

METALLURGY PRODUCTS

AL-EMS electromagnetic stirring solutions

Improving aluminium furnace performance



- Up to 25% higher productivity
- Up to 15% reduction in dross generation
- Up to 10% lower energy consumption

Increase productivity and reduce costs with ABB's electromagnetic stirring technology

ABB's electromagnetic stirrers for the aluminium industry (AL-EMS) help to improve productivity and quality and increase cost-efficiency in aluminium melting, holding and refining operations.

Efficient stirring of the aluminium melt is one of the most decisive factors in speeding up the kinetics of reactions and improving heat and mass transfer, which is essential in terms of increasing productivity with retained or improved quality. With over 320 systems installed worldwide, ABB is the most experienced supplier of AL-EMS systems.

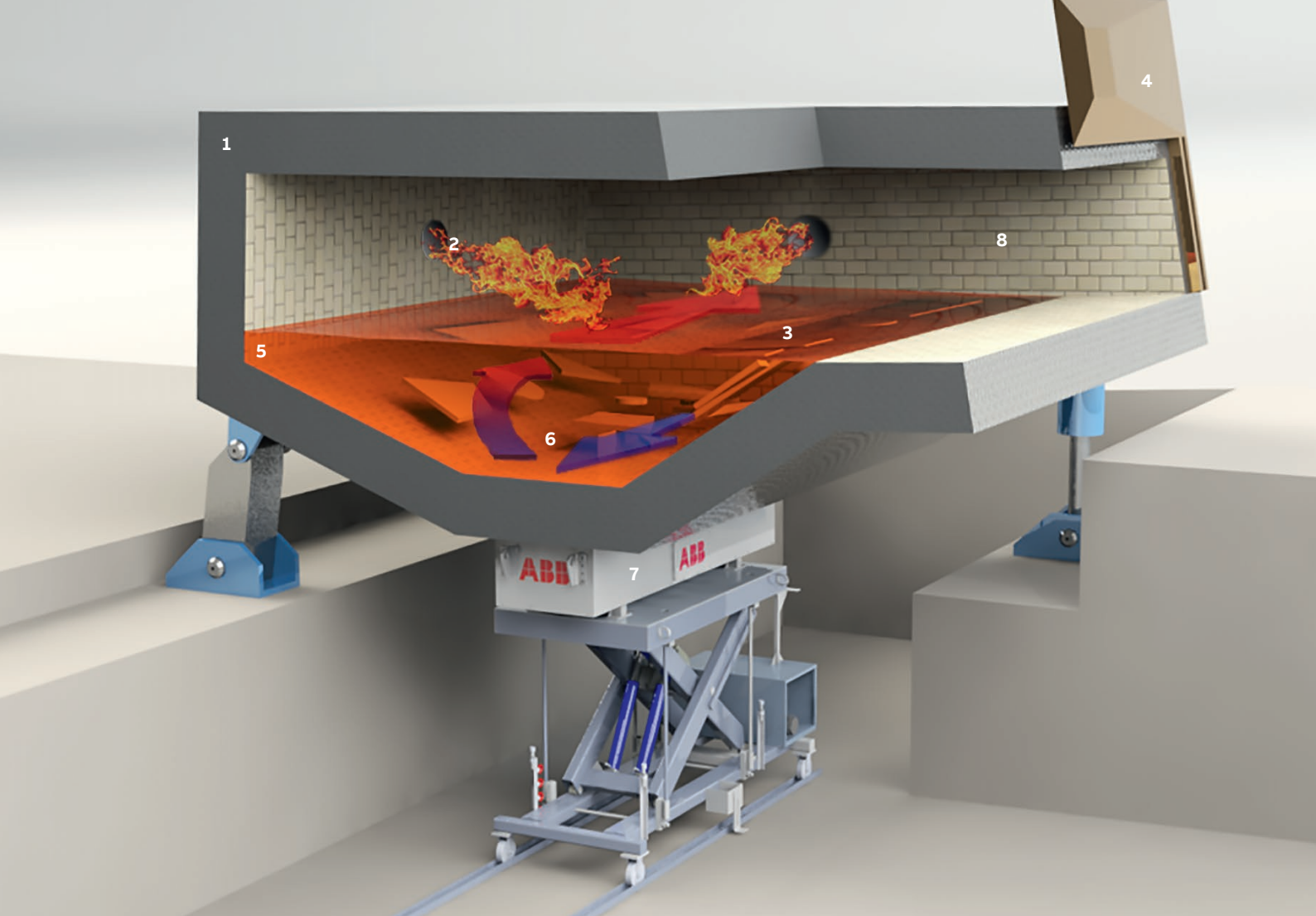
AL-EMS benefits

- Reduced dross formation
- Increased aluminium yield
- Increased productivity
- Rapid chemical and temperature homogeneity
- Increased furnace lining life
- Decreased energy consumption
- Lower maintenance cost
- Attractive payback time, often one year or less

