing parts (check wire guide, has the welding wire sprung off the wire spool?).
 - ✘ Check for a correct mounting of the welding lead. Fit the feeder clamp of the welding lead as close as possible to the arc.

Excess temperature signal light illuminates

- ↗ Excess temperature, welding machine
 - ✘ Allow the machine to cool down whilst still switched on

Functional errors

- ↗ Mains fuse triggers - unsuitable mains fuse
 - ✘ Set up recommended mains fuse > see 8 chapter.
- ↗ Machine does not start up after switching on (device fan and possibly coolant pump have no function).
 - ✘ Connect the control cable of the wire feeder.
- ↗ All machine control signal lights are illuminated after switching on
- ↗ No machine control signal light is illuminated after switching on
- ↗ No welding power
 - ✘ Phase failure > check mains connection (fuses)
- ↗ Machine restarts continuously
- ↗ Wire feeder without function
- ↗ System does not start up
 - ✘ Make control lead connections and check that they are fitted correctly.
- ↗ Loose welding current connections
 - ✘ Tighten power connections on the torch and/or on the workpiece
 - ✘ Properly fasten the contact tip and contact tip holder.

Wire feed problems

- ✓ Contact tip blocked
 - ✘ Clean and, if necessary, replace.
- ✓ Setting the spool brake > see 5.1.10.4 chapter
 - ✘ Check settings and correct if necessary
- ✓ Setting pressure units > see 5.1.10.3 chapter
 - ✘ Check settings and correct if necessary
- ✓ Worn wire rolls
 - ✘ Check and replace if necessary
- ✓ Wire feed motor without supply voltage (automatic cutout triggered by overloading)
 - ✘ Reset triggered fuse (rear of the power source) by pressing the key button
- ✓ Kinked hose packages
 - ✘ Extend and lay out the torch hose package
- ✓ Wire guide core or spiral is dirty or worn
 - ✘ Clean core or spiral; replace kinked or worn cores

7.2 Check the machine type setting

After switching on, the machine type that has been set is displayed for a short time, denoted as "tyP".

If the machine type displayed does not match the machine, you have to correct this setting.

7.2.1 Setting the machine type

Operating element	Action	Result
	1 x	Switch off the welding machine
		Keep both push-buttons pressed
	1 x	Switch on the welding machine; the display shows "AnI".
		With "AnI" on the display, set the machine type: 0 -----Saturn 251 FKG 1 -----Saturn 301 FKG 2 -----Saturn 351 FKG 3 -----all decompact (DK, DG FDG, FDW) 7 -----Mira 301 FKG After a few seconds, the selected machine type is applied and the display switches back to the welding parameter nominal values.

7.3 Resetting the control (Reset all)

M2.xx control: The first action should always be to check and if necessary correct the machine type setting.

All user settings will be overwritten with factory settings and must therefore be checked afterwards, or set up again!

After resetting the machine control to the factory settings, it is essential that the machine type used is checked and reset if necessary.

