

## Rautomead brings Cu Mg trolley wire capability to Wire 2008

Düsseldorf 31st March – 4th April 2008

Stand No  
10/E56



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Rautomead Limited will be presenting technology for the continuous casting of copper-magnesium alloy rods Stand 10/E56, Wire 2008 Düsseldorf.

Rautomead graphite furnace technology offers specific advantages for the manufacture of large diameter high quality copper-magnesium wire rods. With its balance of good electrical conductivity and high tensile strength, copper-magnesium is the favoured material for overhead wires and cables for high-speed trains in many countries.

### Over 30 years of continuous casting expertise

Established in 1978, Rautomead Limited is celebrating 30 years in business and many years at the forefront of continuous casting expertise. Comments company chairman, Sir Michael Nairn, "I would like to take this opportunity to thank customers old and new for their ongoing support and look forward to seeing as many familiar faces as possible at Wire 2008".

At Wire 2008 Düsseldorf, Rautomead will also be promoting casting technology for the manufacture of high quality CuOF wire rod 8.0 – 30mm diameter, 3,000 – 30,000 tonnes per year and also EDM brass wire rod.



# Drawing on

## well-proven expertise: Cu Mg Trolley Wire for High-Speed Trains

Copper-magnesium is rapidly becoming the preferred alloyed copper for high-speed rail applications in many countries, as it provides a combination of good electrical conductivity, high tensile strength and good creep resistance. As well as meeting these physical property requirements, copper-magnesium is also an environmentally benign material with no toxicity hazard.

From a manufacturing point-of-view, however, copper-magnesium is not an easily alloyed copper to produce. This is due to the light and volatile nature of magnesium and its propensity to form slag when molten.

### Unique demands on manufacturing processes



Model RS 3000/S/CuMg

Magnesium is a highly reactive element and is particularly vulnerable to loss when in its liquid state. This places unique demands on the manufacturing equipment design selected to melt, alloy and cast the copper magnesium alloy. To achieve quality results during melting and

casting, the composition of the Cu Mg alloy must be maintained within a very tight tolerance.

### Minimising reaction

The liquid copper should be maintained in a reducing environment to minimise reaction between the magnesium alloying element and any residual oxygen in the copper. There should be minimum agitation and

stirring of the liquid copper and the metal requires a protective layer of high quality graphite flake on the surface of the melt.

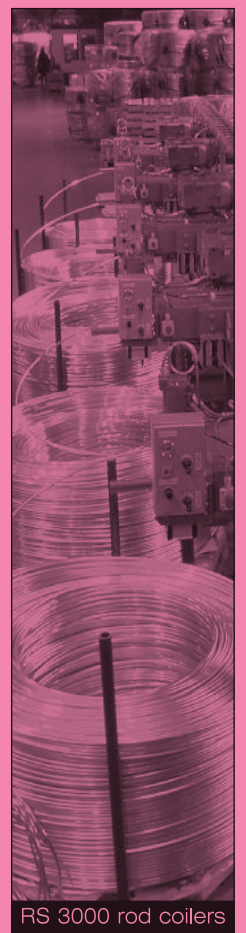
### Controlling solidification

At the same time, the design of the casting die/cooler assembly and the setting of the linear casting parameters must facilitate the control of the solidification process in order to achieve the desired grain structure required for subsequent downstream rolling/drawing operations.

As specialist providers of continuous casting technology for non-ferrous alloys, Rautomead Limited offers a choice of equipment with the necessary core design features that are particularly suited to providing the desired production parameters for copper-magnesium alloy. These design features include:

### Naturally “Oxygen-Free” environment

In the Rautomead process, a graphite melting and casting crucible provides the reducing containment environment for the liquid copper. The unique graphite process eliminates the oxidation problem by providing a naturally reducing oxygen-free environment in which oxygen present in the copper reacts with the graphite containment system.



RS 3000 rod coilers

## Low-voltage resistance heating

Electric resistance heating provides accurate furnace temperature control without any induced movement or agitation of the melt. It offers sophisticated levels of power and temperature control, allowing the furnace to be operated with a minimum 'superheat' metal temperature. The low-voltage system is also safe to use and easy to maintain. Thirty years of die/cooler and withdrawal control technology design and experience, enables Rautomead to provide the correct parameters for the solidification and casting of the copper magnesium alloys.