Basic characteristics

- Both bottom and side mounted versions are available for melting and holding furnaces
- No physical contact with the melt and no moving parts
- Normal refractory lining can be used
- Low maintenance required
- Stirring can be performed throughout the entire melting and refining period
- The stirring direction can be reversed, which can facilitate dross skimming and counteract dead corners
- Wide range of liquid and air cooled stirrers for furnace capacities up to 200 tons, including air cooled models up to 90 tons





- 1 Increased lining life with AL-EMS**
- 2 Decreased gas consumption**
- 3 Reduced dross formation**
- 4 Reduced manual labor and fork lift usage**
- 5 Increased productivity**
- 6 Melt temperature homogenization and rapid chemical homogenization**
- 7 Reduced electricity consumption**
- 8 Reduced maintenance**

AL-EMS savings

The ABB AL-EMS can help increase the lifetime of the furnace lining in many ways. One example is that the burner does not have to be used at such high temperatures for a long period of time since the heat exchange between the molten aluminium and the burner is higher. For the same reason, the gas consumption of the burners can be lowered. While the temperature in the molten aluminium is homogenized, there is no need for overheating the surface and for this reason dross formation can be reduced.

Since the molten aluminium is constantly stirred, there is no need to stir the melt using forklifts. Thanks to the reduced door opening times, heat exchange is increased and dross formation is reduced, leading to an increase in productivity. By constantly stirring, the alloying elements and thermal differences between the top and bottom of the aluminium bath are reduced and efficiently homogenized.

What is electromagnetic stirring (EMS)?

An EMS is based on the principle of a linear motor. An induction coil is placed under or at the side of the furnace and a travelling magnetic field is generated when electrical power is applied to the coil.

The metal movement is the result of the interaction between the magnetic field and the electrically conductive metal bath. An analogy can be made with an electric motor, where the stirrer acts as the stator and the melt as the rotor. Generally, all liquids that are electrical conductors can be stirred with EMS electromagnetic stirring in aluminium furnaces. AL-EMS gives efficient mixing of the entire melt with minimal action by the operator. Installation is easy and maintenance simple.

Will the AL-EMS fit your furnace?

The stirrer can be mounted on round or flat walled furnaces for sizes up to 200 tons. It does not matter if it is a melting, holding or chamber furnace.