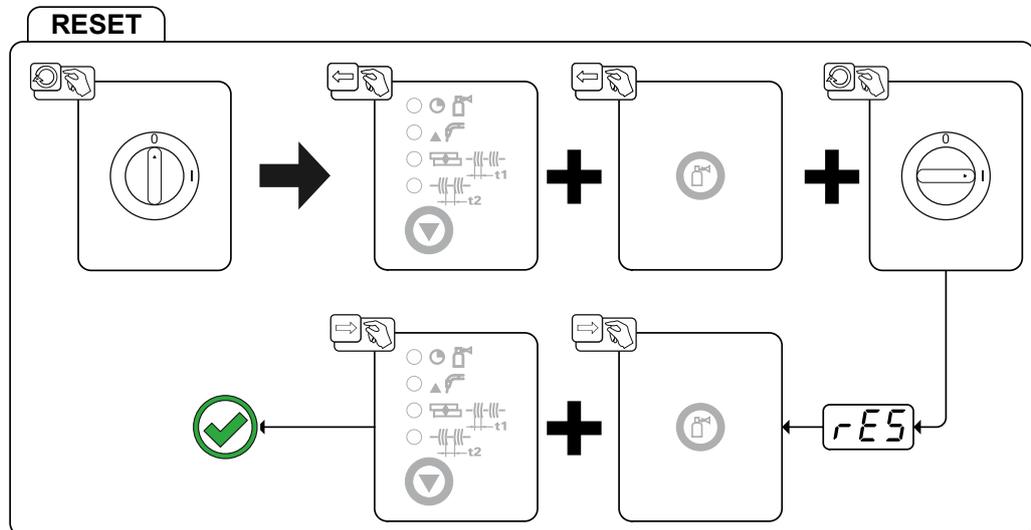


Figure 7-1

8 Technical data

Performance specifications and guarantee only in connection with original spare and replacement parts!

8.1 Saturn 301

Welding current (I ₂)	30 A to 300 A
Welding voltage according to standard (U ₂)	15,5 V to 29 V
Duty cycle DC at 40° C ^[1]	
40 %	300 A
60 %	190 A
100 %	160 A
Open circuit voltage (U ₀)	15,5 V to 38,2 V
Mains voltage (Tolerance)	3 x 400 V (-15 % to +15 %)
Frequency	50/60 Hz
mains fuse ^[2]	3 x 16 A
Mains connection cable	H07RN-F4G2,5
max. Connected load (S ₁)	11,6 kVA
Generator rating (Rec.)	15,7 kVA
Cos φ / Contamination level	0,97 / 3
Protection class / Overvoltage category	I / III
Insulation class / protection classification	H / IP 23
max. Height (Shielding gas cylinder)	1200 mm 47.24 inch
max. Diameter (Shielding gas cylinder)	229 mm 9 inch
Filling quantity (Shielding gas cylinder)	10 l to 33 l 2.6 gal. to -7,3 gal.
max. Filling pressure (Shielding gas cylinder)	300 bar 30 MPa
Residual current circuit breaker	Type B (recommended)
Noise level ^[3]	<70 dB(A)
Ambient temperature	-25 °C to +40 °C
Machine cooling / Torch cooling	Fan (AF) / gas
Wire feed speed	0,5 m/min to 24m/min
Factory-installed roll equipment	0,8/1,0 mm for steel wire
Drive	4 rollers (37 mm)
Wire spool diameter	Standardised wire spools up to 300 mm
Welding torch connection / EMC class	Euro torch connector / A
Workpiece lead (min.)	50 mm ²
Safety marking	 /  / 
Standards used	See declaration of conformity (appliance documents)
Dimensions (l x b x h)	937 x 457 x 726 mm 36.9 x 18.0 x 28.6 inch
Weight	100 kg 220.5 lb.

^[1] Load cycle: 10 min. (60 % DC \pm 6 min. welding, 4 min. pause)

^[2] Safety fuses are recommended DIAZED xxA gG. When using automatic cutouts, the "C" trigger characteristic must be used.

^[3] Noise level during idle mode and operation under standard load according to IEC 60974-1 at the maximum operating point.