### Materials used for Trolley Wire – European Specification

Material		Resistivity (Ohmmeter max. 10 <sup>-08</sup> )	Breaking Load 150mm <sup>2</sup> (kN)	Tensile Strength 150mm <sup>2</sup> (min N/mm <sup>2</sup> )
Copper-Magnesium Alloy	CuMg 0.2	2.240	61.1	420
	CuMg 0.5	2.778	68.4	470
Copper-Tin Alloy	CuSn 0.2	2.395	61.1	420
Copper-Cadmium Alloy	CuCd 1.0	2.155	64.7	445
Copper-Silver Alloy	CuAg 0.1	1.777	50.9	360
High Conductivity Copper	Cu-ETP	1.777	45.1	310

## Upwards-vertical casting technology for TRANSKAT, Russia

Leading Russian railway supply company, TRANSKAT Joint Stock Company, of St Petersburg, has installed and commissioned a Rautomead RS 2200/5 upwards-vertical copper rod casting machine.

Selected by TRANSKAT to extend their capability in the manufacture of Cu Mg trolley wire, the machine will be used both for production of oxygen-free copper wire rod and also for production of copper-magnesium alloy rod to make trolley wire.

Rautomead engineers commissioned the machine at the TRANSKAT works in St Petersburg and have trained the customer's workers in the operating and maintenance of the plant. This new RS 2200/5 machine is the fiftieth upwards-vertical casting machine Rautomead has supplied since entering this field in 1995.

## Second copper magnesium casting machine for Lamifil, Belgium

Rautomead Limited has commissioned a new RS Upwards Vertical Casting Machine for production of 30mm diameter copper magnesium rod at Lamifil, Belgium. This is the second similar Rautomead machine to be installed at Lamifil, who specialise in the manufacture of conductor wires and trolley wire for railway systems.

Commenting on his company's investment in a second Rautomead machine, Mr Charly Verheyden, Managing Director of Lamifil n.v., said: "We are delighted with our new Rautomead machine. Now, with two units, we will have much greater flexibility in planning our production to meet the increasingly demanding requirements of the national railway authorities in the countries where Lamifil trades."

## Rautomead technology for high-speed Chinese railways

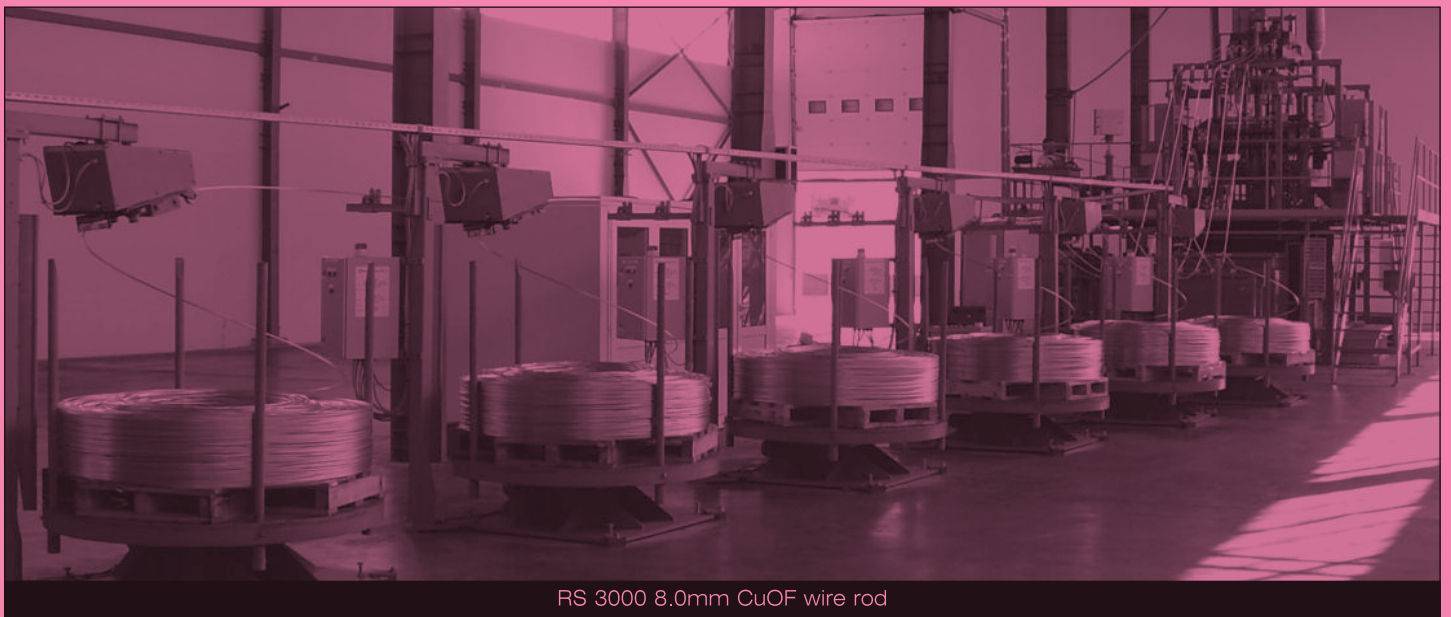
**In a further contract, this time with NKT Cables GmbH, of Cologne, Germany, Rautomead Limited are to supply a copper-magnesium casting machine to NKT's wholly-owned subsidiary company in Changzhou, China.**

