

Instruction Manual for Mini Casting Unit **MC 15**



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1.3. Technical Data

	MC15
Crucible volume	15 cm ³ (ceramic crucible) 10 cm ³ (with grafit inlay)
Crucible temperature	max. 2000 °C
Melting performance	3.5 kW
Mains supply	230 V / 16 A, 50 or 60 Hz
Cooling water supply	2.5 - 5 bar / min. 1,5 ltr./minute
Cooling water recoil	Pressureless
Cooling water entry temperature	10 - 20 °C
Protective Gas	Argon oder Nitrogen, 3-4bar
Vacuum	min. 8m ³ /hr, 0,1 mbar abs.
Room temperature	10 - 35 °C
Relative atmospheric humidity	20 - 80 %
Weight	ca. 27 kg
Dimensions (width * depth * height)	400 mm * 400 mm * 450 mm

1.4. General information

Safety information

In order to ensure a constant, ideal performance of the machine and to ensure safe working conditions, the user is to observe the following safety measures:

- The complete electrical wiring is to be performed only by qualified and specially trained personnel.
- Check the machine and the supply devices regularly on possible damages.
- When opening cabinet/casings or when removing parts (exception: when this is possible by hand), certain parts under electric power can cause danger. If opening up the machine is necessary (before maintenance, change of machine settings, repair or exchange of parts) the machine must be cut off the mains voltage. If working on the opened machine is inevitable, only qualified trained personnel aware of the danger caused hereby and aware of the relevant regulations may be instructed to do this work.
- Capacitors in the machine can still be charged even when the machine's mains supply is switched off.
- When it seems that the machine can no longer be worked safely it has to be taken out of production and secured against further unintentional use. The following incidents indicate that safe working is no longer possible:
 - the machine is visibly damaged
 - the machine does not function
 - uncommonly heavy wear from transportation
- The safety valves placed inside the machine casing may not be removed, closed or altered in any way.
- As melted metal is processed with this machine (= temperatures up to 1800 °C), the utmost care and attention has to be applied when working with the Machine. The following necessary safety clothing is principally to be worn:
 - fireproof clothes
 - fireproof closed shoes
 - fireproof gloves
 - safety goggles
- Special caution is essential when working with graphite crucibles and graphite dies because these are only **visibly** hot at temperatures above 500°C!
- In commercial enterprises the regulations for the prevention of accidents of the relevant authority for electrical machinery are to be followed.

- People with pacemakers must not be near the machine while it is running.
- A trained responsible personnel is to supervise work with this machine.

Use as determined/liability

This casting machine is designed and manufactured to comply with the latest technical knowledge and according to approved safety regulations. When not putting into operation correctly or not using the machine as determined, however, danger and damages may occur. Therefore we suggest reading carefully and completely this manual before putting the machine into operation and to follow the instructions given therein:

- This machine is only to be used for melting, casting and granulating of precious metals normally used for the production of jewellery.
- This machine may only be connected as mentioned in this manual. The mains supply as well as in- and outgoing pressures are to be provided as stated on the machine label.
- This machine was designed for use in closed spaces (indoors) and may only be used for the above-mentioned purpose.
- Only original INDUTHERM consumable and spare parts are to be used.
- The machine may not be modified in any way. Technical changes may only be effected with INDUTHERM GmbH's prior written permission.
- Damages caused by disregard or false interpretation of the contents of this instruction manual result in an immediate expiration of the machine guarantee.
- This instruction manual is conform to the latest technical condition of the machine when printed. Technical changes and fittings subject to change.
- INDUTHERM GmbH cannot and will not take responsibility for any damages resulting of the above mentioned.
- This instruction manual may not even partially be reproduced (photocopy, micro film, computer processing etc.) without prior written permission of INDUTHERM GmbH.

2. Putting into operation

On delivery, immediately check if the machine is complete and if there are any transportation damages. In the case of damages, please contact at once supplier or forwarding agent.

2.1. Set-up directions

The machine should be placed on clean and dry ground. The ground should be even, solid and level. The rear side of the machine must remain freely accessible to ensure sufficient circulation of cooling air. The cooling air temperature must not exceed 35°C and must not be contaminated. Only after all supply and connecting systems have been connected, the machine may be put into operation.

