



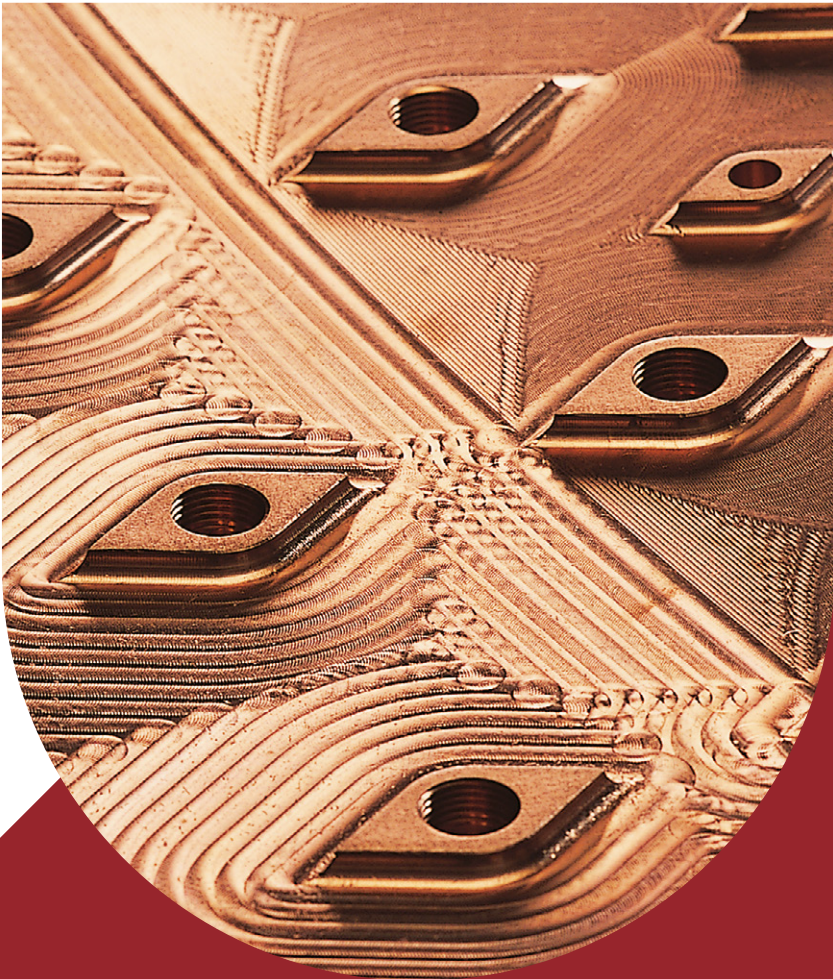
CUNOVA



AFM-ESP Mould
for improved thin slab casting



MELTING & CASTING
TECHNOLOGIES



Engineering Products

cunova has developed various technology packages for the continued development of the moulds used in the casting of bloom and slab shapes. Based on a precise analysis of the cooling water flow and the load on the moulds arising from the process, an improvement in the service life can often be achieved through local optimisation of the cooling geometry. Also completely new designs for cooling improvements were established in recent years, such as optimised-deep-drilled plates, chamfered narrow-faces with special edge cooling and ASM mould plates.

AFM-ESP Mould for improved Thin Slab Casting

The next generation in the evolution of the conventional thin slab casting mould is the AFM-ESP design from cunova. The special hot face geometry is implemented in a thin copper plate mounted on a non-magnetic and non-corrosive backup plate.

Cooling of the cold face is enhanced via a patent protected special machine topography to optimize cooling efficiency. The result is a longer lasting mould with improved productivity and performance. The AFM-ESP pushes the potential casting speed up to new limits together with improved slab quality, compared to standard thin slab plate designs.

A well-known requirement for casting a quality slab is a controlled heat extraction leading to a homogeneous strand shell temperature. Temperature measurements

made via thermocouples and/or optical sensors published in the literature has clearly shown that this uniform cooling is not being achieved when casting with conventional thin slab mould plates. Hot spots exist in these plates just past the funnel as seen in the thermal map images.

To compensate for this effect enhancement to the cooling intensities in these areas of the mould plate are needed.

The design modification of the cooling in the mould is one feature of the AFM-ESP design and uses a water "gap" cooling flow, for uniform cooling.

