

C/IM



CORELESS INDUCTION

Coreless Induction Melting Systems



Coreless Induction Melting

The Pacer® Advantage

Ajax TOCCO Magnethermic's experience in coreless melting dates back to the early part of the twentieth century with the initial development of the induction "wireless, fireless furnace." We continue that innovation into the twenty first century with the latest in power supply and furnace designs. Our Pacer power supplies feature an extremely wide conductance window, which allows the operator to draw full power during the melt thus maximizing melt rates no matter what furnace condition exists; from cold charge to fully molten. Our furnace construction is designed to survive the rugged conditions of the foundry or mill. One example is our latest Ajax TOCCO "HPD" coreless furnace that features a tie rod coil compression system that maintains coil integrity and refractory life under high magnetic and thermal stresses.

In addition to our technology, ATM offers our customers a wide variety of support services after the sale. We feature worldwide service and repair centers from many locations across the globe, a large inventory of repair parts, circuit board repair, operator and maintenance training at our location or yours, installation services, and many more.

All of ATM's products or services are designed for one reason: to maximize your uptime and allow you to pour more metal over the spout. Equipment reliability, easy maintenance, and quality support have been the foundation of our success in the foundry industry over the years and we remain committed to those concepts today.

Ajax TOCCO Magnethermic® Corporation

The Global Force in Induction Technology



CORELESS MELTING

Systems

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AJAX
TOCCO

Selecting Your Coreless Furnace

Sizing the coreless furnace, or determining the optimal capacity of the furnace and the rating of the associated power supply must begin with an understanding of the application requiring the use of the furnace. While there are many varied uses for these systems, we will concentrate on a foundry application for this example. Other application needs should be discussed with Ajax TOCCO's Application Engineering department.

Furnace sizing starts with the understanding of how the molten metal is to be utilized. What is the largest pour, how often, total volume per hour of production? The largest pour can determine the required furnace size, however if multiple furnaces are planned and the large pour is rarely required, multiple furnaces can be simultaneously used and thereby reduce the size of the average furnace.

Typically, the hourly volume of molten metal determines the furnace size, unless multiple furnaces are utilized simultaneously. Charging, prepping, and pouring the furnace on the basis of a one-hour cycle, is the most common practice in foundries today. Therefore, a production rate of 2000 pounds per hour would indicate the need for a 2000-pound capacity furnace.

Determining the power requirements is somewhat more complicated, since it depends on the metal being melted. Non-ferrous materials melt at a lower temperature and melt faster, requiring less power.

Estimated Production Rates & Energy Consumption

Material	Melt Temperature (°F)	Melt Rate (lbs./HR)/kW	Energy Usage kWhr/Ton
Iron	2700	4.60	462
	2750	4.50	473
	2800	4.40	483
	2850	4.30	495
	2900	4.20	506
Steel	2900	4.10	519
	2950	4.00	532
	3000	3.90	545
	3050	3.80	560
	3100	3.70	575
Brass	1850	7.70	276
	1900	7.50	284
	1950	7.30	291
Copper	2100	6.10	349
	2150	6.00	354
	2200	5.90	360
Aluminum	1250	4.00	526
	1300	3.90	540
	1350	3.80	554
Zinc	800	24.50	86
	860	22.40	94

Estimated melt rates are optimal based upon 100% utilization and proper furnace size/power/frequency selection.