8.2 Saturn 351

Welding current (I ₂)	30 A to 350 A
Welding voltage according to standard (U ₂)	15,5 V to 31,5 V
Duty cycle DC at 40° C ^[1]	
45 %	350 A
60 %	250 A
100 %	220 A
Open circuit voltage (U ₀)	15,5 V to 41 V
Mains voltage (Tolerance)	3 x 400 V (-15 % to +15 %)
Frequency	50/60 Hz
mains fuse ^[2]	3 x 16 A
Mains connection cable	H07RN-F4G2,5
max. Connected load (S ₁)	14,7 kVA
Generator rating (Rec.)	19,8 kVA
Cos φ / Contamination level	0,97 / 3
Protection class / Overvoltage category	I / III
Insulation class / protection classification	H / IP 23
max. Height (Shielding gas cylinder)	1200 mm 47.24 inch
max. Diameter (Shielding gas cylinder)	229 mm 9 inch
Filling quantity (Shielding gas cylinder)	10 l to 33 l 2.6 gal. to -7,3 gal.
max. Filling pressure (Shielding gas cylinder)	300 bar 30 MPa
Residual current circuit breaker	Type B (recommended)
Noise level ^[3]	<70 dB(A)
Ambient temperature	-25 °C to +40 °C
Machine cooling / Torch cooling	Fan (AF) / gas
Wire feed speed	0,5 m/min to 24m/min
Factory-installed roll equipment	0,8/1,0 mm for steel wire
Drive	4 rollers (37 mm)
Wire spool diameter	Standardised wire spools up to 300 mm
Welding torch connection / EMC class	Euro torch connector / A
Workpiece lead (min.)	50 mm ²
Safety marking	 /  / 
Standards used	See declaration of conformity (appliance documents)
Dimensions (l x b x h)	937 x 457 x 726 mm 36.9 x 18.0 x 28.6 inch
Weight	115 kg 253.5 lb.

^[1] Load cycle: 10 min. (60 % DC \pm 6 min. welding, 4 min. pause)

^[2] Safety fuses are recommended DIAZED xxA gG. When using automatic cutouts, the "C" trigger characteristic must be used.

^[3] Noise level during idle mode and operation under standard load according to IEC 60974-1 at the maximum operating point.

9 Accessories

Performance-dependent accessories like torches, workpiece leads, electrode holders or intermediate hose packages are available from your authorised dealer.

9.1 Options

Type	Designation	Item no.
ON Filter F.0004	Retrofit option, dirt filter for air inlet	092-002090-00000
ON FSB WHEELS S	Retrofit option for locking brake for machine wheels	092-002109-00000
ON Drahteinschleich Poti M1.02	Retrofit option, wire creep rotary dial	092-001102-00000
GH 2X1/4" 2M	Gas hose	094-000010-00001
A/V EN1090	Display unit for non-digital welding machines within the scope of EN 1090	090-008788-00000

9.2 General accessories

Type	Designation	Item no.
AK300	Wire spool adapter K300	094-001803-00001
DM 842 Ar/CO2 230bar 30l D	Pressure regulator with manometer	394-002910-00030
GH 2X1/4" 2M	Gas hose	094-000010-00001
16A 5POLE/CEE	Mains plug	094-000712-00000

10 Replaceable parts

Performance specifications and guarantee only in connection with original spare and replacement parts!

10.1 Wire feed rollers

10.1.1 Wire feed rollers for steel wire

Type	Designation	Item no.
FE 2DR4R 0,6+0,8	Drive rollers, 37 mm, steel	092-000839-00000
FE 2DR4R 0,8+1,0	Drive rollers, 37 mm, steel	092-000840-00000
FE 2DR4R 0,9+1,2	Drive rollers, 37 mm, steel	092-000841-00000
FE 2DR4R 1,0+1,2	Drive rollers, 37 mm, steel	092-000842-00000
FE 2DR4R 1,2+1,6	Drive rollers, 37 mm, steel	092-000843-00000
FE/AL 2GR4R	Pressure rollers, smooth, 37mm	092-000844-00000

10.1.2 Wire feed rollers for aluminium wire

Type	Designation	Item no.
AL 4ZR4R 0,8+1,0	Twin rollers, 37 mm, for aluminium	092-000869-00000
AL 4ZR4R 1,0+1,2	Twin rollers, 37 mm, for aluminium	092-000848-00000
AL 4ZR4R 1,2+1,6	Twin rollers, 37 mm, for aluminium	092-000849-00000
AL 4ZR4R 2,4+3,2	Twin rollers, 37 mm, for aluminium	092-000870-00000