2.2. Mains supply

Only trained personnel may connect the machine. Please pay attention to the nominal voltage and frequency stated on the machine label. The 1-phase current may differ +/- 10% (maximum) from the nominal value. The mains supply must at least be furnished with 20 A delay-action fuses (at 1* 230 V AC). The machine is equipped with a 16 A-Ceecon-connector when leaving INDUTHERM. All 3 lines (L1, N, PE) must be connected correctly.

2.3. Cooling water

Use two hoses with an outer $\varnothing$ of 6 mm for the cooling water. The water entry pressure must be at least 2.5 bar and must not be more than 5 bar. The water drainage must be without pressure. The water entry temperature must be above 10°C and must not exceed 20°C. The concentration of lime in the water must not be more than 60 mg CaO/l. The cooling water must not be contaminated.

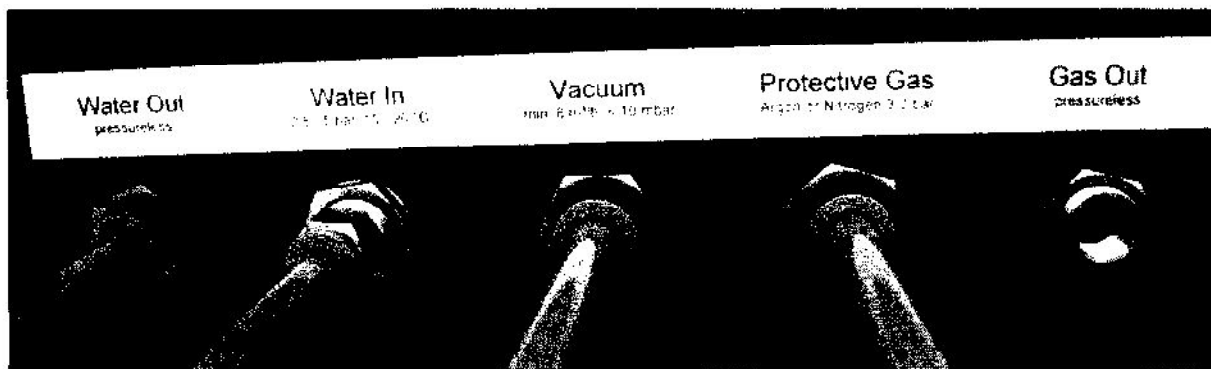
Caution: As long as the crucible temperature is above 100°C, the cooling water supply must be open; otherwise the inductor insulation could be destroyed. In case the cooling water supply stops while there is still a hot crucible inside the machine, the crucible must be removed immediately.

2.4. Protective Gas

Use a hose with an outer $\varnothing$ of 8 mm for the protective gas. The gas entry pressure must be 3-4 bar. The unit should be only connected to a pressure regulator (not a flow regulator!) on the gas tank. Alternatively to the protective gas dry compressed air at 3-4 bar pressure could be used for alloys without oxidation behaviour. Keep the gas/air tube as short as possible to avoid pressure loss.

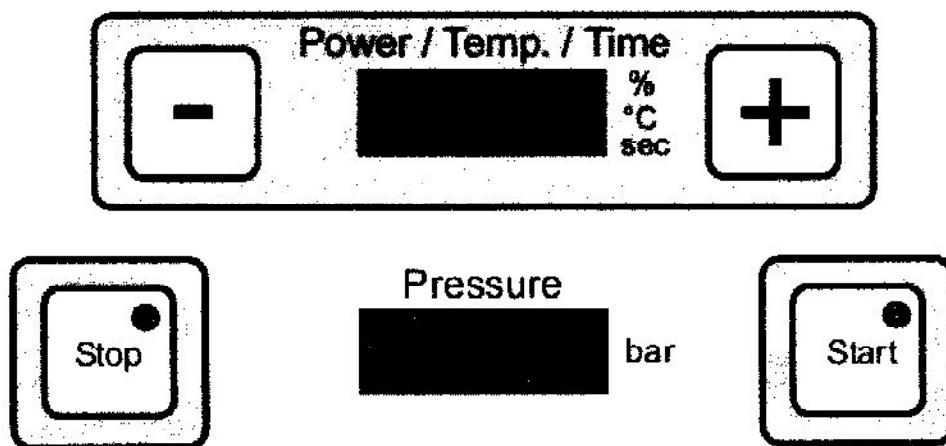
2.5. Vacuum Pump

The vacuum pump should be connected with the supplied tube with a outer $\varnothing$ of 8 mm. Keep the vacuum tube as short as possible to avoid pressure loss.