Typical Furnace Size

Application	Production Volume	Furnace Type/Size	Power Supply Rating/Frequency
LAB-ANALYSIS-DEVELOPMENT	1-50 POUNDS	TABLE FURNACE	10-50 kW, 10 kHz.
FERROUS MELTING			
Iron	50-300 Pounds	Crucible	100-200 kW, 3 kHz.
	500-2000 Pounds	Box Furnace	200-750 kW, 1 kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-18000 kW, 200-300 Hz.
	5-30 Tons	"HPD" Open Frame	1500-18000 kW, 200-300 Hz.
Ductile Iron	500-2000 Pounds	Box Furnace	200-750 kW, 1kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-18000 kW, 200-300 Hz.
	5-30 Tons	"HPD" Open Frame	1500-18000 kW, 200-300 Hz.
Steel Alloys	50-300 Pounds	Crucible	100-200 kW, 3 kHz.
	500-2000 Pounds	Box Furnace	200-500 kW, 1kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-18000 kW, 200-300 Hz.
	5-30 Tons	"HPD" Open Frame	1500-18000 kW, 200-300 Hz.
NON FERROUS MELTING			
Brass Alloys	50-300 Pounds	Loose Crucible	100-200 kW, 3 kHz.
	500-2000 Pounds	Box Furnace	200-500 kW, 1kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-6000 kW, 200-300 Hz.
Copper	50-300 Pounds	Loose Crucible	100-200 kW, 3 kHz.
	500-2000 Pounds	Box Furnace	200-500 kW, 1kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-6000 kW, 200-300 Hz.
Aluminum Alloys	50-300 Pounds	Loose Crucible	100-200 kW, 3 kHz.
	500-2000 Pounds	Box Furnace	200-500 kW, 1 kHz.
	1-5 Tons	Small Steel Case	500-1500 kW, 300-500 Hz.
	5-30 Tons	Large Steel Case	1500-6000 kW, 200-300 Hz.

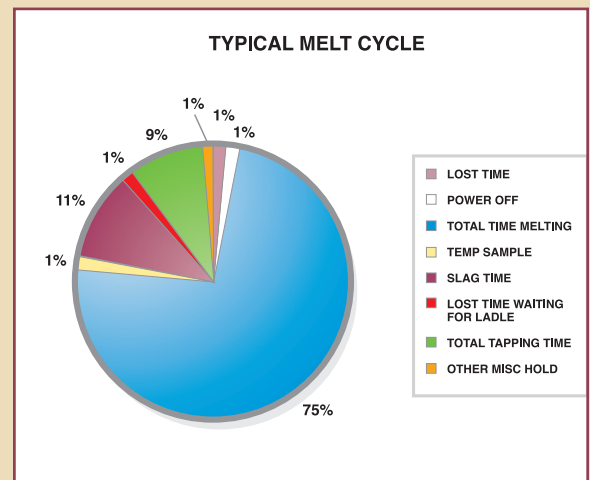
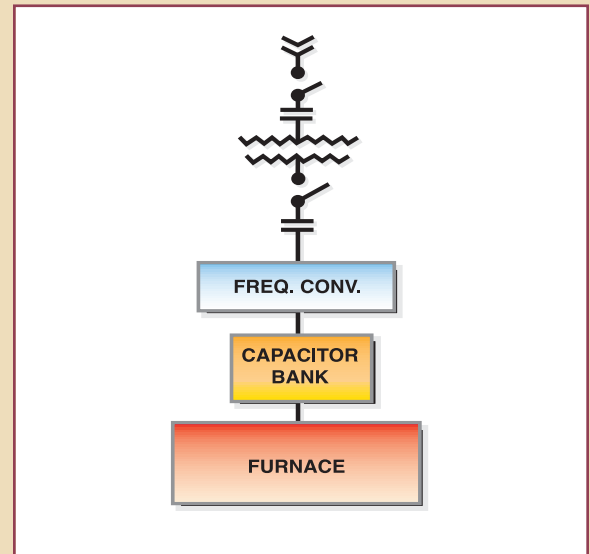
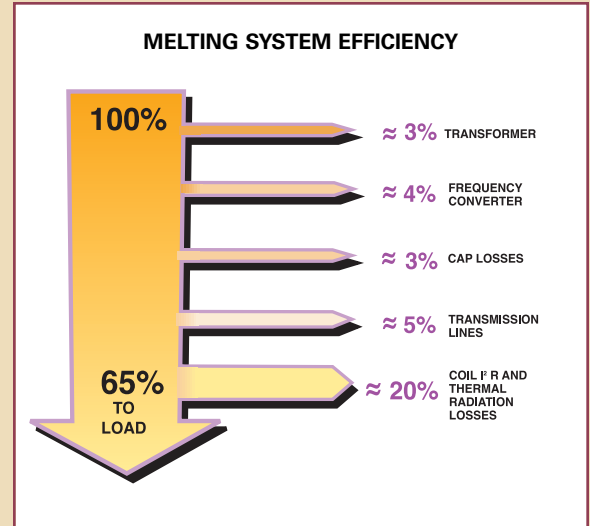
Utilization Versus Efficiency

