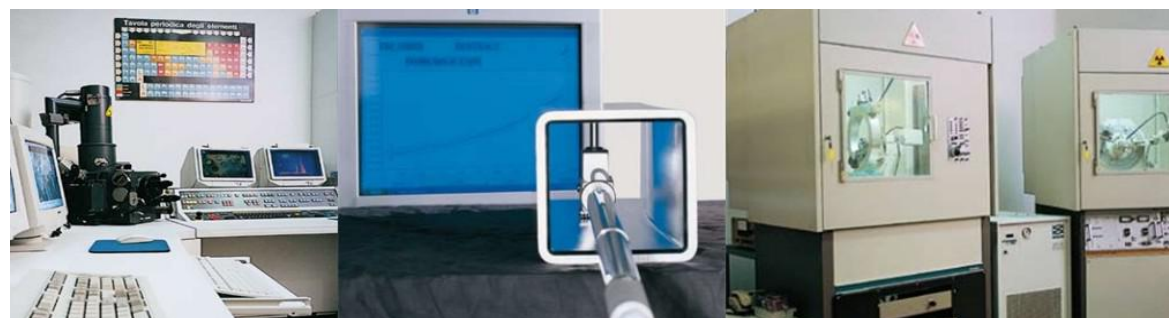




COPPER MOULD TUBE & PLATE

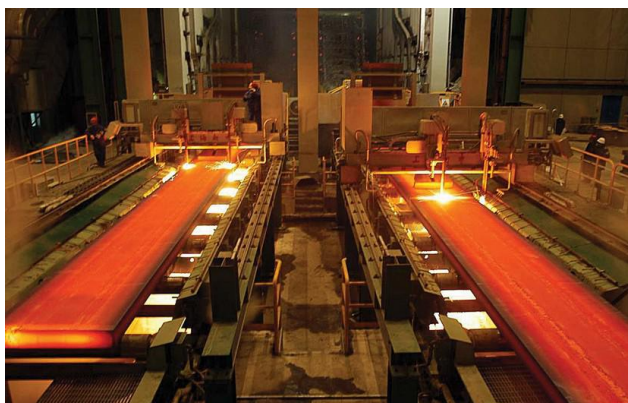
- Company Profile
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- Mould Coatings
- Mould Cooling Jacket
- Mould Assembly
- Manufacturing Facilities
- Testing Facilities





● Company Profile

SINOM CCM CO., LTD. founded in 1995, is one of the world's leading professional designer and manufacturer of copper mould tube and plate for continuous casting in China, with cutting-edge technology and much experience in metallurgy field of copper and copper alloys. It covers an area of 450,000 square meters with building area 230,000 square meters. And it has more than 3000 employees, owns fixed assets of CNY 300,000,000. It is powerful in machining with more than 2000 sets equipment including CNC gantry machining centre, CNC boring & milling machine, CNC grinding machine, oil press, etc. SINOM CCM also has our own electro-plating workshops for mould tubes and mould plates which enable us to control coating with our advanced electro-plating technologies. For years, we have cooperate with many Scientific research institution including General Iron and Steel Institute, Continuous Casting Centre, University of Science and Technology Beijing, Yanshan University, and etc.for our research and production. Furthermore, we are the production base for the mould tubes named by the State Continuous Casting Centre, i.e. the test centre for key equipment.



We have a complete quality control testing procedure, which controls the whole production process from raw material to final inspection. Meanwhile, SINOM CCM also provides close and prompt after sales services to ensure the customers' production with high efficiency and lowest cost. We have manufactured mould tubes 50,000pcs in 2015. SINOM CCM products' quality was approved by many famous third party internationally inspection companies, such as SGS, OMIC, IKA, ISQI, COTECNA, etc. And our SINOM Brand Mould and Copper Tube are appraised as *high-tech and new products*, as *satisfied products for customer*, and our copper mould tubes of bloom and billet are evaluated of famous brand product by our local Technology Supervision. SINOM CCM always keep the principles of "quality creates value, innovation leads development, integrity casts the future".