Engineering Products

In addition to improved overall cooling of the new plate, this AFM-ESP concept includes a special cooling enhancement in the meniscus area as well as a stress free mounting of the copper plate to the backup plate.

Both of these design features results in a longer mould plate lifetime.

On the mould hot face side, the ESP hot face geometry supports and guides the initial shell during its initial formation and ensures stress reduced growth, all while maintaining a optimal support between it and the mould surface.

The critical design improvements of the AFM-ESP mould form the backbone to incorporate cunova's special copper alloys Elbrodur® GP/H, together with a suitable mould step coating, in the overall mould design.

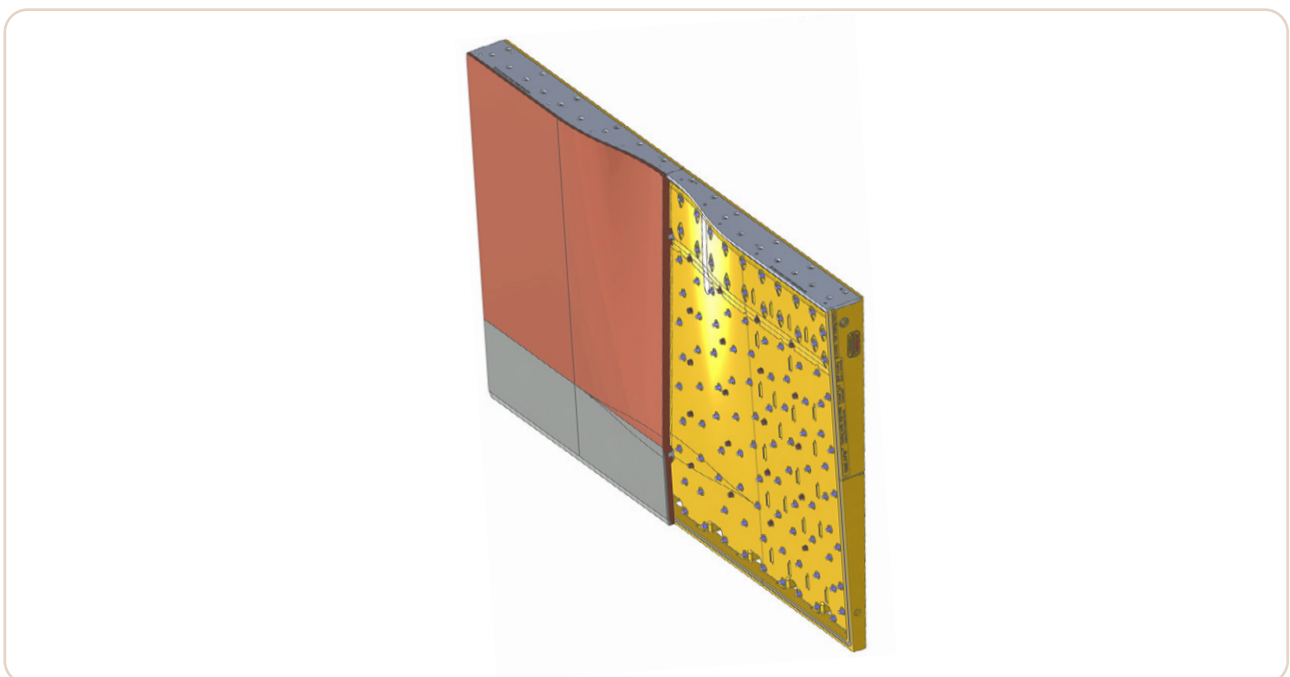
cunova-ESP Hot Face Funnel Geometry

The curved hot face mould geometry with its special design characteristics provides a continuous contact to the steel during initial solidification of the steel slab in the mould resulting in excellent cooling conditions. This allows for uniform thickness of the shell over its circumferences and along the casting direction.

Longitudinal cracks on the slab surface, which finds its root in non-uniform cooling and resulting stresses that often form cracks (sometimes called caster folds).

The improved uniformity of cooling in the mould will also greatly assist the casting powders to work better, due to the more uniform melting of the casting powder.