Whenever we discuss coreless induction melting for the understanding of existing equipment operations, or the consideration for new equipment, the topic of equipment operating efficiency arises. Often the efficiency of operation is confused with the term utilization. System efficiency, or power system conversion efficiency, is a function of how effectively the total system converts electrical line energy into heat energy in the metal to be melted. In coreless melting technology the total system is made up of the primary power input transformer, power conversion unit, power factor correction capacitors, transmission lines, and coreless furnace. This total system is generally 65-75% efficient. Efficiency measures the equipment performance.

When we consider how effectively the equipment is used, we apply the term "utilization" to define the effective operation of the equipment. If the system were to be operated at 100% utilization, it would mean the power system was operating at full power (100%), for the entire cycle time (typically 1 hour), without interruption. The industry measures the ability of the equipment to melt at a certain production rate, in pounds per hour, or tons per hour, at 100% utilization, or without interruption. Interruptions might include actions like slagging, sampling, alloying, or tapping. These actions subtract time from the available melting time and reduce utilization. Therefore utilization measures the efficiency of the human operation of the melting system.

A basic coreless melting operation, made up of one furnace and one power system, will have a reduced utilization due to normal operating factors that detract from melting the full 60 minutes of every hour. A time study might show the time lost to slag, sample, alloy, and tap a furnace would consume 15 minutes of every 1-hour furnace cycle. This would result in a furnace utilization factor of 75%. Therefore the potential production rate of the system is only 75% of the full melt rate at 100% power. A typical medium frequency (300 Hz.) power system could melt iron to 2750°F at the rate of 4.6 pounds per kW. Therefore, a 1000 kW coreless melting system could produce 4600 pounds of molten iron per hour at a 100% power level if the utilization were at 100%. Due to utilization losses of time to melt however, the system would only produce 3450 pounds (75%), if it were operated at 75% utilization. This means the power supply operating at 1000 kW was only able to operate 45 minutes out of the hour. The remaining 15 minutes were lost due to other human action and the system was unable to operate.

Utilization can be improved, and operating time losses reduced by adding an additional furnace for holding during these periods of slagging and tapping. This can increase the amount of production from a given power system, or reduce the amount of power needed to achieve a desired production rate.



System Utilization is 75%



Iron Melting Foundry

The conversion from a cupola to a coreless furnace in this iron melting foundry was easy with the Ajax TOCCO Pacer melting system and steel shell furnaces.

Ferrous Melting

Ajax TOCCO's line of power supplies for melting applications are designed with wide load characteristics that allow them to draw full power from start to finish for either a tap and charge or batch melt operation. This ability minimizes total melt times and allows for maximum metal "over the spout" to enhance productivity in any ferrous or non-ferrous melting operation.

The molten metal stirring action in a coreless furnace produces homogeneous melts at a uniform temperature for rapid alloying. There is minimal oxidation due to the fast melt times, resulting in low metal losses.

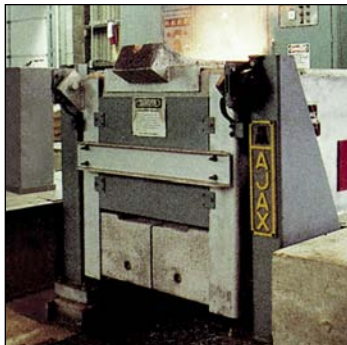
With a Pacer® coreless furnace melting system, a flexible production schedule can be accommodated. The dependability of the Pacer power unit complements furnace reliability, resulting in lower operating and maintenance costs.