Through their European operations at HFB Hettstedter Fahrleitungs-und Bronzedraht-GmbH, NKT Cables Group has been using Rautomead technology for production of copper-magnesium wire rod since 1991. NKT Cables Group's latest investment for manufacture in China reflects the enormous scale of development of the transport infrastructure in the country and also recognition by the Chinese railway authorities of the advanced technology available in this field from Europe.

# Choosing the right tec

## *A question of horses for courses*

Rautomead Limited, offer two different technologies of plant for the production of oxygen-free copper wire rod. The choice is based essentially on required plant capacity. The two technologies are explained below.



RS 3000 8.0mm CuOF wire rod

### *Resistance heated stand-alone graphite furnaces for production of up to 5,000 to 6,000 tonnes per year*

These particular machines are compact, plug-in-and-go floor standing units. Feedstock required is good quality grade A cathode or equivalent, with which up to 10% clean mill scrap can be blended. Standard machines are suitable for 8-12.5mm rod diameter production, but can be specified for up to 30mm diameter where required. Cathode feed may be automatic or by manually operated electric hoist.

#### *Simple, safe and forging*

The resistance-heated graphite furnace used is extremely simple, safe and forging in its design and operation. The copper is exposed to a massive surface area of graphite (pure carbon) as the molten metal passes through the system, thus ensuring that the product contains less than 5ppm oxygen (normally less than 3ppm), while using a feedstock which may well contain up to 80ppm oxygen content.

The system is self-regulating in that sense, thus ensuring both good quality oxygen-free copper rod, reliable production and long casting die life – normally 12-14 tonnes.

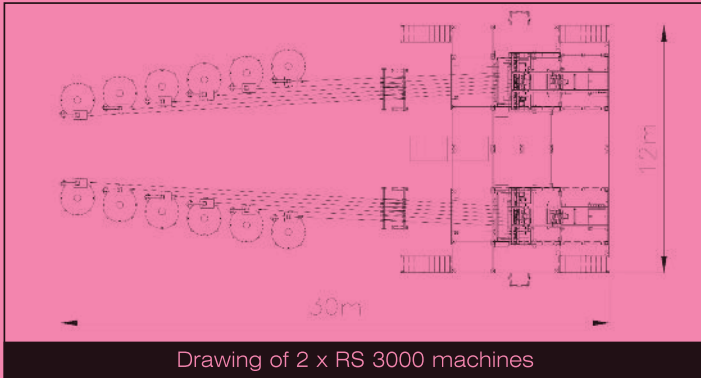
#### *Low voltage graphite resistance heating*

The simplicity of this machine design is in the heating system. This is based on a low voltage graphite resistance element circuit surrounding the crucible and heating the copper by radiation through the walls of the crucible. No inductor is used, no capacitor banks and no possible problems occur from disturbance of furnace transformers caused by harmonic waves. It is the essence of simplicity for easy maintenance.