● Tubular Moulds

The development and increasing use of continuous casting have transformed ingot moulds from pure and simple containers for the molten metal into the principal component required by the producer to attain his goals in terms of quality and production. The choice of ever more sophisticated materials which increase the products life and improve its heat-exchange features, coupled with studies on optimal taper, have successfully turned the ingot mould into an object which is at the cutting edge of modern technology. Its features are specific to each production unit, and thus increasingly developed and designed in close consultation with the end user. Like in the past, SINOM CCM continues to be a key promoter in this ongoing process of technological improvement.

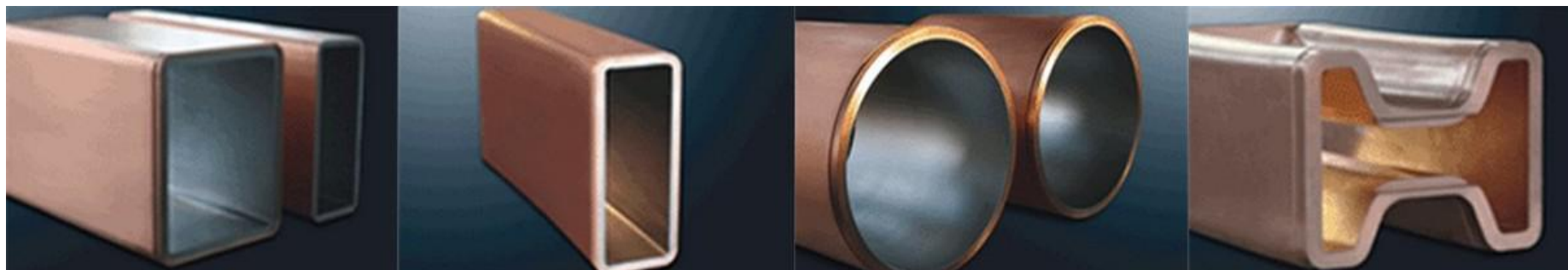
While SINOM CCM is clearly not the only supplier of ingot moulds with top-quality geometrical, mechanical and physical features, it is without a doubt the only one which has the necessary know-how to appreciate your specific requirements. Indeed, SINOM CCM brings you a product of its own design which in every way meets the aims of all steel producers, and can even supply the mould-cooling jacket where this is required.

Having said this, which in itself is reason enough to justify the use of SINOM CCM ingot moulds, let us add that we are unrivalled for:

- ✓ Speedy delivery
- ✓ High quality at competitive prices
- ✓ Personalized after-sales technical service
- ✓ High quality of the steel produced with our mould
- ✓ Benefits to production costs

Working with SINOM CCM means you will get exactly what you desire:

- ✓ Reduction of production costs
- ✓ Improvement in the quality of your steel
- ✓ Trouble-free existence



Materials	CuDHP CuAg CuCrZr CuNiP
Shape	Square, Rectangular, Round, Polygonal, Beam blank
Size	Up to 750mm of diagonal, larger sizes on special inquiry
Internal profile	Parallel, single taper, multi taper, parabolic
Curvature	Straight, Curved
Corner radius	> 1mm
Length	No limitation
Wall thickness	No limitation
Coating	Chrome max 0.2 mm thickness; Ni+Cr;
Special moulds for SINOM CCM technology center	





● Plate Moulds

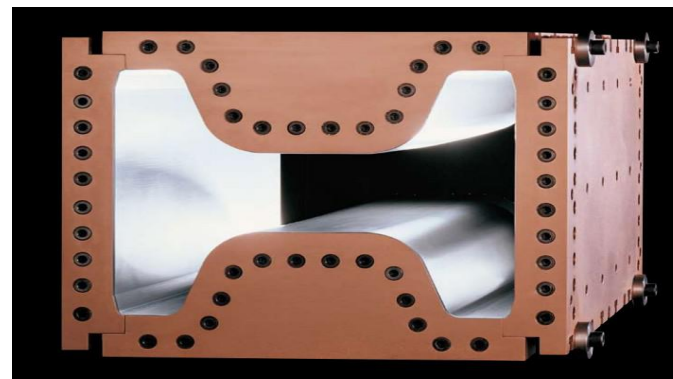
SINOM CCM is one of the world's leading suppliers of plate moulds for continuous casting, with much experience in metallurgy of copper and copper alloys and in-depth knowledge of its products' applications. Products' range includes all the types of plate moulds currently in use - CuAg, CuCrZr or CuNiP, with or without Nickel and Chromium coating. Ingot moulds must be capable of rapidly conveying the heat of the molten steel to the cooling water. The materials used - i.e., both the copper substrate and the nickel or chromium lining - are thus expected to meet high-level specifications to ensure long life, even in critical conditions, and avoid deformation, which could mar the quality of the cast steel.