Contact Ajax TOCCO to properly match the Pacer power supply with the furnace size for a successful melt system. Ajax TOCCO Pacer is the only choice for coreless melting.



Steel Shell Furnace

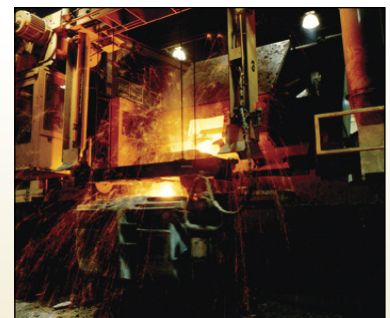
Heavy duty steel shell furnaces are used world wide in applications, such as this Mediterranean producer's installation for speciality irons.



Batch or tap & charge melting are both accomplished in this Magne-melt furnace with Pacer power.



This open frame, "HPD" furnace incorporates closed capture fume collection, vibratory feeding and load cells for automated control.



A wide range of metals can be produced, regularly and reliably in this furnace. Always ready to respond to demanding production schedules, the Pacer power unit is recognized as a proven performer.

Non-Ferrous Melting

The wide load matching characteristics of the Pacer® make it ideal for batch melting applications in coreless furnaces. The ability to draw full power from the beginning to end of a melt results in maximum production with the shortest melt time.

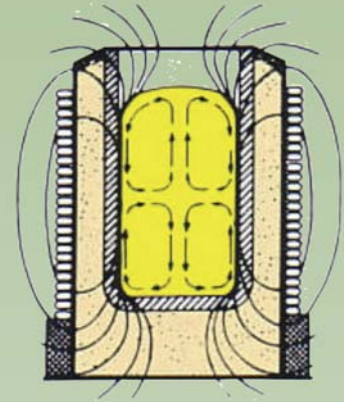
Precise temperature control, reduced metal losses, minimal gas pick-up and exact alloying are features of Pacer coreless melting systems. Furnaces are available for brass, bronze, copper, aluminum, zinc and the full range of precious metals.

The Pacer can be used with all styles and sizes of coreless furnaces. From foundry melting to mill applications, the only choice for your next coreless furnace – Ajax TOCCO Pacer.



The Ajax TOCCO Lift Swing "Swinger" furnace is the preferred choice when it comes to melting a variety of brass or aluminum alloys. No other furnace comes close to the rugged construction or safety features inherent in this design.

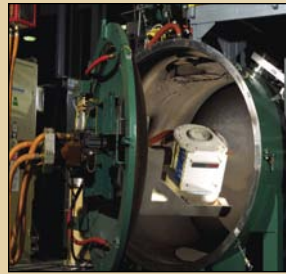
Forces and Stirring



Specialty alloys are produced with this 500 kW, 1 kHz Pacer and 2000 pound high frequency coreless furnace. This furnace, along with an Ajax TOCCO channel furnace, produce more than 1/2 million pounds of brass and bronze castings per month.