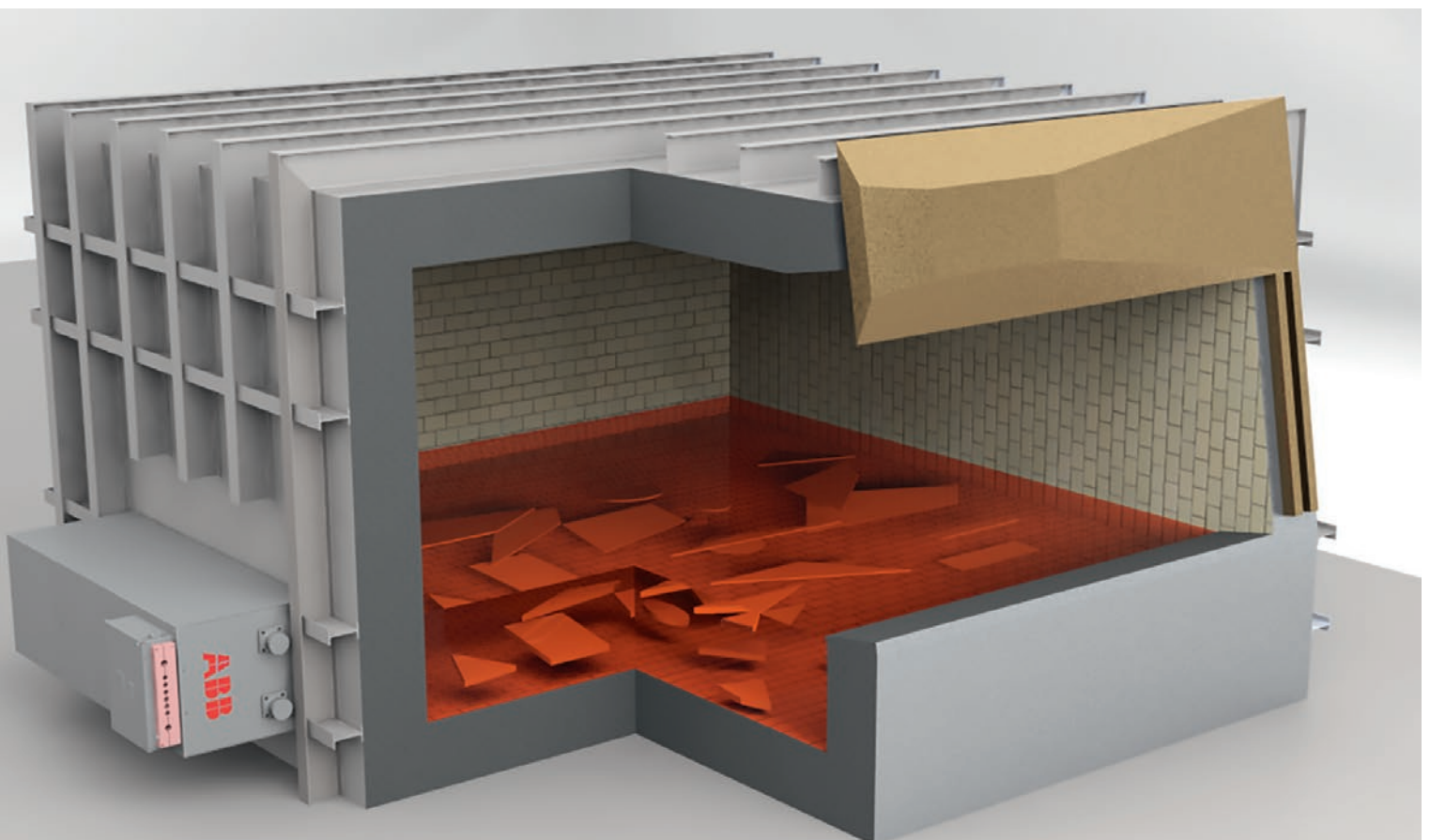
The installation is simple. What is needed is a non-magnetic plate window (stainless steel) in front of the stirrer, and when the AL-EMS is placed under the furnace, head room of about one meter is required. The AL-EMS has no limitations regarding installation on tilting or stationary furnaces.

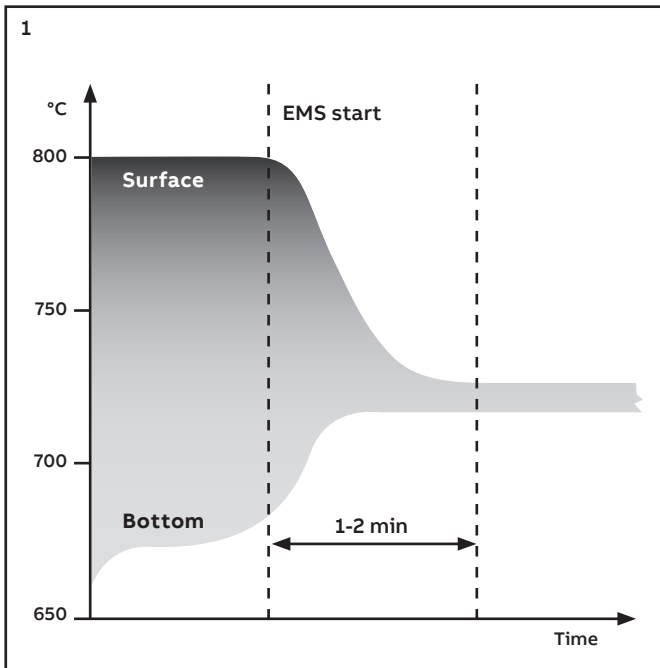
Homogenization of temperature and analysis

The temperature difference between the top and bottom of an unstirred bath is normally in the range of 50 to 80°C.

