



Instruction Manual for Mini Casting Unit *LUKACast S*



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1. Introduction

1.1. General description of the LUKACast S

With this casting machine, the melting charge is heated up by induction. The special advantage of inductive heating is that the melting temperature is reached rapidly, because the heat is directly generated in the metal. During the melting process, the metal is thoroughly mixed by means of a magnetic field, ensuring a homogenous mixing even when using new alloys.

Vacuum-Pressure mode in only one chamber

Casting mode is based on this new method: while melting process is metal and flask as well under full vacuum. As far as metal is poured into flask by pivoting whole chamber, vacuum will be replaced by overpressure rapidly: Pressure impulse (inside of flask is still under vacuum!) ensures excellent form filling.

1.2. Machine components

The machine consists of separate units built into one casing:

1. Inside the casing, the following components are installed:
 - microprocessor controlled induction generator
 - medium frequency transformer
 - oscillation circuit capacities

2. The front panel consists of:
 - operating panel for control of melting cycles

3. The casting unit consists of:
 - inductor
 - crucible
 - insulation parts

4. The backside covers:
 - RS 232 Port for service
 - Connectors for water, vacuum, air pressure

1.3. Technical Data

	LUKACast S
Crucible volume	15 cm ³ (ceramic crucible) 10 cm ³ (with graphite 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, 6 bar
Vacuum	min. 8m ³ /h, 0,1 mbar abs.
Ambient 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 2000 °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 Lukadent consumable and spare parts are to be used.
- The machine may not be modified in any way. Technical changes may only be effected with Lukadent 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.
- Lukadent 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 Lukadent 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- -connector when leaving Lukadent. 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 6 bar. The unit should be only connected to a pressure regulator (not a flow regulator!) on the gas tank. Apply for a type of gas pressure regulator with big flow rate. Alternatively to the protective gas dry compressed air at 6 bar pressure could be used for alloys without oxidation behaviour. Keep the gas/air tube as short as possible to avoid pressure loss.