The safety aspect is through the use of three-phase secondary power at only 40 volts, making the operation inherently very safe for the operators.

The forging characteristic of these machines occurs particularly in the case of mains power failure. In such an event, casting dies are automatically and immediately lifted out of the melt by battery-powered motor, while the resistance heated furnace will cool only slowly and without risk of damage to the machine, giving ample time for recovery of mains power or start-up of an emergency generator.

# Technology for the production of oxygen-free copper rod:

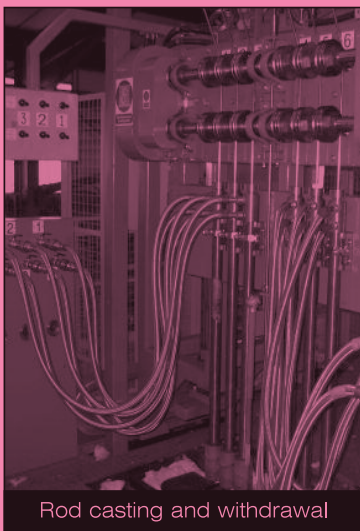


## 5,000 to 6,000 tonnes per year capability

The size of these machines is limited to 5,000 to 6,000 tonnes per year by practical limitation of the economic size of graphite crucible blocks. It is a technology well-suited to the smaller producer, where oxygen content in the cathode available cannot be guaranteed to be less than 30ppm, where mains power supplies are not always reliable and where starting operator skills may be relatively low.

## Induction-heated stand-alone channel furnaces for production of up to 12,000 tonnes per year

For output requirements up to 12,000 tonnes per year, the user has a choice either to install two resistance-heated stand-alone graphite furnaces side-by-side (as above), or a single stand-alone channel induction furnace. Either arrangement will have an annual capacity of 10,000 to 12,000 tonnes, depending on selection of model. Investment required is similar, whichever route is chosen.



## Lower operating cost or independent failsafe

The headline operating cost of a single 12,000 tonnes channel induction machine will be about 10% lower than the same output from two resistance heated machines. In ideal conditions, that will

make a strong case for selection of the channel induction approach. On the other hand, a choice of two independent resistance heated machines has something of the failsafe characteristics of an aeroplane with twin engines and should not be underrated. A lower theoretical unit cost of production disappears very quickly if a single machine is at a standstill for any reason.

## Weigh up the benefits

The points made above should be carefully weighed, as the channel induction machine, with its comparably reduced ability to reduce oxygen will not perform to expectations if the cathode contains 60-80ppm oxygen, as is relatively common in the industry. Additionally, channel induction furnaces are very sensitive to mains power failures and carry real risks of inductor damage and even furnace lining damage with substantial downtime for repairs if operators do not react very quickly and correctly in an emergency.



## Twin channel arrangement for greater outputs

For outputs up to 30,000 tonnes per year, Rautomead offers twin channel induction furnace arrangements, whereby the copper is loaded into a large drum-type channel induction furnace and melted under a heavy charcoal cover, before transferring into a smaller channel induction holding and casting furnace. The constraint of cathode oxygen content is removed in this arrangement and operating cost is minimised.

### Rautomead Model Range

Model	Strands	Tonnes output per year
<b>Stand Alone Resistance-Heated Machines</b>		
RS 2200/3	3	2,700 – 3,000
RS 2200/5	5	4,500 – 5,000
RS 3000/6	6	5,400 – 6,000
<b>Stand Alone Channel Induction Machines</b>		
RDG 150/10/8	10	9,000 – 10,000
RDG 150/12/8	12	10,800 – 12,000
<b>Twin Channel Induction Furnaces</b>		
RDG 240/20/8	20	18,000 – 20,000
RDG 360/32/8	32	28,000 – 30,000

# 'QDC' technology in horizontal casting machines brings die change process down to just one hour

*The patented Rautomead Quick Die Change (QDC) technology is now available on the company's highly proven RT range of horizontal continuous casting machines for brass and bronze semi-finished bar and hollow bar production.*

The robust design of these machines has enabled them to give excellent service to customers over many years - indeed many units supplied in the 1980s remain in daily production. Rautomead believes that the introduction of QDC will provide RT machine users with a worthwhile and significant enhancement to the casting process.

to less than 400 deg C before changing the casting dies. This was required to avoid erosion of the graphite high temperature components when exposed to atmosphere. Cool down time was about 16 hours, followed by 2 hours to change the dies and a further 8 hours to reheat, before production could recommence. In conventional brass rod casting, the casting dies would last typically for three weeks, enabling a die change procedure to be carried out each third weekend, with no serious disruption to production schedules.