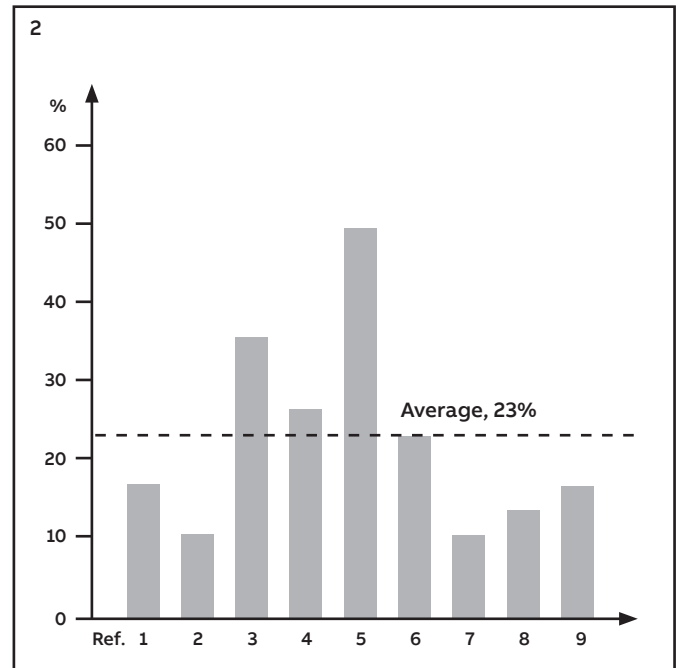
With the forced circulation of the AL-EMS, the temperature difference decreases to less than 5°C in about two to three minutes after the start of the stirrer. At the same time, the dissolution rate of alloys can be improved greatly.

ABB can also provide side mounted AL-EMS stirrers for stationary furnaces





1 Schematic sketch of the temperature homogenization when AL-EMS is turned on
2 Dross reduction from customers using ABB AL-EMS



Energy savings

Heat transfer to the melt is improved since the temperature difference between the melt surface and the roof is maximized.

Savings up to 15% have been achieved due to reduced heat losses and improved heat transfer to the melt.

Reduction in dross formation

The oxidation of aluminium increases rapidly at temperatures over 775°C. By stirring the melt with AL-EMS a decreased temperature gradient will be obtained resulting in a lower surface temperature which will significantly reduce the surface oxidation.

The rapid and complete homogenization of the analysis throughout the entire melting and refining period coupled with complete elimination of mechanical stirring due to electromagnetic stirring further reduces the formation of dross.

- Reduction of dross formation by more than 25% has been achieved.
- Substantially decreased need for mechanical stirring and knockdown of scrap.
- Stirring pattern on the melt surface can facilitate dross skimming.

AL-EMS are designed for high performance, simplicity, reliability and long life

The power supply equipment is extremely compact, resulting in smaller space requirements in the electrical room. If needed in the facilities, a container solution is also available to house the electrical equipment and the water cooling system. ABB's frequency converter and the ABB controller enable both stirring power and direction to be customized to process needs. Low frequency is applied to all AL-EMS systems in order to generate a deep-penetrating magnetic field. Cooling of the stirrer is accomplished using hollow copper conductors, which require a small amount of low conductivity cooling water.

In between the windings dry, rigid vibration-proof insulation is used. For air cooled stirrers, solid copper wire is used around the core and cooled by using a cooling fan that blows air between the windings.

By using many of ABB's well-proven and widely accepted standard components, we are able to minimize technical risks and deliver high-quality systems with extremely long lifespan and minimal maintenance requirements.



Air cooled AL-EMS systems

- EMS unit, standard model ORZ 110, 120, 150, 190, 240 and 310
- Cooling fan
- ABB frequency converter
- Dry type transformer
- CFD calculations based on customer furnace design

Water cooled AL-EMS systems

- EMS unit, standard model ORZ 200, 250, 320, 360, ORD 43 and ORD 55
- Cooling water station
- ABB frequency converter
- Control system
- Dry type transformer
- CFD calculations based on customer furnace design