In recent years special impetus has been given to studies exploring different types of lining for plate moulds, and a good number of different configurations have been put to the test. Each type of solution is carefully researched and then verified in close association with the technical experts of the steel mill.

Consult our steel-casting experts as to the best solution for your plant.

We will be happy to give you all the help and expertise you require.

Materials	CuAg CuCrZr CuNiP
Designs	With cooling slots, with drilled cooling channels, with welded studs, beam blank, funnel type for thin slab
Size	No limitation
Coating	Nickel, Nickel and Chrome, Chrome, Nickel alloys
Special moulds for SINOM CCM technology center	





● Mould Materials

To ensure optimal performance, moulds must keep their original specifications at mean operating temperatures as long as possible, and must, above all, have adequate heat transfer capacity. Thermal stresses which arise mainly on the hot faces in the area of the meniscus result in more or less rapid and permanent deformation of the mould, thus cutting short its life.

The seriousness of this phenomenon is related to the temperature level inside the mould, and to temperature differences between the hot faces and the cold faces, and between the area of the meniscus and the area immediately below it.

The appropriate solution for each of the various operating conditions depends on correctly choosing one of the following materials:

➤ **CuDHP - Phosphorus Deoxidized Copper**

The properties of this material are widely known. DHP copper is still today the most widely used material to manufacture moulds for the continuous casting of billets, where the thermal flow is usually moderate and the thickness of the mould not excessive.

➤ **CuAg - Silver Bearing Copper**

Adding 0.10% silver to the copper increases the recrystallization temperature by approx. 100°C. Thanks to its special properties, this alloy is used to manufacture moulds for the casting of blooms and slabs, where the temperature at the meniscus reaches and exceeds 300°C. Such high temperatures are due to the considerable thickness of the walls and to the high thermal flow inside the mould.

The fact that this material maintains its initial hardness, $HB > 80$, for long periods of exposure at 300°C, also makes it possible to re-process plates that have been subjected to repeated wear before reaching the minimum prescribed thickness.

Silver-bearing copper is also widely used for moulds producing billets in special conditions, such as weekly sequential casting, high casting speeds, cooling conditions which are not optimal, high temperature delta of the cooling water, and others.

➤ **CuCrZr - Copper Chromium Zirconium**

To improve the mechanical properties at high temperatures of copper alloys with high thermal conductivity, metallurgical experts have turned to structurally hardened alloys.

The main elements used for these copper alloys, whose solubility generally varies according to temperature variations, are the following: Be - Cr - Co - Cd - Fe - Mg - Mn - Ni - Nb - P - Si - Sn - Ti - Zr.

There are numerous alloys which can be obtained in saturated solution of these elements, but results are not always compatible with industrial realities, such as coping with pollution problems, high costs, and excessive loss of thermal conductivity. Thus the number of alloys which can be used in practice is considerably reduced.

The percentage of addition of elements is further restricted by the need to harmonise a high level of hardness with a high degree of thermal conductivity. The Copper-Chromium-Zirconium alloy satisfies all the above-mentioned requirements, and is used also because its excellent