Although the copper plate is significantly thinner than conventional designs, it is possible to equip the copper plate with thermocouples or optical temperature sensor with fiber bragg grating for thermal mapping and break out prediction systems.



AFM-ESP Cooling Concept

Stress-free Connection between Copper & back-up Plate

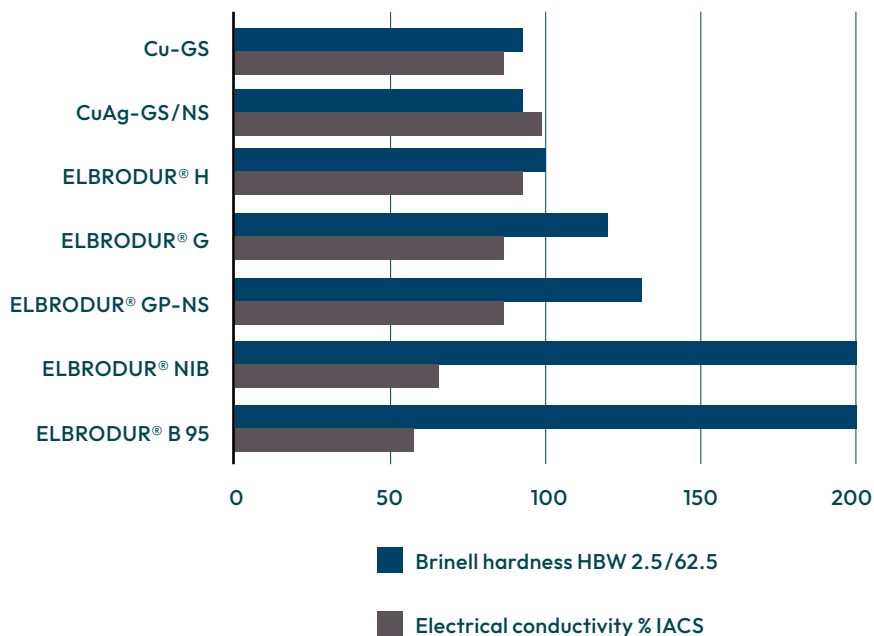
The cunova patented mounting system ensures stress-free floating assembly between the copper plate and back-up plate. This is achieved by using a special mounting system that provides for the inevitable movement between the two due to copper expansion from the high operating temperature.

The result is that no additional material stresses are being induced in the copper from the fixation between the two plates.

The benefits of the cunova-ESP mould can be summarized as follows:

- Reduced meniscus cracking due to lower stress in the steel shell from improved cooling
- Improved slab surface quality from the more uniform slab surface temperature and controlled casting powder melting
- Uniform mould powder melting giving better thermal protection and reduced mould friction
- Potential for higher casting speed

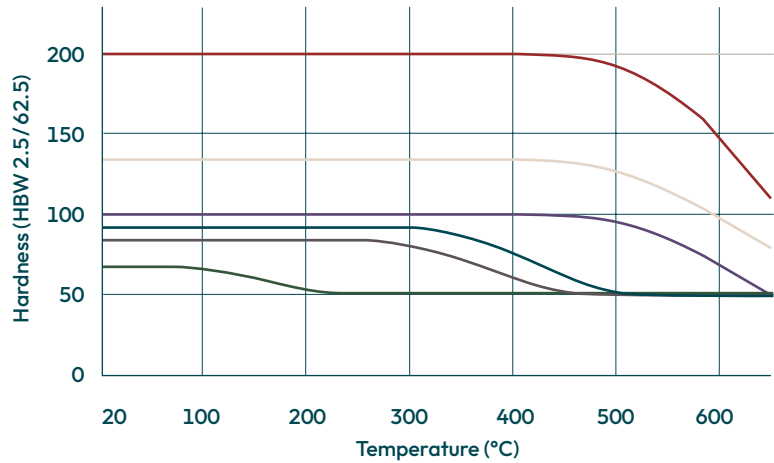
Hardness and electrical conductivity of cunova mould materials



Stress-free Connection between Copper & back-up Plate

Recrystallisation/softening behaviour of cunova mould materials versus standard copper (ETP Cu)