3. Operation

3.1. Operation elements



Display "Power/Temperature/Time"

"_ _ _"	initial state "ready"
"P010 to P100"	heating power in % (10% steps), or
"xxxx"	for optional temperature control display of temperature in °C (thermocouple type N up to 1300°C, type B up to 1700°C)
"0.00 to 1.00"	In tilted position after casting display shows a timer in seconds. casting pressure, displayed after pressing "+" and "-" simultaneously
"Exxx"	error code

Buttons "+" und "-"

to set the heating power in %, only activated without thermocouple
to set the nominal temperature value, with optional temperature control only
to set the casting pressure (press "+" and "-" simultaneously, set value with "+" or "-"
between 0.00-1.00 bars)
for parameter setting

Button "Start"

1x press heating on
2x press heating on and casting chamber will be evacuated

3x press heating on and the vacuum in the casting chamber will be released with protective gas to ambient pressure

Button "Stop"

1x press running programm will be aborted, generator off, the vacuum in the casting chamber will be released with protective gas to ambient pressure

Display "Pressure"

shows the actual pressure (absolute) inside the casting chamber

"-0.10 to - 1.00" vacuum

"0.00" ambient pressure

" 0.01 to 1.00" overpressure

Service Connection (RS232)

remote connection for service/diagnostics at the backside of the machine

3.2. Casting

Before starting check crucible and crucible insulation for dirt residues/possible damages.

Insert a small piece of the white quartz fleece into the crucible shield.



The crucible should touch slightly the quartz fleece, but the collar of the crucible should align with the top of the crucible shield.



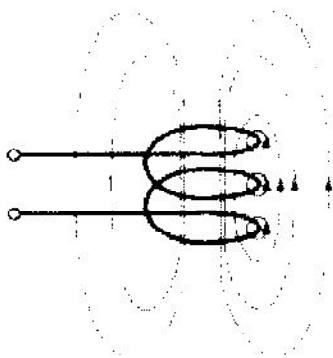
Important note for the use of the ceramic crucible without graphite:

The induction system needs for a good coupling into the metal a certain mass/volume of metal. Thin wires or chipping need to be compressed or added in an already molten amount of metal. Attention, risk of squirting metal!

If you use metal in small plate shape, place the plates horizontal, parallel to the crucible bottom. Also short cylinders should be placed this way for a better heating performance. Leave enough space to the crucible wall, because the heated metal will expand and can break the crucible.

Direct induction melting is necessary on metals with high temperature melting points, such as Pt, steel etc. High temperatures do not allow the use of graphite crucibles because of quick burning under standard atmosphere. Also direct induction melting is necessary on metals, which react unwanted with graphite.

An induction coil used in our systems, creates streamlines of electrical field, with an specific direction.



Field lines on an induction coil

If now a conductive material like metal is brought into this induction field, metal absorbs energy, it couples. This metal is separated in an uncondutive ceramic crucible in between.

As bigger now the working surface of the metal, as more energy can be absorbed, as quicker melting can happen.

This is why metal parts should be placed rectangular to field line = parallel to the crucible bottom, to provide optimal absorption of energy.

So it makes sense to place metal plates horizontal, also bigger wires couple more energy in horizontal position.

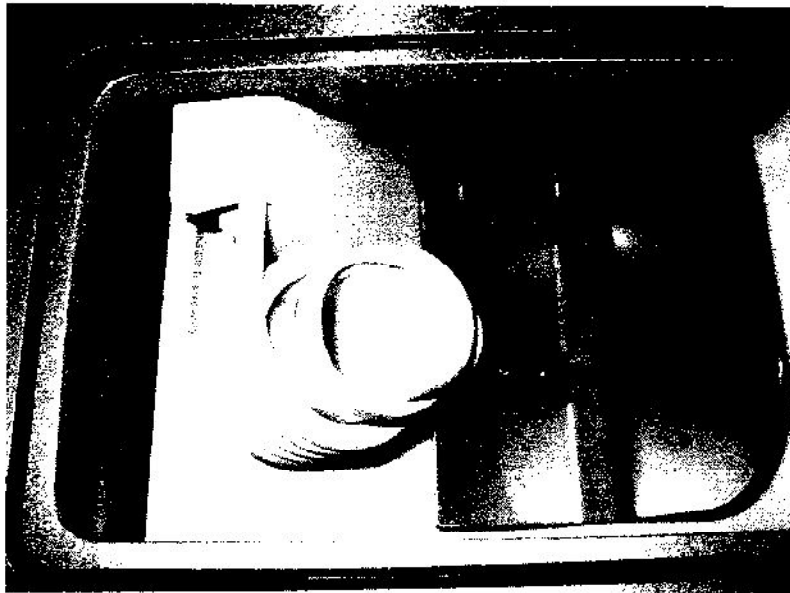
Please take care that this metal parts have enough distance to crucible's wall to prevent disruption of crucible by extension of the metal pieces during melting.