### Radically new concept

Now, however, Rautomead has patented and is introducing the radically new concept of Quick Die

Change – a process that enables the casting dies to be changed without cooling the furnace. Die change time is therefore dramatically reduced from around 26 hours to one hour. This new QDC technology is best used in conjunction with a separate melting furnace, so that a fresh batch of molten metal is ready to pour as soon as the new casting die has been fitted.

Using QDC, the RT 650 and RT 850 machines become highly efficient units for jobbing applications where relatively short production runs are undertaken before a need to change to another size. Rautomead expects that this greatly enhanced

production efficiency will open up a series of new applications and new markets for their highly proven horizontal continuous casting technology.

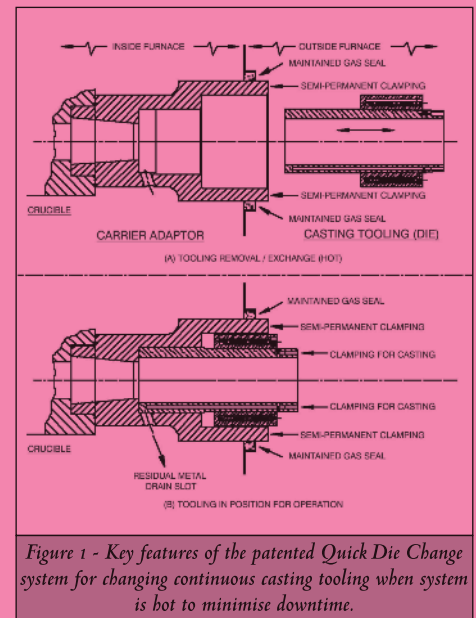
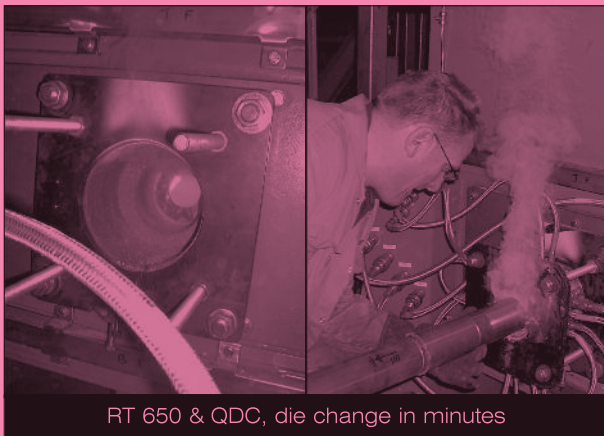


Figure 1 - Key features of the patented Quick Die Change system for changing continuous casting tooling when system is hot to minimise downtime.

Today's RT models are the RT 650 and RT 850. They can be charged with molten metal from a separate melting furnace, or can be used as integrated melting and casting machines. The machines can be configured to produce one, two or four strands according to product size. Maximum size is 150mm and minimum is 15mm. Output is influenced by product profile and the alloy in production, but 400 kg and 600 kg per hour is typical from the RT 650 and RT 850 machines respectively, when fed with molten metal.