—	E-Cu (ETP Cu)
—	Cu-GS
—	CuAg-GS/NS
—	ELBRODUR® H
—	ELBRODUR® G
—	ELBRODUR® B 95/NIB

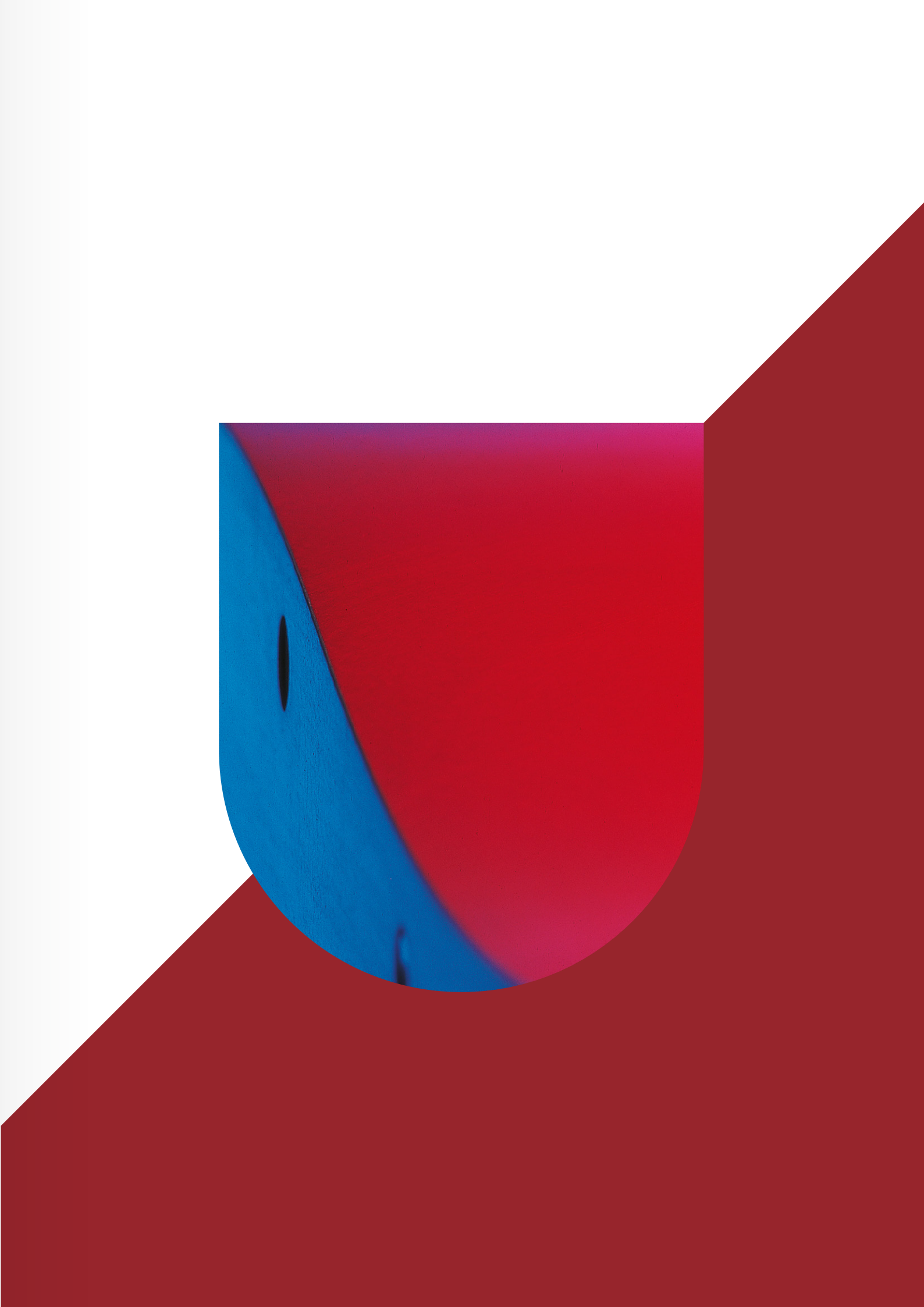


Elbrodur®

In developing this alloy cunova has an alloy with increased heat conductivity and improved ductility in its portfolio.

Thereby

- limiting bulging due to good creep resistance compared to CuAg-alloys and
- better resistance to crack propagation due to improved ductility





CUNOVA

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