10.1.3 Wire feed rollers for cored wire

Type	Designation	Item no.
ROE 2DR4R 0,8/0,9+0,8/0,9	Drive rollers, 37 mm, cored wire	092-000834-00000
ROE 2DR4R 1,0/1,2+1,4/1,6	Drive rollers, 37 mm, cored wire	092-000835-00000
ROE 2DR4R 1,4/1,6+2,0/2,4	Drive rollers, 37 mm, cored wire	092-000836-00000
ROE 2DR4R 2,8+3,2	Drive rollers, 37 mm, cored wire	092-000837-00000
ROE 2GR4R	Pressure rollers, knurled, 37mm	092-000838-00000

10.1.4 Conversion kit

Type	Designation	Item no.
URUE VERZ>UNVERZ FE/AL 4R	Conversion kit, 37mm, 4-roller drive on non-toothed rollers (steel/aluminium)	092-000845-00000
URUE AL 4ZR4R 0,8+1,0	Conversion kit, 37mm, 4-roller drive for aluminium	092-000867-00000
URUE AL 4ZR4R 1,0+1,2	Conversion kit, 37mm, 4-roller drive for aluminium	092-000846-00000
URUE AL 4ZR4R 1,2+1,6	Conversion kit, 37mm, 4-roller drive for aluminium	092-000847-00000
URUE AL 4ZR4R 2,4+3,2	Conversion kit, 37mm, 4-roller drive for aluminium	092-000868-00000
URUE ROE 2DR4R 0,8/0,9+0,8/0,9	Conversion kit, 37mm, 4-roller drive for cored wire	092-000830-00000
URUE ROE 2DR4R 1,0/1,2+1,4/1,6	Conversion kit, 37mm, 4-roller drive for cored wire	092-000831-00000
URUE ROE 2DR4R 1,4/1,6+2,0/2,4	Conversion kit, 37mm, 4-roller drive for cored wire	092-000832-00000
URUE ROE 2DR4R 2,8+3,2	Conversion kit, 37mm, 4-roller drive for cored wire	092-000833-00000

Verschleißteile 4 Rollen-Antrieb Ø = 37mm		St= Stahl Al= Aluminium CrNi= Edelstahl Cu= Kupfer	St= Steel Al= Aluminium CrNi= Stainless steel Cu= Copper	Wear parts 4-Roller drive system Ø = 37mm	
V-Nut: St-, CrNi-, Cu-Draht „Standard V-Nut“, oben unverzahnt und glatt, Rollenbezeichnung: „1,0“		V-groove: St-, CrNi-, Cu wire "Standard V-groove", on the top ungeared and plane, rolls description: "1,0"			
Antriebsrollen- Ø (b): Drive rolls- Ø (b): 0,6 + 0,8 0,8 + 1,0 0,9 + 1,2 1,0 + 1,2 1,2 + 1,6	Ersatzset: Spare set: 092-000839-00000 092-000840-00000 092-000841-00000 092-000842-00000 092-000843-00000				
Gegendruckrollenset (a) <i>Set of counter pressure rolls (a)</i> 092-000844-00000 Umrüstung verzahnt → unverzahnt: <i>conversion geared → ungeared:</i> 092-000845-00000					
U-Nut: Al-, Cu-Draht „Option U-Nut“, oben verzahnt, Rollenbezeichnung: „1,0 A2“		U-groove: Al-, Cu wire "Option U-groove", on the top geared-twin rolls, rolls description: "1,0 A2"			
Antriebsrollen- Ø (a+b): Drive rolls- Ø (a+b): 0,8 + 1,0 1,0 + 1,2 1,2 + 1,6 2,4 + 3,2	Ersatzset: Spare set: 092-000869-00000 092-000848-00000 092-000849-00000 092-000870-00000	Umrüstset: Conversion set: 092-000867-00000 092-000846-00000 092-000847-00000 092-000868-00000			
U-Nut gerändelt: Füll-/Röhrchendraht „Option U-Nut gerändelt“, oben verzahnt, ohne Nut gerändelt, Rollenbezeichnung: „1,0-1,2 R“		knurled U-groove: Cored wire "Option knurled U-groove", on the top geared, without knurled groove, rolls description: "1,0-1,2 R"			
Antriebsrollen- Ø (b): Drive rolls- Ø (b): 0,8 / 0,9 + 0,8 / 0,9 1,0 / 1,2 + 1,4 / 1,6 1,4 / 1,6 + 2,0 / 2,4 2,8 + 3,2	Ersatzset: Spare set: 092-000834-00000 092-000835-00000 092-000836-00000 092-000837-00000	Umrüstset: Conversion set: 092-000830-00000 092-000831-00000 092-000832-00000 092-000833-00000			
Gegendruckrollenset (a): <i>Set of counterpressure rolls (a):</i> 092-000838-00000		094-006025-00603			