Please also take notice, that induction melting systems need a certain amount of volume to absorb enough energy for melting. Thin wires, chipping do not have enough volume and should be compressed (by a press) or better, charged into already molten metal.

At direct induction melting please notice following hint:

If a too voluminous piece of metal will given to already molten metal, molten metal can „freeze“, it becomes solid again. If this form-fitting metal now is heated-up again, it expands can disrupt the crucible.

Crucible shield with crucible in the induction coil



A suggestion for a general casting process:

- open cooling water supply
- open protective gas supply
- switch on main switch
- switch on vacuum pump
- After successful self test the display "Power" shows "---". (ready)
- Insert crucible with material into the quartz glass tube inside the inductor.
- Press "Start" 1x. The display "Power" shows the actual heating power in %. With "+" and "-" the desired heating power from 10-100% can be adjusted.
- Place flask in the flask holder and set into the casting chamber. Close and lock casting chamber.
- Press "Start" 1x again, unit automatically switches to vacuum inside casting chamber. **Before every first casting the machine performs a short pressure test. The casting chamber is set under a slight overpressure before the vacuum starts.** If this test fails (e.g. the casting chamber lid is not closed properly, an error code is displayed, e.g. E081)
- If casting temperature is reached (see data sheet of manufacturer of the alloy) press the button on the handle to release and tilt the unit uninterrupted clockwise till the catch. Release the button on the handle to lock the unit in the tilted position. During the tilting the unit automatically switches from vacuum to overpressure inside the casting chamber. The generator stops. On the display "Time" a timer counts the seconds after casting.
- After a sufficient waiting time, unlock the handle and tilt the unit back to horizontal position. The vacuum inside the crucible chamber is released by protective gas to ambient pressure.
- Open the casting chamber and remove the flask and the flask holder.

Hint: load complete amount of metal in cold crucible or charge only small pieces into molten metal

3.3. Optional Temperatur Control

To use the temperatur contoller a thermocouple type N up to 1300°C (parameter -01- must be set to 0002) or type B up to 1700°C (parameter -01- must be set to 0004) has to be connected to the socket inside the casting chamber. The nominal temperature can be set with the buttons "+" and "-". The heating power is now controlled by the temperature controller.

If the temperature control is not in use (e.g. for temperatures above 1700°C, platinum alloys) the dummy plug must be connected to the thermocouple socket. The machine automatically switches to the manual heating power mode. The heating power can now be adjusted with the buttons "+" and "-" (display "P010" to "P100"). Without thermocouple, without dummy plug or with defective thermocouple the display shows "E041".

3.4. Mixing instructions for flasks

gypsum bonded investment powder like Hoben Goldstar XL, XXX, Kerr Satin Cast 20 etc. 100:40 powder:water

flask size	investment powder in grams	water in ml	mixing time in min:sec
Ø 30mm x 55 mm	60	24	3:00
Ø 50mm x 55 mm	150	60	3:00
Ø 65mm x 55 mm	270	108	3:00
Ø 80mm x 55 mm	390	156	3:00
Ø 50mm x 80 mm	220	88	3:00
Ø 65mm x 80 mm	370	148	3:00
Ø 80mm x 80 mm	560	224	3:00

phosphate bonded investment powder like Hoben Platincast, Hoben H.T.
100:35

flask size	investment powder in grams	water in ml	mixing time in min:sec
Ø 30mm x 55 mm	60	21	2:30
Ø 50mm x 55 mm	150	52	2:30
Ø 65mm x 55 mm	270	95	2:30
Ø 80mm x 55 mm	390	136	2:30
Ø 50mm x 80 mm	220	77	2:30
Ø 65mm x 80 mm	370	130	2:30
Ø 80mm x 80 mm	560	196	2:30

standard burnout cycle gypsum: (from mixing to casting in 6,5 hrs)

resting time after mixing 30 min

in 2 hrs (2,5°C/min) to 300°C, hold 30 min

in 2 hrs (6°C/min) to 730°C, hold 30 min

(for flasks Ø 65mm x 80 mm and Ø 65mm x 80 mm increase hold time to 60 min)