Vacuum Induction Melting and Atmosphere Controlled Systems



Precision casting furnace typical for SX/DX or Equiax systems



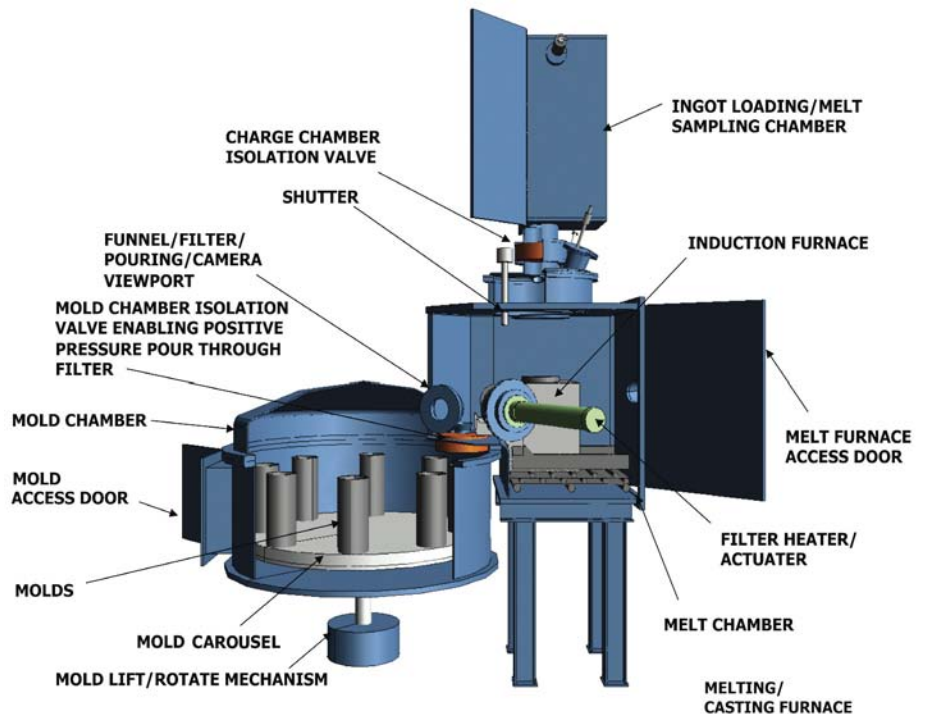
High temperature graphite materials processing

Ajax TOCCO has always been known for supplying the best induction power systems for vacuum melting applications around the world. Now, the leader in vacuum induction power supply technology can offer you the complete vacuum melting or heating system as well. Our equipment capabilities include the power supply, furnace, chamber, material handling, all auxiliary equipment, and controls.

Our applications include investment casting, specialty alloy production, silicon melting, many highly specialized processes such as cold wall melting, sintering, chemical vapor deposition, calcining, atomization/shot production, hot pressing, purification, and many more.

In addition to our equipment expertise, we offer installation services including engineering, supervision, or a complete turnkey package for your entire project.

Automated Vacuum Melting and Casting on to Mold Carousel





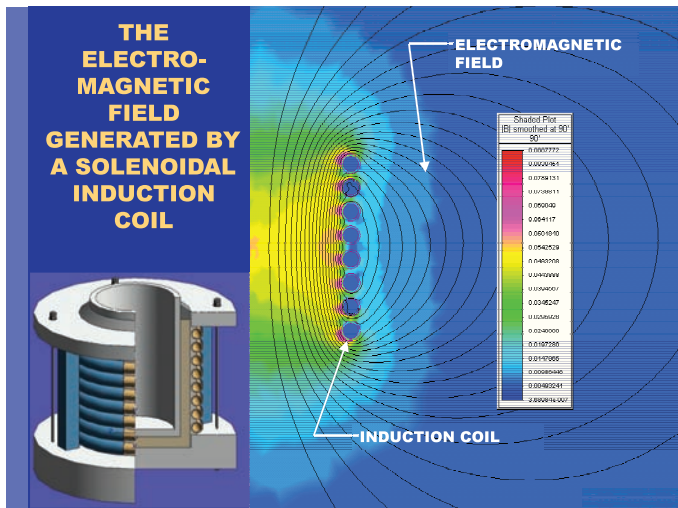
Multi-stage vacuum/atmospheric controlled system for induction preheat/melting/infiltration using internal robotics for part transfer



Typical continuous vertical multizone induction heating and cooling reactor



Dual processing takes advantage of long process cycles heating and cooling



FEA Modeling – ATM uses extensive FEA modeling to evaluate electromagnetic, thermal and other processing requirements