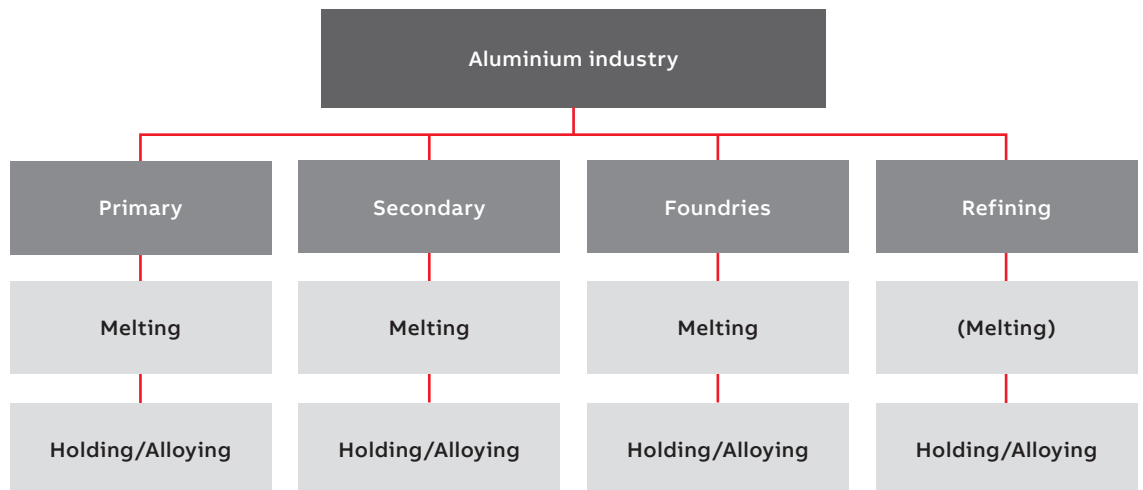
Technical data

| | Furnace size (ton) | Distance furnace/ladle (mm) | Non-magnetic window minimum (mm) | Air cooled | Water cooled | Active power EMS (kW) | Dimensions Length (mm) | Deep (mm) | Height (mm) |
|---------|--------------------|-----------------------------|----------------------------------|------------|--------------|-----------------------|------------------------|-----------|-------------|
| ORZ 110 | 1-5 | 10 | 1,700x1,250 | x | | 5 | 1,695 | 948 | 197 |
| ORZ 120 | 5-10 | 10 | 1,700x1,250 | x | | 15 | 1,695 | 948 | 412 |
| ORZ 150 | 10-20 | 10 | 2,500x1,300 | x | | 25 | 2,494 | 1,094 | 365 |
| ORZ 190 | 20-35 | 10 | 3,250x1,375 | x | | 30 | 3,025 | 1,300 | 430 |
| ORZ 200 | 20-35 | 10 | 2,800x1,500 | | x | 49 | 2,515 | 797 | 699 |
| ORZ 240 | 35-55 | 10 | 3,400x1,550 | x | | 39 | 3,241 | 1,370 | 530 |
| ORZ 250 | 35-55 | 10 | 3,300x1,500 | | x | 65 | 2,994 | 817 | 701 |
| ORZ 310 | 55-90 | 10 | 3,650x1,525 | x | | 60 | 3,385 | 1,390 | 580 |
| ORZ 320 | 55-90 | 10 | 3,500x1,800 | | x | 95 | 3,206 | 978 | 700 |
| ORZ 360 | 70-100 | 10 | 3,900x1,900 | | x | 110 | 3,866 | 1,078 | 765 |
| ORD 43 | 80-145 | 10 | 4,500x2,150 | | x | 210 | 4,350 | 1,940 | 1,030 |
| ORD 55 | 135-200 | 10 | 5,700x2,700 | | x | 225 | 2,280 | 5,550 | 1,150 |

AL-EMS applications

ABB AL-EMS is currently used in all parts of the aluminium process, such as primary and secondary aluminium production, foundries and refining process. We provide stirrers for all parts of the aluminium production process.

We can equip both new and existing furnaces: The ABB AL-EMS can be customized to work with any furnace on the market! We offer a variety of solutions including single stirrers that can be used on multiple furnaces, stirrers for tipping and stationary furnaces and much more.



New optional control program a simple, cost-effective way of maximizing AL-EMS performance and unlocking a higher level of operational efficiency

The new AL-EMS Control offers a fully automated stirring profile aimed at further optimizing performance of ABB's electromagnetic stirrer for aluminium furnace and improving overall efficiency in the furnace process. This optional program, which utilizes a range of input signals from the furnace itself, is integrated into a PLC module with an HMI and provides a flexible interface where AL-EMS control parameters such as start criteria, temperature, stirring interval and/or direction can be

adapted to achieve an optimal stirring profile. This allows manufacturers to unlock a higher level of process improvement including further reductions in electrical energy and gas consumption, greater repeatability as well as increasing safety due to less human intervention. What's more AL-EMS Control is a simple and cost-effective way of increasing return on investment for your AL-EMS.



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