in 30 min (4,3°C/min) to 600°C, hold 30 min

rapid burnout gypsum: (from mixing to casting in 3 hrs)

resting time after mixing 30 min

in 30 min (10°C/min) to 300°C, hold 30 min

in 30 min (14,3°C/min) to 730°C, hold 30 min

(for flasks Ø 65mm x 80 mm and Ø 65mm x 80 mm increase hold time to 60 min)

in 10 min (13°C/min) to 600°C, hold 20 min

standard burnout cycle phosphate: (from mixing to casting in 5 hrs)

resting time after mixing 1 hr

in 1 hrs (5°C/min) to 300°C, hold 30 min

in 2 hrs (5°C/min) to 900°C, hold 30 min

(for flasks Ø 65mm x 80 mm and Ø 65mm x 80 mm increase hold time to 60 min)

rapid burnout phosphate: (from mixing to casting in 2hrs 15 mins)

resting time after mixing 30 min

in 75 mins (12°C/min) to 900°C, hold 30 min

(for flasks Ø 65mm x 80 mm and Ø 65mm x 80 mm increase hold time to 60 min)

4. Service

4.1. Trouble shooting

Only trained personnel should open the machine.

The machine cannot be turned on:

- when there is no mains supply

The heating cannot be turned on:

- when there is no cooling water supply
- any error code "Exxx", see appendix 5.2.

4.2. Maintenance

A routine check/regular cleaning of the following is necessary.

Caution: disconnect the machine first!

Daily (before casting):

Remove crucible and quartz glass tube, carefully clean inductor housing.
Before reinstalling the above parts, check those and replace if necessary.

Annually:

Depending on the water quality, the cooling system should be cleaned with 25% citric acid. The cooling system should be treated with this acid for approx. 1 hour.
Then clean the system thoroughly with pure water and check on eventual leakages.

5. Appendix

5.1. Consumables

The spare part list for this machine start on next page.

INDUTHERM is now using only machine specific spare parts lists, which contain all the information for your machine.

The list is printed on the following pages.

The name of the stored list starts with a

- 1.) G
- 2.) The next 5 digits are the machine number.
- 3.) Next is the specification for what application it is used for. (only at multipurpose machines)
- 4.) The version index. A new machine has the index _00.

One example is G05120_VC_00. This is the list of the machine serial no 05120 and the spare parts shown are for vacuum casting, index 00.

We are pleased to send you this data on request as a PDF file G05120_VC_00.pdf. This makes it easy for you to order the correct spare parts. If the list changes and the index get one step higher to _01 please save the old file _00 into a section "old" or delete it.

If spare parts are replaced by new parts, the index will be incremented. This ensures that you always receive the latest version of consumables and spares. To be sure that the data is correct, INDUTHERM and their sales partners or end customers must work together.

If the machine is used for several purposes like sintering and granulating, more than one list is used for one machine like:

G05120_VC_00	All parts for vacuum casting
G05120_CC_00	All parts for continuous casting
G05120_SI_00	All parts for sintering
G05120_GR_00	All parts for granulating
G05120_PA_00	All parts for steel and Palladium casting

For other spare or replacement parts please contact our sales partner for your country or our order department at the telephone no.: +49-7203-9218-40.



INDUTHERM

Erwärmungsanlagen GmbH

Order from:

INDUTHERM

Erwärmungsanlagen GmbH
Brettener Straße 32
75045 Walzbachtal
Germany

Telefon: +49/72 03/92 18-0
Telefax: +49/72 03/92 18-70

your customer no.: _____

your customs no.: _____

your order no.: _____

Order-list for spare parts

MC15 serial no.:07119 customer 500AJS1

Pos.	Art.-No.	Qty.	Unit	Description
C083	12279021		pcs	ceramic crucible with graphite inlet for MC15 silver/gold casting, quality of graphite Q=0102, 10ccm
C011	23000760		pcs	glas tube for inductor MC15 Øo=40mm h=92mm
	14679050		pcs	flask adapter with slide for flask Ø=50mm h=55mm-80
	14679080		pcs	flask adapter with slide for flask Ø=80mm h=55mm-80mm
	14079050		pcs	flask for MC15, Ø=50mm h=55mm
	14079180		pcs	flask for MC15, Ø=80mm h=80mm
	14579050		pcs	flask tongs MC15 for Ø=30 and Ø=50mm
	14579080		pcs	flask tongs MC15 for Ø=65 and Ø=80mm
	14779050		pcs	rubber base, Ø=50mm, MC15
	14779080		pcs	rubber base, Ø=80mm, MC15
	20100037		pcs	gold foil MC15 as eye protection
	86079010		pcs	instruction manual MC15 with training video CD
	81179010		pcs	CD-ROM "MC15 video"
	30000422		pcs	connector Festo quick stop 1/4-8