The Achilles heel has been that until now it was necessary to cool the furnace

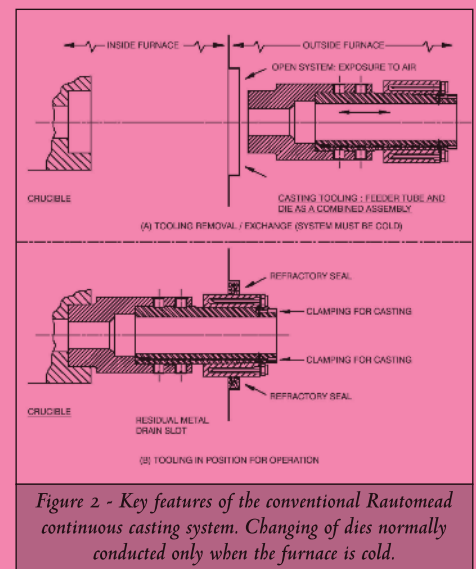
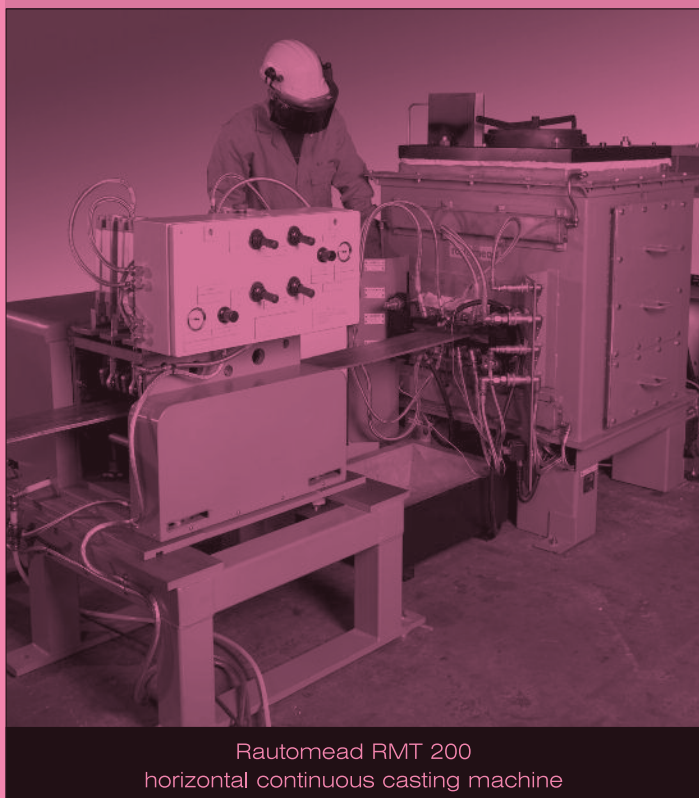


Figure 2 - Key features of the conventional Rautomead continuous casting system. Changing of dies normally conducted only when the furnace is cold.

The Perth Mint, of Western Australia, installed a new RMT 200 model continuous casting machine during 2007 for processing silver and silver alloy coinage strip

# Perth Mint

## fifth Rautomead continuous casting machine



Rautomead RMT 200 horizontal continuous casting machine

The new machine will be the fifth Rautomead continuous casting machine in use at Perth Mint. This model RMT 200 is designed specifically for the production of silver-based alloy strips of up to 100mm x 25mm. Output capacity is 80 -100kg (Ag) per hour.

### Oxygen-reducing

Silver has a strong propensity to attract oxygen in the molten state. The totally enclosed nature of the Rautomead process, where the molten metal is in contact only with the pure carbon surfaces of the holding crucible and casting die, is a particularly suitable process for casting silver and eliminating any residual oxygen present.

An additional feature is the still metal bath created by the external resistance heating elements, thus avoiding the turbulence associated with many induction heating systems in close proximity to the casting die.

### Natural Choice

Rautomead Limited has supplied 150 continuous casting machines for processing of gold and silver alloys for coinage strip, jewellery, electronics and dental alloy applications around the world.

The special features of these machines are conducive to production of the highest quality, blemish-free silver strip and make Rautomead the natural choice for mints around the world.

# Rautomead continuous casting technology for Bangalore

*Rautomead Limited is to supply two horizontal continuous casting machines to Rapsri Engineering Industries Ltd., of Bangalore, India.*

Rapsri is one of the leading producers of high quality bronze alloy bearings in India, and the purchase of the two Rautomead machines – an RT 650 and an RMT 200 model – will enable the company to expand the range of alloys and sizes that are produced by the continuous casting process.