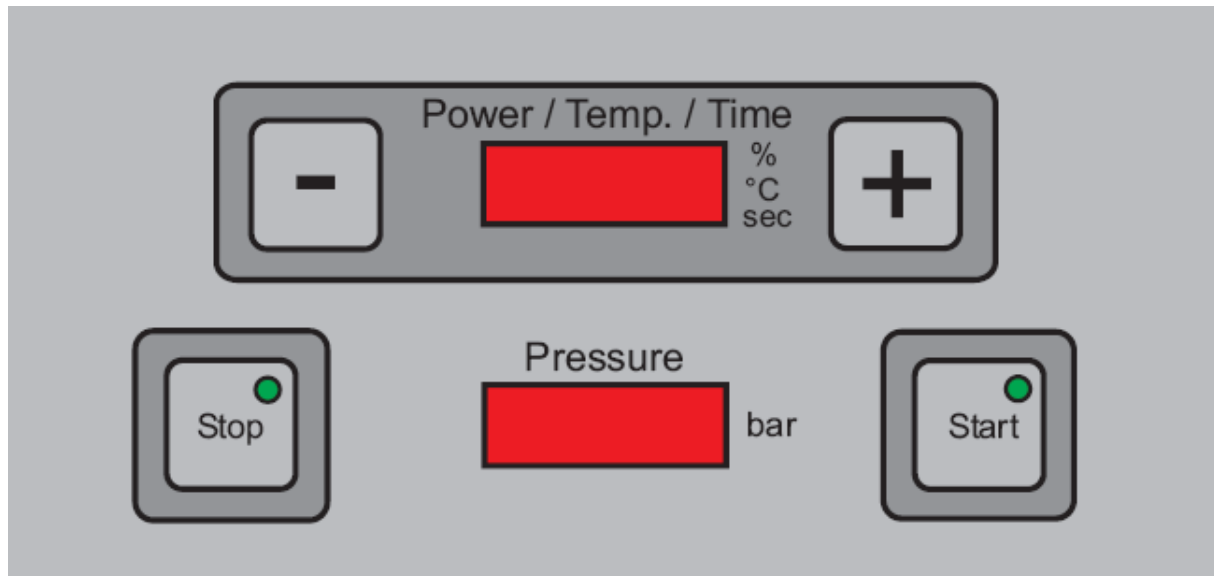
2.5. Vacuum Pump

The vacuum pump should be connected with the supplied tube with an 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"
"P000 to P100"	heating power in % (10% steps), or
"xxxx"	for optional temperature control display of temperature in °C (thermocouple type S up to 1600°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 0.00-2.00 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 program 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
- "xxxx" If a vacuum of < -0.98 bars is reached, the display switches to a timer counting in seconds. The maximum possible vacuum is achieved after approx. 30 seconds.
- "0.00" ambient pressure
- " 0.01 to 2.00" overpressure

Service Connection, interface (RS232)

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

3.2. Different crucibles



Ceramic crucible with graphite inlet for precious metals
#12279021

Ceramic crucible for CrNi, CrCo und other steel alloys
#12279020

3.3. 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.



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.
- Place the to the diameter of the flask matching flask holder into the casting chamber. The holder can be fixed to keep flasks of 50-80mm length in 5mm steps.
- Press "Start" 1x. The display "Power" shows the actual heating power in %. With "+" and "-" the desired heating power from 0-100% can be adjusted.
- Place flask in the flask holder. 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 the achieved vacuum is higher than -0.98 bar, the display switches to a timer. The maximum possible vacuum is reached after approx. 30 seconds. For best form filling we recommend to wait these 30 seconds before casting.

- 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.

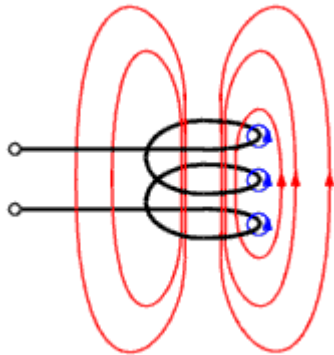
Important note for the use of the ceramic crucible without graphite:

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 non-conductive ceramic crucible.

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.

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

3.4. Optional Temperature Control

To use the temperature controller a thermocouple type S article no 13000030 up to 1600°C (parameter -01- must be set to 0001) *

has to be connected to the socket inside the casting chamber. Very important is that you use the thermocouple together with the thermocouple protection cover article no 13200045.



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 1600°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 "P000" to "P100").

Without thermocouple, without dummy plug or with defective thermocouple the display shows "E041".

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 6.3.

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.

6. Appendix

6.1. CE-declaration

EG- Declaration of Conformity

Manufacturer: LUKADENT GmbH
Felsenbergweg 2
71701 Schwieberdingen
Germany
Tel.: +49-7150-32955
Fax.: +49-7150-34113

Machinery
Description: Mini Casting Machine MC15

Relevant European
Community (EC)-guidelines:

	98/37/EG	(guide-line of machinery)
	72/23/EWG	(guide-line of low voltage)
changed in	93/68/EWG	
	89/336/EWG	(guide-line of electro- magnetic compatibility)
changed in	91/263/EWG; 92/31/EWG; 93/68/EWG	

Directive complied with: EN 50081-1
EN 50082-1

LUKADENT GmbH
Felsenbergweg 2 - 71701 Schwieberdingen
GERMANY



Peter Hofmann Dipl.-Ing. (FH)

, 03.07.2006

6.2. Consumables

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

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, Lukadent and their sales partners or end customers must work together.

For other spare or replacement parts please contact our sales partner for your country or our order department at the telephone no.: +49-7150-32955.

6.3. Error and Warning Codes

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.		alle/all	
	I _{ZK} peak current (absolute) too high. Possible fault conditions: - no material inside crucible - old crucible - no crucible inserted.			
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	
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	
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 Vakuumversorgung - Glockenverschluß (Spanner) zu schwach eingestellt Crucible pressure out of tolerance range Possible fault conditions: - bell lid not closed - vacuum supply missing - bell lock adjusted to weak		alle/all	