Figure 10-1

11 Appendix

11.1 Setting instructions

11.1.1 Saturn 301

SATURN 301		EWM/HIGHTEC WELDING																	
mm	mm	SG2/3 G3/4 Si1 Ar 82/18				SG2/3 G3/4 Si1 CO ₂ 100				CrNi Ar 98/2				AlMg Ar 100					
		mm	m/min	1 / m	2 / m	3 / m	mm	m/min	1 / m	2 / m	3 / m	mm	m/min	1 / m	2 / m	3 / m	mm	m/min	1 / m
0,8	0,8	1,1	0	1	1	2,5	0	1	1	2,8	0	2	1	7,6	0	2	2		
	1,0	1,4	0	2	1	1,0	0	1	1	2,3	0	2	1	7,1	0	2	2		
	0,8	1,1	0	1	1	2,5	0	1	1	2,8	0	2	1	7,6	0	2	2		
1,0	1,0	1,4	0	2	1	1,2	0	2	1	2,3	0	2	1	7,1	0	2	2		
	1,2	1,6	0	2	1	0,5	0	2	1	1,5	0	2	1	5,3	0	2	2		
	0,8	3,8	0	5	1	3,5	0	5	1	3,4	0	3	1	8,5	0	3	2		
1,5	1,0	1,5	0	3	1	1,8	0	5	1	2,7	0	3	1	7,9	0	3	2		
	1,2	1,9	0	3	1	1,5	0	5	1	2,1	0	3	1	6,0	0	3	2		
	0,8	6,1	0	7	2	4,3	0	7	1	6,3	0	5	1	10,8	0	5	2		
2,0	1,0	2,9	0	5	1	3,4	0	7	1	4,0	0	5	1	9,8	0	5	2		
	1,2	3,0	0	5	2	2,1	0	6	1	3,7	0	5	1	6,6	0	4	2		
	1,6	1,5	0	3	1	1,3	0	6	1	1,4	0	3	1	6,1	0	4	2		
3,0	0,8	10,5	0	9	2	6,0	0	9	1	10,1	0	7	2	13,8	0	7	2		
	1,0	4,8	0	7	2	4,8	0	8	1	6,8	0	7	2	12,3	0	7	2		
	1,2	4,3	0	7	2	2,8	0	7	1	6,0	0	7	2	8,2	0	6	2		
4,0	1,6	2,2	0	5	2	1,6	0	7	1	2,5	0	7	1	7,0	0	5	2		
	0,8	12,0	0	10	2	10,3	0	11	2	13,7	0	9	2	15,5	0	8	2		
	1,0	7,3	0	9	2	6,8	0	9	1	9,4	0	9	2	14,0	0	8	2		
5,0	1,2	5,0	0	8	2	4,2	0	8	2	7,9	0	9	2	9,2	0	7	2		
	1,6	2,8	0	7	2	1,9	0	8	1	3,4	0	9	2	8,0	0	6	2		
	0,8	16,6	0	12	2	11,9	0	12	2	15,3	0	10	2	17,7	0	9	2		
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8,0	0,8	16,6	0	12	2	11,9	0	12	2	15,3	0	10	2	17,7	0	9	2		
	1,0	10,5	0	11	2	11,1	0	11	2	12,8	0	11	2	16,1	0	9	2		
	1,2	6,0	0	9	2	5,1	0	10	2	9,4	0	11	2	12,0	0	9	2		
10,0	1,6	3,9	0	10	2	3,0	0	10	2	5,3	0	11	2	9,6	0	8	2		
	0,8	16,6	0	12	2	11,9	0	12	2	22,7	0	12	2	22,4	0	11	2		
	1,0	11,8	0	12	2	13,8	0	12	2	14,1	0	12	2	20,4	0	11	2		
12,0	1,2	9,0	0	11	2	7,2	0	12	2	11,6	0	12	2	14,0	0	10	2		
	1,6	4,8	0	12	2	3,8	0	11	2	6,2	0	12	2	10,3	0	9	2		
	0,8	16,6	0	12	2	11,9	0	12	2	22,7	0	12	2	22,4	0	11	2		
14,0	1,0	11,8	0	12	2	13,8	0	12	2	14,1	0	12	2	20,4	0	11	2		
	1,2	9,7	0	12	2	7,2	0	12	2	11,6	0	12	2	16,7	0	11	2		
	1,6	4,8	0	12	2	4,4	0	12	2	6,2	0	12	2	10,8	0	10	2		
16,0	1,0	11,8	0	12	2	13,8	0	12	2	14,1	0	12	2	21,3	0	12	2		
	1,2	9,7	0	12	2	7,2	0	12	2	11,6	0	12	2	16,7	0	11	2		
	1,6	4,8	0	12	2	4,4	0	12	2	6,2	0	12	2	11,7	0	11	2		
20,0	1,0	11,8	0	12	2	13,8	0	12	2	14,1	0	12	2	21,3	0	12	2		
	1,2	9,7	0	12	2	7,2	0	12	2	11,6	0	12	2	16,7	0	11	2		
	1,6	4,8	0	12	2	4,4	0	12	2	6,2	0	12	2	11,7	0	11	2		

