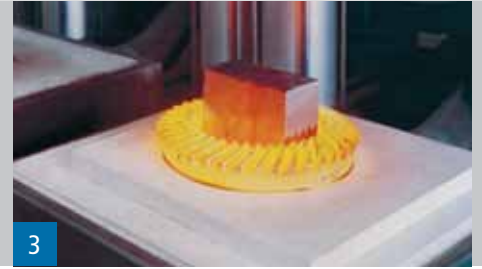
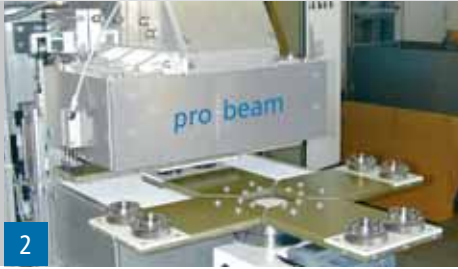


Uniform Magnetic Heating of Work Pieces

Heating Technology



1. Shrink fitting of gear components 2. UMH-Machine with rotating index table
3. Gear with through core

Applications of UMH technology

Pre-heating and Post-heating

of hardened components for electron beam and laser welding or surface hardening

Tempering selective tempering of complex hardened components

Shrink Fitting joining of rotor and shaft, gearbox and bearing

Stress Relief homogeneous heating optimises material properties

Die Heating

- replaces sources of conventional heating
- rapid heating eliminates production bottle necks.

Bonding homogeneous and precise heating leads to excellent surface adhesion

Industrial processes like electron beam or laser welding and surface hardening require heating of the work piece. For these heating processes pro-beam is applying the UMH (uniform magnetic heating) technology, a patented technology used in many industrial applications.

Machines utilizing the homogeneous magnetic heating (UMH) technology help to optimise the production processes of high quality products. Due to the homogeneous, controllable and tension free heating of work pieces prior and after the electron beam or laser welding it opens up new possibilities for welding and heating applications.

Homogeneous magnetic heating avoids internal tensions and deformations of the work pieces. UMH machines built by pro-beam optimise the production process of various applications in the industrial heating technology. Disadvantages of conventional heating technologies can be overcome.

Traditional heating technologies – including inductive heating – suffer from internal heat gradients. Inhomogeneities of the heat distribution in the work piece are caused by the skin effect or the thermal conductivity of the material. Traditional technologies are characterized by large temperature gradients, the risk of mechanical deformation and high energy consumption.

With UMH systems made by pro-beam the work pieces are heated homogeneous. The technology is based on the effect of hysteresis losses. They lead to heat generation in materials that are exposed to an alternating magnetic field. This innovative technology is controllable, has higher efficiency than traditional methods and is more flexible when integrated into industrial manufacturing processes.

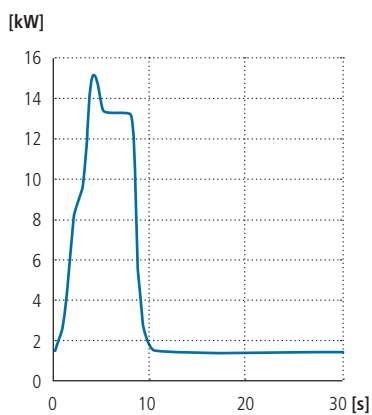
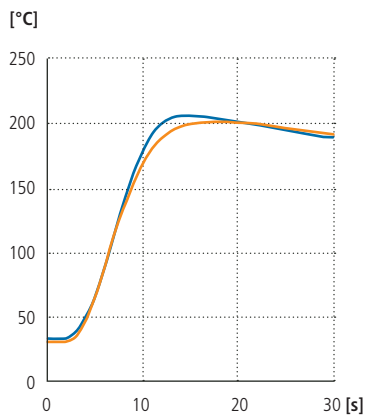