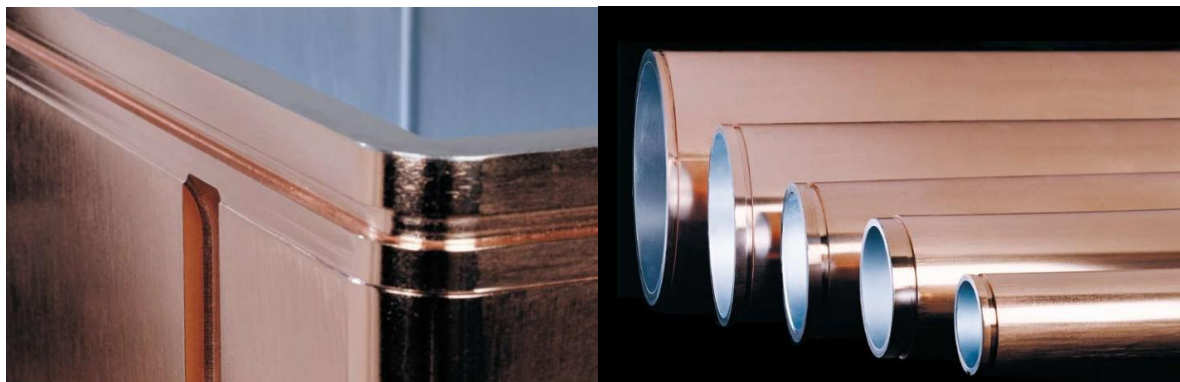
properties allow it to maintain its hardness for long exposure periods at high temperatures.

➤ **CuNiP - Copper Nickel Phosphorus**

The remarkable success in further developing the continuous casting process has greatly increased the need to carry out adjustments to the mould which will enable the new technology of continuous casting to fulfil the expectations of the players in this field.

Rising to the challenge, SINOM CCM has broadened the range of traditional materials with a new alloy, whose chemical composition can be altered in accordance with single applications - thus personalizing each type of mould to meet the specific requirements of each customer. The alloy in question allows us to correctly combine thermal conductivity and mechanical resistance at high temperatures, in an effort to minimize the problem of temperature variations across the mould's entire perimeter.

This has obvious advantages for solidification conditions without excessive thermal stress in the solidification skin, as well as in the mould itself. The controlled thermal conductivity of this new alloy considerably diminishes the critical state of the cooling conditions, which, as we know, are linked to three variables: thickness of the lubricating film, thermal flow and shrinkage of the solid skin. As a result, excessive thermal stress and problems of cracking are both eliminated.