Figure 11-1

11.1.2 Saturn 351

SATURN 351																	
		SG2/3 G3/4 Si1 Ar 82/18				SG2/3 G3/4 Si1 CO ₂ 100				CrNi Ar 98/2				AlMg Ar 100			
					$\frac{1}{m}$ $\frac{2}{m}$ $\frac{3}{m}$				$\frac{1}{m}$ $\frac{2}{m}$ $\frac{3}{m}$				$\frac{1}{m}$ $\frac{2}{m}$ $\frac{3}{m}$				$\frac{1}{m}$ $\frac{2}{m}$ $\frac{3}{m}$
mm	mm	m/min			m/min				m/min				m/min				
0,8	0,8	1,6	0	1	1	1,3	0	1	1	1,7	0	1	1	7,2	0	1	2
	1,0	1,5	0	1	1	1,0	0	1	1	1,3	0	1	1	6,7	0	1	2
1,0	0,8	2,2	0	2	1	1,3	0	1	1	2,7	0	2	1	8,1	0	2	2
	1,0	2,0	0	2	1	1,0	0	1	1	1,8	0	2	1	7,5	0	2	2
	1,2	1,7	0	2	1	0,4	0	1	1	1,3	0	1	1	5,6	0	2	2
	1,5	2,0	0	3	1	2,7	0	6	1	5,5	0	5	1	8,7	0	3	2
1,5	1,0	2,0	0	2	1	2,1	0	6	1	2,2	0	3	1	8,1	0	3	2
	1,2	1,7	0	2	1	1,3	0	5	1	1,8	0	2	1	6,1	0	3	2
	1,5	3,6	0	5	2	3,7	0	7	1	7,8	0	7	1	10,6	0	5	2
	1,0	2,3	0	3	1	3,0	0	7	1	3,9	0	5	1	9,7	0	5	2
2,0	1,2	1,9	0	3	1	1,8	0	6	1	2,1	0	3	1	6,6	0	4	2
	1,5	1,4	0	3	1	1,7	0	8	1	1,7	0	3	1	6,1	0	4	2
	0,8	5,2	0	7	2	6,2	0	9	1	11,3	0	9	1	12,8	0	7	2
	1,0	2,6	0	4	1	3,9	0	8	1	6,2	0	7	1	11,4	0	7	2
3,0	1,2	2,7	0	5	1	3,2	0	8	1	3,5	0	6	1	7,9	0	6	2
	1,6	1,7	0	5	1	2,0	0	9	1	2,4	0	5	1	7,5	0	6	2
	0,8	8,0	0	9	2	7,9	0	10	1	14,2	0	11	2	15,5	0	9	2
	1,0	2,9	0	5	1	4,6	0	9	1	8,7	0	9	1	14,0	0	9	2
4,0	1,2	3,9	0	7	2	4,7	0	10	2	4,8	0	8	1	9,4	0	8	2
	1,6	1,9	0	6	1	2,3	0	10	1	3,1	0	7	1	8,4	0	7	2
	0,8	12,3	0	12	2	9,4	0	11	2	15,5	0	12	2	17,4	0	10	2
	1,0	4,4	0	7	2	5,6	0	10	1	10,9	0	11	2	15,7	0	10	2
