

Melting Process for Special Alloys

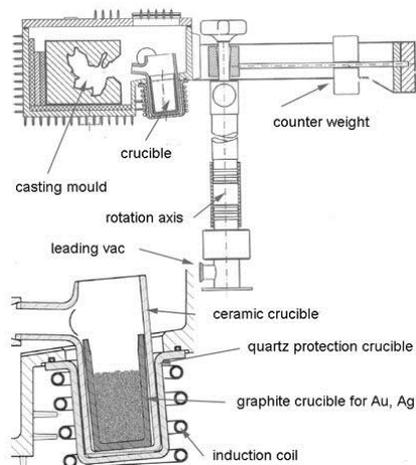
Induction crucible furnaces

Coreless induction crucibles are used for alloy development in high quality casting, for jewellery industry, in model making, automobile, watch and optical industry as well as in instrument building, implant manufacturing and dental area as well as for spectrometer sample preparation.

Centrifugal casting furnaces (picture 5.1-1 and 5.1-2) and vacuum pressure furnaces are used.

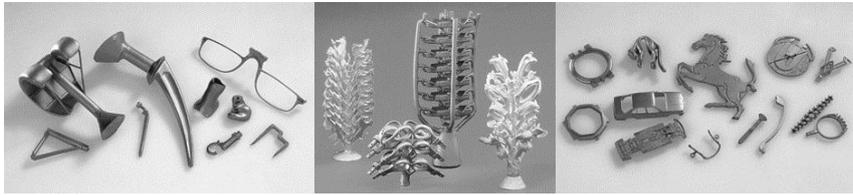


picture 1
Casting machine up to 3,0 kg
picture Linn High Therm



picture 2
diagrammatic drawing casting machine
picture Linn High Therm

These induction furnaces should cast in a lost wax melting process thin-walled precision cast parts up to max. 0,1 mm thickness as casting trees. However, induction furnaces are used not only for the casting of parts with thin wall thickness and small weights of 0.5 – 500 g but also for casting trees up to 3500 g Fig. 5.1-3).



picture 3

Ti, CoCr, Ni, Au, TiAl-casting parts for implants, optic, jewellery/clock, industry
picture Linn High Therm

Fast solidifying alloys, inter metallic compounds i.e. Au, Pt, Pd, Ti and Ti-Al-systems, steels, super alloys etc. are homogenized by electromagnetic forces effected agitation of melt. Mostly it is cast in ceramic moulds from which wax and plastic parts are burned out or in copper, graphite and steel moulds.

The preheating temperature for ceramic moulds varies from 250 °C to 1100 °C and for metal moulds between 20 °C and 300 °C.

The frequency range for such induction furnaces, which melting crucible and/or melt acts as the “secondary winding”, is between 8 kHz and 800 kHz. Due to the bath elevation (coupling formation), which is typical for the low frequency, it has to be considered that frequencies are high enough. It is absolutely necessary to observe the relation to the penetration depth, which depends on the melt. For the smaller melts high frequencies, for bigger melts deeper frequencies have to be chosen. Depending on metal in view of the *Paschen laws* in order to avoid destroying plasma development in accordance with the induction coil voltage, you can melt at vacuum between 100 mbar and 10^{-4} mbar. It is also possible to work under Argon or Nitrogen protective flushing. Even protective gas atmospheres up to 3 bar are possible.

The induction coil lies within or outside the process vessel. Due to operation and applications typical peculiarities, a galvanic separation of the melting coil from line is absolutely necessary.

The frequency depending adjustment of the output circuit has not only be included very different physical dates of the metals invoices, but also be considered the crucible material. But loose coupling costs efficiency and melting time in favour for universality. Typical power for these induction furnaces is between 3 kW and 50 kW.

Fast heating up to the melting point is important for reducing the casting delay time during centrifugal casting and vacuum pressure systems.

These points demand high requirements on the temperature change constancy of the induction coil and crucible material in form of mostly pressed, slip cast crucibles made of SiO_2 , Al_2O_3 , TiO_2 , ZrO_2 , Y_2O_3 , BN and others. Graphite or metal crucibles need a good thermal as well as electrical insulation. Crucibles are sometimes also coated with ceramics.

Optical pyrometer or plunger thermocouple in sheeted design (field shielding) control the medium frequency converter or high frequency generators on semiconductor or

tube basis in connection with PLC or simple control units by melting temperature. Vacuum, protective gas and casting process can be reproducibly automated and documented.

Casting times are important during vacuum pressure casting (not that suitable for high melting and fast solidifying metals) or centrifugal casting. An optimal coil and crucible design with leading of the molten metal during the casting radiation leading and high acceleration values i.e. of a casting arm from 1,0 – 3 s to end speed of rotation are extremely important in order to fill the mould. Vacuum pressure furnaces with difference pressures up to approx. 4 bar are used (picture 5.1-4).



picture 4
vacuum pressure casting machine up to 2,5 kg
picture Linn High Therm