Order-list for spare-parts, page 2

Pos.	Art.-No.	Qty.	Unit	Description
	30000421		pcs	connector Festo quick stop 1/4-6
	30000710		m	blue pneumatic tube 6mm for machine inside
	30000711		m	blue pneumatic tube 8mm for machine inside
	13400010		pcs	Thermocouple type N for MC15, 1300 degree Centigrade
	13200045		pcs	Cover for Thermocouple D4/D2 x 40, Ceramic, up to 1600 degrees centigrade
	13400020		pcs	Dummy connector for MC15 thermocouple plug
	11400020		m	fibre mat 50mm thick 610mm broad up to approx. 1400°.
When you need larger quantities please ask for special offers. Customer specific sizes for crucibles/dies are available on demand.				

5.2. Error and Warning Codes

The Error and Warning Codes for this machine start at next page.

Generator Dokumentation der MI_948.02 Software
Generator Documentation of MI_948.02 Software

15.02.07 S. Kley

System Parameter und Fehlermeldungen **System Parameter and Error Codes**

System Parameter **System Parameter**

Zur Parameterauswahl sind die Tasten 'Tiegeltemperatur +' und 'Tiegeltemperatur -' für mindestens 5 Sekunden gleichzeitig zu betätigen.

Innerhalb der Parameterauswahl (Parameternummer (-xx-) in der Temperaturanzeige sichtbar) läßt sich durch Betätigen der Tasten 'Temperatur +' oder 'Temperatur -' der gewünschte Parameter selektieren.

Zur Parameterverstellung sind die Tasten 'Temperatur +' und 'Temperatur -' kurzzeitig gleichzeitig zu betätigen. Danach läßt sich der Parameter durch Betätigen der Tasten 'Temperatur +' oder 'Temperatur -' verstellen.

Zum Verlassen der Parameterverstellung zur Parameterauswahl sind die Tasten 'Temperatur +' und 'Temperatur -' kurzzeitig gleichzeitig zu betätigen.

Wird während 15 Sekunden keine Taste betätigt, wechselt die Anzeige zurück zur Tiegeltemperatur.

Wichtiger Hinweis: Um eine korrekte Speicherung aller Parameter zu gewährleisten, ist es notwendig, nach dem Verlassen der Parametereinstellung mindestens 45 Sekunden zu warten, bis die Spannung ausgeschaltet wird.

To reach the parameter setup menu you have to press the 'crucible temperature +' and 'crucible temperature -' button for at least 5 seconds at the same time.

Within the parameter selection level (parameter number (-xx-) visible at temperature display) select the required parameter by pressing the 'temperature +' or 'temperature -' button.

To enter the parameter adjust level the buttons 'temperature +' and 'temperature -' have to be pressed at the same time. Now the adjustment of a parameter is possible by pressing the 'temperature +' or 'temperature -' button.

To leave the parameter adjust level to the parameter selection level the buttons 'temperature +' and 'temperature -' must be pressed at the same time.

If no action is taken within 15 seconds, the display will return to the present crucible temperature.

Important Note: To ensure a proper storage of all parameters, it is recommended to wait for at least 45 seconds after the parameter setup was left before turning off the power.