5,0	1,2	4,9	0	8	2	5,4	0	11	2	5,4	0	9	1	10,4	0	9	2
	1,6	2,4	0	7	1	3,2	0	12	2	3,6	0	9	1	9,1	0	8	2
	0,8	23,2	0	16	2	10,6	0	12	2	20,5	0	13	2	19,2	0	11	2
	1,0	6,2	0	9	2	7,7	0	12	2	11,9	0	12	2	17,4	0	11	2
6,0	1,2	5,8	0	9	2	6,3	0	12	2	6,8	0	11	2	11,7	0	10	2
	1,6	4,0	0	9	1	3,2	0	12	2	4,8	0	11	2	9,6	0	9	2
	0,8	23,2	0	16	2	12,8	0	13	2	23,6	0	16	2	21,3	0	12	2
	1,0	7,1	0	10	2	8,9	0	13	2	18,6	0	14	2	19,2	0	12	2
8,0	1,2	8,0	0	12	2	8,9	0	14	2	7,4	0	12	2	13,2	0	11	2
	1,6	4,9	0	12	2	5,0	0	14	2	5,2	0	12	2	10,6	0	11	2
	0,8	23,2	0	16	2	18,6	0	16	2	23,6	0	16	2	22,6	0	13	2
	1,0	7,9	0	11	2	13,1	0	16	2	22,6	0	16	2	20,6	0	13	2
10,0	1,2	9,3	0	13	2	10,3	0	16	2	12,8	0	14	2	14,8	0	12	2
	1,6	5,1	0	13	2	5,4	0	15	2	6,9	0	13	2	11,0	0	12	2
	1,0	10,3	0	13	2	13,1	0	16	2	22,6	0	16	2	21,4	0	14	2
	1,2	10,9	0	14	2	10,3	0	16	2	15,9	0	16	2	17,4	0	13	2
12,0	1,6	5,4	0	14	2	5,9	0	16	2	9,0	0	14	2	11,9	0	13	2
	1,0	14,9	0	15	2	13,1	0	16	2	22,6	0	16	2	21,8	0	15	2
	1,2	12,4	0	16	2	10,3	0	16	2	15,9	0	16	2	20,1	0	14	2
	1,6	5,6	0	16	2	5,9	0	16	2	10,0	0	15	2	12,9	0	14	2
16,0	1,0	16,4	0	16	2	13,1	0	16	2	22,6	0	16	2	22,3	0	16	2
	1,2	12,4	0	16	2	10,3	0	16	2	15,9	0	16	2	21,5	0	15	2
	1,6	5,6	0	16	2	5,9	0	16	2	10,8	0	16	2	13,5	0	15	2
	1,0	16,4	0	16	2	13,1	0	16	2	22,6	0	16	2	22,3	0	16	2
20,0	1,2	12,4	0	16	2	10,3	0	16	2	15,9	0	16	2	23,0	0	16	2
	1,6	5,6	0	16	2	5,9	0	16	2	10,8	0	16	2	14,0	0	16	2

Figure 11-2

11.2 Searching for a dealer

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