1. UMH-Machine
Type 100/100.55

2. View behind the magnetic
screen of exciter coil



General principle of UMH-systems



Upper diagram:
Typical temperature curve for gear heating

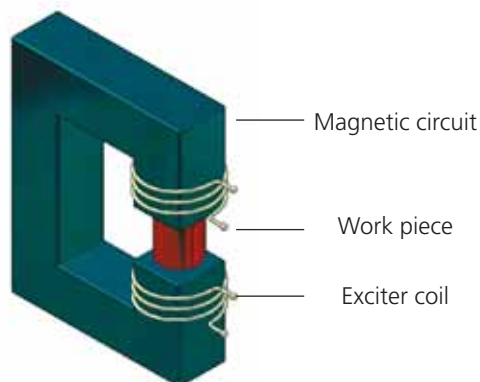
Lower diagram:
Reference curve for power consumption

Hysteresis effect ■ To heat the work piece it is placed into an alternating magnetic field. The magnetic field penetrates the material and aligns the magnetic domains to the polarization of the applied magnetic field. Reversing the direction of the external magnetic field changes the orientation of the domains of ferromagnetic materials and crystalline structures of paramagnetic materials. Result is a hysteresis effect: the polarization reversal engenders friction losses and heat. Performed at higher frequency of the field reversal this leads to heating-up of the material.

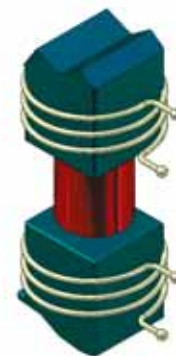
Homogeneous heating ■ Advantage of the heating through hysteresis losses is a homogeneous distribution of the heat in the material. In contrast to traditional heating systems that couple the heat through the surface and conduct or radiate to the core of the work piece, the UMH technology develops no heat gradient. pro-beam UMH-systems comprise two exciter coils and a laminated steel core of high permeability and low reluctance. The core concentrates the magnetic flux and guides it thru the work piece. Penetrating the work piece the periodic reversal of the magnetic flux results practically in homogeneous heating.

Control ■ Heat generation through hysteresis loss is reliant on the magnetic flux density and the field reversal frequency. In order to regulate the temperature the voltage amplitude and frequency applied to the exciter coils is controlled. Thereby optimum heating power and speed for any material can be set, independent from size and shape of the work piece.

Optimisation ■ Depending on the application the heating process is further optimised using special tools. In contrast to inductive heating no exchanging of the exciter coils is required.

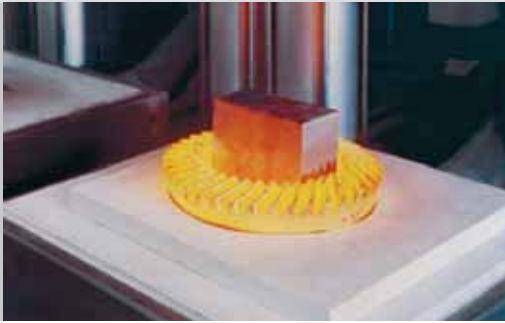


C-shaped magnetic circuit
made from laminated steel



Air gap with work piece

Homogeneous heating of gears



Suppliers to the automobile industry are using the advantages of homogenous heating in the production of gears

In the fabrication of gear boxes forward or reverse gears are welded along a radial joint. The already hardened gears are heated to a temperature of approximately 200 °C. During heating the hardened surface of the gear rim is not affected.

Short cycle time

pro-beam UMH machines require only 10 seconds to bring a steel gear with a diameter of approximately 10 centimetres to processing temperature. Both parts are heated homogeneously from the inside out. Customised core extensions direct the magnetic flux thru the work piece. Process parameters of the machine are adjusted to shape and size of the work piece.

No overheating

UMH technology prevents overheating of the delicate gear tooth. A homogeneous temperature distribution in the work piece avoids internal mechanical stress, resulting in crack free welding seams and durable gears.

pro-beam UMH machines can easily be integrated into complex automated manufacturing systems. With cycle times of 15 to 18 seconds, including a heating time of only 10 seconds, and the option of parallel heating of work pieces, UMH machines integrate seamlessly into the process chain of gear fabrication.