Versatile Induction Melting Furnaces

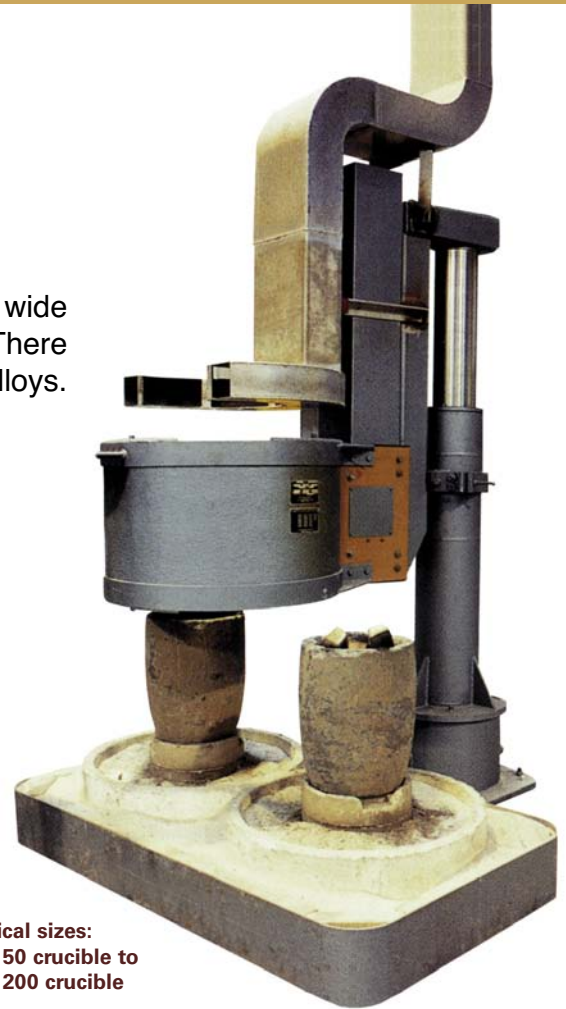
Ajax TOCCO Magnethermic coreless furnaces are designed in a wide variety of styles and capacities to meet exacting melt requirements. There is an Ajax TOCCO coreless furnace for all melting applications and alloys.



Tabletop Furnaces

These furnaces are ideal for assay determination, precious metals, small melting requirements, and laboratory projects. The lift coil furnace design allows for crucible melting, while the hand-tilted, interchangeable body provides maximum flexibility.

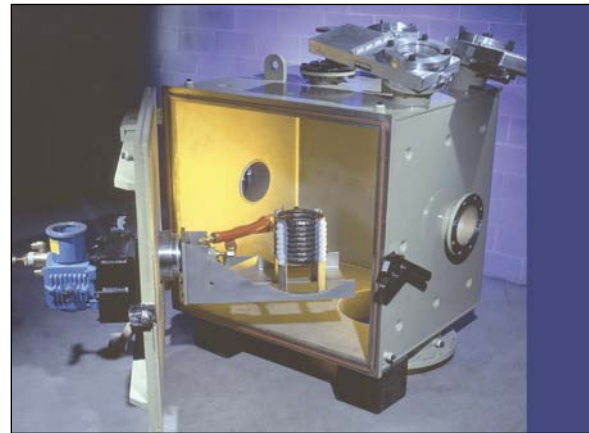
Typical sizes range from 2 lbs. to 50 lbs.