Parameter	Parameter	Mögliche Werte	Possible Values	Standardwert	Default Value	Beschreibung	Description	gültig für	valid for
00		0 ... 99		0		Reserviert, muß immer auf 0 gesetzt bleiben Reserved, has to be set to 0 all the time		alle/all	
01		0 ... 9		0		Thermoelement Typ: 0: Typ K (NiCr-Ni / grün) mit der Maximaltemperatur 1200 °C. 1: Typ S (Pt10Rh-Pt / orange) mit der Maximaltemperatur 1600 °C. 2: Typ N (NiCrSi-NiSi / rosa) mit der Maximaltemperatur 1300 °C. 3: reserviert 4: Typ B (Pt30Rh-Pt6Rh / grau) mit der Maximaltemperatur 1700 °C. 5 bis 8: reserviert 9: Keine Temperaturmessung. Temperatur-Messwert immer 0. Thermocouple Type: 0: Type K (NiCr-Ni / green) with maximum temperature 1200 °C. 1: Type S (Pt10Rh-Pt / orange) with maximum temperature 1600 °C. 2: Type N (NiCrSi-NiSi / pink) with maximum temperature 1300 °C. 3: reserved 4: Type B (Pt30Rh-Pt6Rh / grey) with maximum temperature 1700 °C. 5 to 8: reserved 9: No temperature measurement. Temperature reading always 0.		alle/all	
02		20 ... 80		50		Temperaturregler: Generator Ausgangsleistung bei Gleichheit von Soll- und Ist-Temperatur. 20 % ... 80% der maximalen Ausgangsleistung. Crucible temperature controller: Generator power output rate during set temperature and present temperature are equal. 20 % ... 80 % of maximum output rate.		alle/all	
03		1 ... 100		5		Temperaturregler, Proportionalwert Crucible temperature controller, proportional value		alle/all	
04		5 ... 255		50		Temperaturregler, Integralwert 255: Integralanteil deaktiviert (größere Werte verlangsamen Integralbildung) Crucible temperature controller, integral value 255: no integral component used		alle/all	
05		0 ... 200		25		Temperaturregler, Differentialwert Crucible temperature controller, differential value		alle/all	
06		0 ... 99		5		Temperaturregler: Dauer der Integrationsausblendung nach dem Eintritt in das Proportionalband. 0 ... 99 Sekunden. Crucible temperature controller: Integration start delay after entry into proportional range. 0 ... 99 seconds.		alle/all	
07		0		0		Reserviert Reserved		alle/all	
08		0		0		Reserviert Reserved		alle/all	
09		0		0		Reserviert Reserved		alle/all	
10		0 ... 950		0		L-Code, nicht verändern. L-code, don't change.		alle/all	
11		0 ... 20		0		Abgussdrucksteuerung: Druck 1 Startverzögerung 0 ... 20 bedeutet 0.0 ... 2.0 Sekunden. Casting pressure control: Pressure 1 start delay 0 ... 20 correspond to 0.0 ... 2.0 seconds		alle/all	

12	0 ... 50	0	Abgussdrucksteuerung: Druck 2 Startverzögerung (bezogen auf den start von Druck 1) 0: Druck 2 deaktiviert. 1 ... 50 bedeutet 0.1 ... 5.0 Sekunden. Casting pressure control: Pressure 2 start delay 0: Pressure 2 deactivated. 1 ... 50 correspond to 0.1 ... 5.0 seconds	alle/all
13	0 ... 10	0	Abgussdrucksteuerung: Druck 2 Ueberdruck 0 ... 10 bedeutet 0.00 ... 1.00 bar. (Hinweis: Der maximal einstellbare Druck wird vom maximalen Systemdruck begrenzt.) Casting pressure control: Pressure 2 overpressure 0 ... 10 correspond to 0.00 ... 1.00 bar. (Note: The maximum settable pressure is limited by the maximum system pressure.)	alle/all
14	0	0	Reserviert Reserved	alle/all
15	0 ... 1	0	Sonderfunktionen (bitcodiert): Bit 0 gesetzt: Messe Mode (Keine Leistungsabgabe, Medienversorgung (Wasser) wird als vorhanden simuliert, keine Synchronisations und Phasenüberwachung, keine Kühlkörpertemperaturüberwachung, keine Izkpeakrel Überwachung) Bit 1 bis 7 nicht verwendet Dieser Wert muß im Normalbetrieb immer auf 0 gesetzt bleiben. Special functions (bit selectable): Bit 0 set: Exhibition mode (No power output; simulation of present water, no sync. and no phase monitoring, no IGBT temperature monitoring, no Izkpeakrel monitoring) Bit 1 to 7 not used This value has to be set to 0 during normal operation.	alle/all
16	90 ... 130	100	Korrekturwert für Temperaturmessung Korrekturfaktor von der Temperaturmessung zur Temperaturanzeige in %. Correction value for temperature measurement. Correction value from temperature measurement to temperature display in %.	alle/all
17	10 ... 100	100	Temperaturregler: Maximale Leistung im Regelbereich. 10 ... 100 % Hinweis: - Bei starkem Temperaturabfall ($\Delta T > -0.5 \text{ K/s}$) erfolgt keine Leistungsbegrenzung durch den Temperaturregler. Crucible temperature controller: Maximum power at temperature control area. 10 ... 100 % Note: - No power limitation will be carried out at high temperature decrease ($\Delta T > -0.5 \text{ K/s}$).	alle/all
18	0	0	Reserviert Reserved	alle/all
19	0 ... 2000	0	Temperaturregler: Differenztemperatur für Leistungsbegrenzung im Regelbereich. 0 ... 2000 K Crucible temperature controller: Difference temperature for power reduction at temperature control area. 0 ... 2000 K	alle/all
20 ... 27	0	0	Reserviert Reserved	alle/all
28	0, 1	0	Externes RS232 Gerät 0: RS232 Standard 1: RS232 über GSM Modem External RS232 device 0: RS232 standard 1: RS232 via GSM modem	alle/all