Type of machine

UMH 100/100.55

Rated power: 37 kW
Core dimensions:
100 x 100 mm
Dimensions of standard machine:
800 x 1200 x 1800 mm

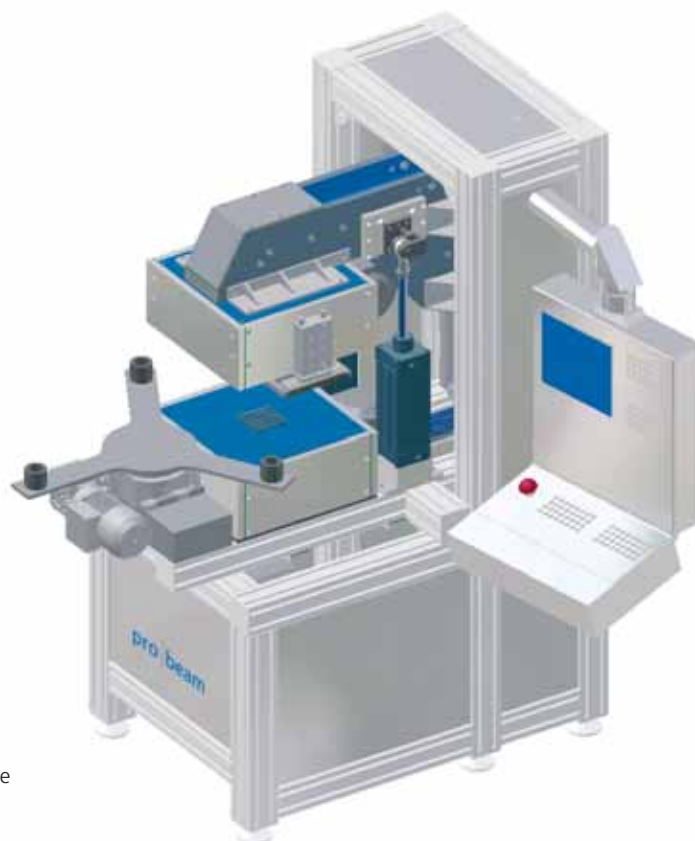
UMH 100/200.75

Rated power: 50 kW
Core dimensions:
100 x 200 mm
Dimensions of standard machine:
800 x 1200 x 1800 mm

UMH 100/300.140

Rated power: 94 kW
Core dimensions:
100 x 300 mm
Dimensions of standard machine:
800 x 1200 x 1800 mm

Dimensions of switch gear cubicle:
900 x 1300 x 2000 mm.
Mains supply:
400 V at 50 Hz.



Model of a Standard-Heating Machine
Type 100/100.55

Right picture: UMH-Machine with horizontal core arrangement

Left picture: UMH-Machine integrated into complex manufacturing system



The machine concept

Advantages of the homogeneous magnetic heating

- Homogeneous heating to a max. of 1.100°C
- Precise and accurate temperature control up to +/- 2°C
- Flexible in handling different work pieces of various shapes and sizes with simple tools with no requirement for coil exchange
- Total control of the machine functions through touch screen display and PLC
- Special PID control routines optimise the heating time
- Energy efficient design saves space and reduces operation costs

pro-beam UMH-systems are available as standard and special design for specific applications.

Model variety ■ Depending on the required heating power one, two or multiple head machines with installed power varying from 55 to 630 kW are used. Operating frequency of the machines is between 40 and 400 Hz. The frame for standard machines is made from aluminium profile. Special designs are made with welded steel frames.

The core ■ Heart of the system is the laminated iron core. Formed as a C-core the work piece is placed into the air gap. Two electro-magnetic coils on both legs of the C-core generate the alternating magnetic field. In order to reduce the magnetic stray field the magnetic circuit is screened by a aluminium housing. For loading and unloading of the work pieces the C-core is opened and closed by means of pneumatic cylinders. In automatic mode, motors are used to move the work piece in and out of the machine.

Control software ■ The machine is equipped with a programmable control system. Individual heating profiles for reliable and reproducible heating of different components can be stored in the system. Control routines (PID controller) for temperature and power control are available. Interfaces enable integration of the machine into automated manufacturing systems.

Temperature control ■ Temperature measurement is performed with temperature sensors or contact less through pyrometers.

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