Guy Henderson & Derek Scott, Rautomead Limited, with Mr Santhanam & Dr K Praveen, Rapsri Bangalore November 2007

# NEW CONTRACTS... NEW CONTRACTS... NEW CONTRACTS...

## First Rautomead Silver Billet Caster for USA

Rautomead Limited has recently delivered a horizontal continuous billet casting machine to Cimini & Associates Inc., of Rhode Island, USA.

The new machine is a model RT 650 single strand billet casting machine. It will be fed with pre-alloyed molten metal and will be used to cast 4" diameter silver and silver alloy billets for subsequent extrusion. The machine may also be used to produce flat products up to 6" wide.

Rautomead's oxygen reducing graphite crucible technology makes it particularly suitable for the holding and casting of silver which is otherwise very prone to oxygen pick-up in the molten state.

### Third Rautomead RS machine for AB Elektrokoppar



Bill Smith, Brian Allardyce, Guy Henderson, Mervyn Cooper (standing) Rautomead, Bengt Jonason, Thomas Roslund, Tom Karvonen AB Elektrokoppar Carsten Ahlvena

AB Elektrokoppar, the Swedish-based manufacturer of electric conductor materials, has ordered its third Rautomead RS 3000 model continuous

casting machine. The order was concluded during a visit to Rautomead's headquarters in Dundee during November 2007.

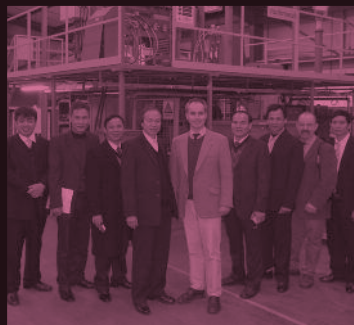
This latest RS 3000 will, primarily, be used to produce oxygen free silver bearing copper wire rod, increasing the installed capacity of Rautomead continuous casting equipment to over 17,000 tonnes per year at the Helsingborg facility in Sweden.

The continuous cast wire rod is further processed within the Elektrokoppar group by continuous rotary extrusion technology to produce rectangular wires and other profile shapes.

The Rautomead RS 3000 will be supplied with an automated cathode feed and alloy dosing system to facilitate the production of copper silver alloys (0.01% - 0.20%) with minimal operator participation.

### FOURTH RAUTOMEAD CASTING MACHINE FOR VIETNAM

Representatives of 127 Company and Mechanical Enterprise 59 (Hanoi, Vietnam) visited the Rautomead factory in December 2007 to participate in the pre-shipment testing of their recently purchased RS 2200 model continuous casting machine.



Pre shipment inspection at Rautomead. Vietnamese delegation with Mr Bui Trong Binb & Mr Nguyen Ngoc Binh, 127 Company & Guy Henderson

The RS 2200 will be installed as part of a new wire and cable manufacturing facility which is located close to Hanoi. The Rautomead graphite furnace continuous casting machine will process copper cathode and produce high quality 8.0mm diameter oxygen free copper wire rod. This will be the fourth Rautomead casting machine to be delivered to Vietnam since 2003.

## RAUTOMEAD GOLD CASTER FOR CHINA



Mr David Wu - Rautomead Shanghai, Mr Brian McLauchlan - Rautomead Limited, Mr Zhao Suimeng -

Guangzhou Jiabao, manufacturers of gold bonding wire, recently commissioned a new Rautomead RMJ/H025 model continuous casting machine.

The new machine, a model RMJ, rated at 30 kVA, will be used to melt and cast 7mm diameter gold rod for drawing down to gold bonding wire.

This machine will be the 9th Rautomead machine to have been built for gold bonding wire production. Similar machines have been supplied in the USA, Germany, Korea as well as elsewhere in China.



The full range of Rautomead continuous casting technologies – complete with comprehensive specifications and literature downloads - can be viewed at [www.rautomead.com](http://www.rautomead.com)

### Diary Dates 2008 See Rautomead at the following events...

Wire 2008	Düsseldorf	Germany	31 March – 4 April
MJSA Exhibition (Jewellery)	New York	USA	13 – 15 April
Metal Bulletin International Copper Conference	Sofia	Bulgaria	9 – 11 June
Wires & Fasteners Exhibition	Kiev	Ukraine	18 – 20 June
Wire Shanghai	Shanghai	China	23 – 26 September

# rautomead®

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