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29			Reserved	
43			Reserved	
44	0 ... 255	0	Nicht verwendet, muß immer auf 0 gesetzt bleiben Not used, has to be set to 0 all the time	alle/all

Fehler- und Warnungsnummern
Error and Warning Codes

Fehler
Errors

Fehler stoppen den Generator. Fehler werden angezeigt, solange die Fehlerursache nicht beseitigt ist.

In nachfolgender Auflistung nicht enthaltene Fehlernummern kennzeichnen grobe Systemfehler. Bitte kontaktieren Sie INDUTHERM.

Errors will cause the generator to stop heating. Errors will be displayed continuously.

Not mentionend error codes in the list below characterize fatal system errors. Please contact INDUTHERM for assistance.

Fehler Error	Beschreibung	Description	gültig für valid for
E012	Kühlwasserdruck zu gering. Water pressure to low.		alle/all
E021	Übertemperatur Leistungsteil. Overheat generator power amplifier.		alle/all
E030	I _{zk} Spitzenstrom (absolut) zu groß. Mögliche Fehlerursache: - Kein Material im Tiegel - Alter Tiegel - kein Tiegel eingesetzt.	I _{zk} peak current (absolute) too high. Possible fault conditions: - no material inside crucible - old crucible - no crucible inserted.	alle/all
E040	Generator wird zu häufig ein- bzw. ausgeschaltet (Maximal fünf Schaltzyklen je Minute sind möglich) Generator was turned on and off to frequent. (Maximum five switching cycles per minute are possible.		alle/all
E041	Fehler im Tiegeltemperatursensor (Tiegeltemperatur größer 2000°C) Mögliche Fehlerursache: - Thermoelement nicht eingesteckt - Thermoelement defekt - Falscher Thermoelement Type eingestellt (Parameter 01)	Crucible temperature sensor error (crucible temperature higher than 2000°C) Possible fault conditions: - thermocouple not connected - thermocouple broken - wrong thermocouple type selected (parameter 01)	alle/all
E050	Generator Gehäusetemperatur zu hoch. Generator housing temperature to high.		alle/all
E051	Mittlere Einschaltdauer zu hoch. Turn on time (mean value) to high.		alle/all

Warnungen
Warnings

Warnungen werden nur angezeigt, um den Bediener über Fehlerzustände zu informieren. Der Generator wird nicht angehalten. Warnungen werden Blinkend dargestellt.

In nachfolgender Auflistung nicht enthaltene Warnungsnummern kennzeichnen kritische Systemzustände. Bitte kontaktieren Sie INDUTHERM.

Warnings will be displayed only to inform the operator about incorrect operating conditions. Heating will not be stopped. Warnings will be displayed as flashing codes.

Not mentioned warning codes in the list below characterize critical system conditions. Please contact INDUTHERM for assistance.

Warnung Warning	Beschreibung Description	gültig für valid for
E064	Mittlere Einschaltdauer zu hoch. Turn on time (mean value) to high.	alle/all
E065	Generator Versorgungsspannung zu gering (mehr als 15% Unterspannung) Generator supply voltage to low (more than 15% to low)	alle/all
E066	Generator Versorgungsspannung zu hoch (mehr als 15% Überspannung) Generator supply voltage to high (more than 15% to high)	alle/all
E081	Tiegeldruck außerhalb Toleranzbereich Mögliche Fehlerursache: - Glockendeckel nicht geschlossen - Fehlende Schutzgasversorgung - Fehlende Vakuumversorgung - Glockenverschluß (Spanner) zu schwach eingestellt Crucible pressure out of tolerance range Possible fault conditions: - bell lid not closed - protective gas supply missing - vacuum supply missing - bell lock adjusted to weak	alle/all