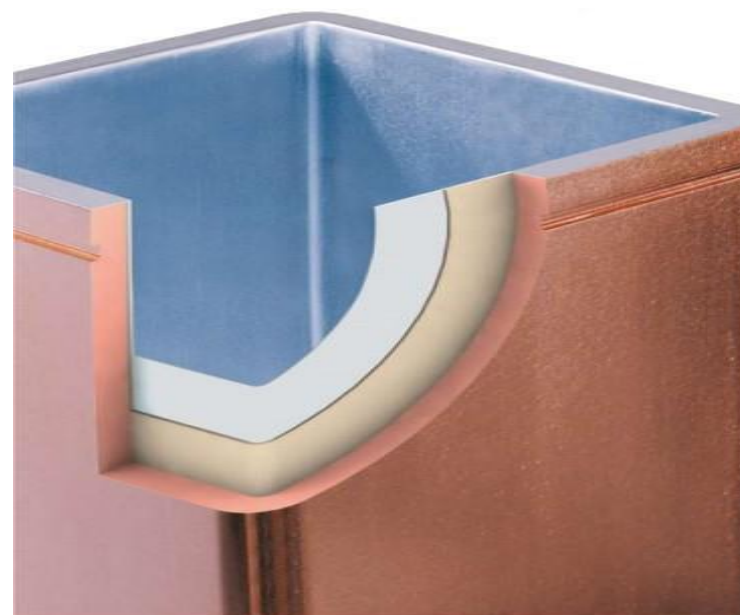


Material	CuDHP	CuAg		CuCrZr		CuNiP	
Chemical Composition	P 0.015 - 0.040	Ag 0.08 - 0.12		Cr 0.30 - 1.20		Ni 0.47 - 0.53	
		P 0.004 - 0.012		Zr 0.03 - 0.30		P 0.09 - 0.115	
Physical Properties							
Coefficient of thermal expansion at 20°C [K ⁻¹]	1.68 10 ⁻⁵	1.68 10 ⁻⁵		1.70 10 ⁻⁵		1.68 10 ⁻⁵	
Thermal Conductivity at 20°C [W/(m·K)]	340	377		325		284	
Electric Conductivity [% ACS] - minimum values	83	93		80		70	
Recrystallization Temperature [°C]	330	370		700		600	
Softening Temperature [°C]	-	-		500		400	
Young Modulus [Mpa]	1.2 10 ⁻⁵	1.2 10 ⁻⁵		1.3 10 ⁻⁵		1.2 10 ⁻⁵	
Mechanical Properties		Tubular	Plate	Tubular	Plate	Tubular	Plate
Ultimate Tensile Strength at 20°C [Mpa]	295	300	275	415	400	335	320
Ultimate Tensile Strength at 200°C [Mpa]	-	245	230	385	370	310	300
0.2% Proof Stress at 20°C [Mpa]	270	275	260	340	310	320	300
0.2% Proof Stress at 200°C [Mpa]	-	230	210	320	280	280	265
Elongation at 20°C [%]	20	18	18	20	20	18	20
Hardness 20°C [HB]	93	95	90	125	120	115	110
Application	Tubular moulds	Tubular & plate Moulds		Tubular & plate Moulds		Tubular & plate Moulds	



● Mould Coatings

Copper has lower hardness which leads to lower anti-abrasive property. Therefore, the area at the lower part of the moulds, where the stress increases drastically due to shells will be more severely worn. To increase the life time of copper moulds, SINOM CCM provides uniform mould interior surface plating with suitable hardness. Most of the copper mould tubes for small size billet casting are not used in any casting system where there are rigid casting stream support, therefore they are very sensitive to wearing. We use hard chrome plating which provides efficient anti-wearing protection on the interior surface of the mould tubes and increase the life of mould tubes. The plating thickness recommended by SINOM CCM will be controlled in the best range, As for the coating copper mould plates, based on our years of experience, we are able to provide Chrome coating, Ni-Cr coating and Ni-Co coating to meet the demand of various customers both at home and abroad.



Material Properties	CuDHP	Nickel	Hardened Nickel	Chromium	Nickel Cobalt
Hardness (HV)	93	220	400	980	410
Coefficient of thermal expansion	$1.68 \cdot 10^{-5}$	$1.28 \cdot 10^{-5}$	$1.25 \cdot 10^{-5}$	$0.84 \cdot 10^{-5}$	$1.00 \cdot 10^{-5}$
Thermal Conductivity at 20°C [W/(m·K)]	340	88	78	70	80



● Mould Cooling Jacket

A stainless steel mould-cooling jacket is available at last. A single piece with big wall thickness, very small size tolerances and non-deformable over time. Years of work have demonstrated that this part has to meet the quality standards to enable you to make full use of all the excellent characteristics of the last generation of moulds.

With the aim of making an even more efficient use of its products, SINOM CCM supplies stainless steel mould-cooling jackets, which are specially designed to go with its ingot moulds. The main features of our cooling jackets include: no mechanical joints, very close size tolerances, no distortion in time.

Rivets are once and for all high-precision gauged directly at the production plant. This makes for automatic centering of the ingot mould in the mould assembly, a fact which minimizes assembly time and eliminates error risk.





● Mould Assembly





- Manufacturing & Testing Facilities



Precision machining production line



CNC Boring & Milling Machine
TKA6920/L 120



CNC Gantry Boring & Milling Machine
GMB400 4000x8000



CNC Gantry Boring & Milling Machine
TK422 2000x4000



Vertical Oil Press
THP32-3000



Horizontal Oil Press THP69-1250



Universal Tool Microscope



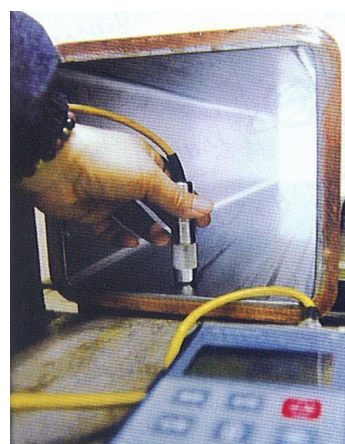
Universal Material Testing Machine 30t



Large-scale Metallurgical Microscope



Full Spectrum Direct-reading Plasma
Emission Spectrograph Made in USA



Coating Thickness Gauge



Hardness Testing Device



Copper Mould Tube & Plate

SINOM CCM CO., LTD.

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