Typical sizes:
No. 50 crucible to
No. 200 crucible

The Swinger Furnace

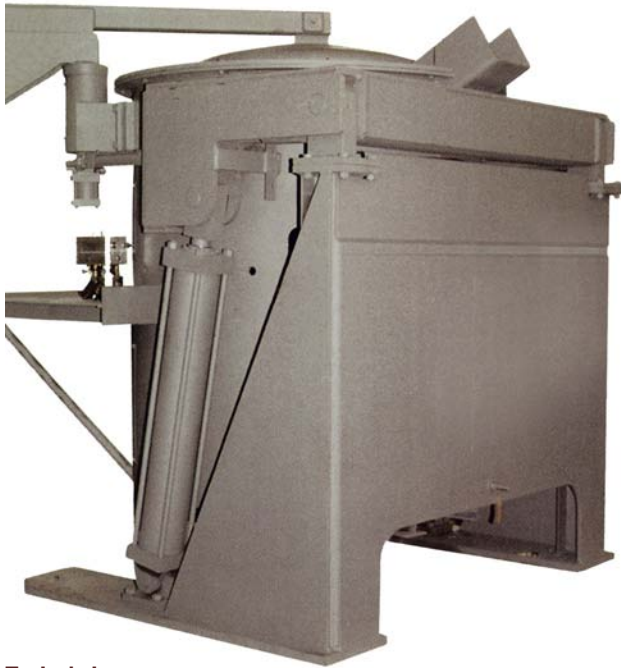
The Swinger furnace provides fast, clean and efficient melting of non-ferrous alloys. Low metal losses justify this two position melter for the non-ferrous foundry. This furnace is ideal when batches of different alloys are required.



Small vacuum melting furnace

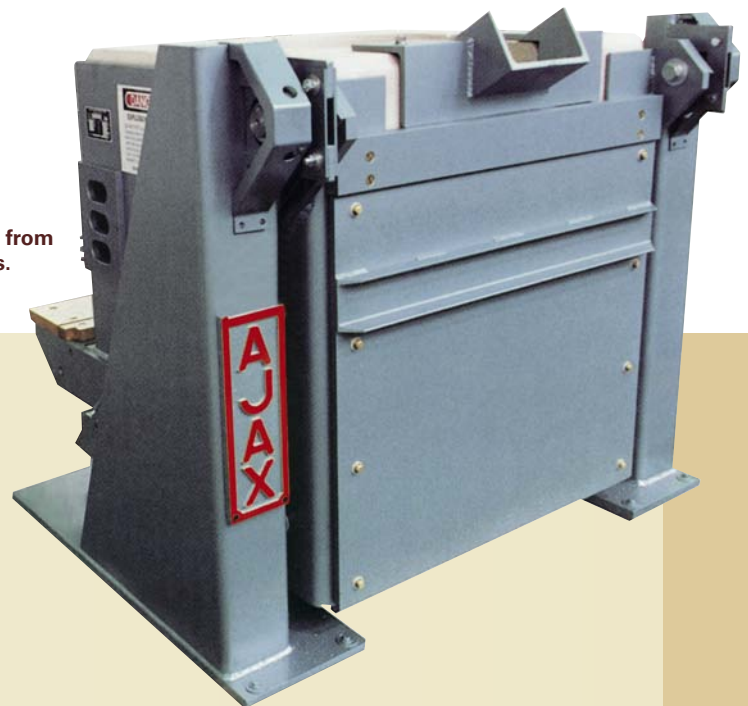
Low Capacity Steel Shell Furnaces

Steel shell furnaces feature increased durability and higher efficiencies with a shunted coil and steel construction. In addition, these furnaces provide greater "EMF" containment than box furnace designs.



Typical sizes range from 1000 lbs. to 6000 lbs.

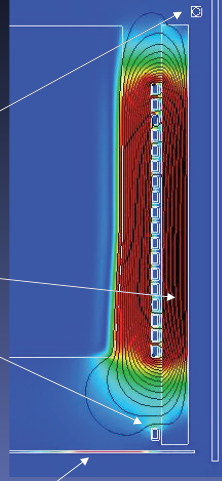
Typical sizes range from 100 lbs. to 4000 lbs.



FLUX CONTAINMENT SYSTEM

- TOP FARADAY
- SHUNTS
- BOTTOM FARADAY

Note that there can still be excess energy in the floor even with a bottom faraday ring



Magne-Melt Furnaces

This furnace is a rugged design for high frequency melting applications. It features a cast refractory top and bottom, stainless steel tie rods, and the heavy-duty fabricated aluminum side plates to form a rigid structure.

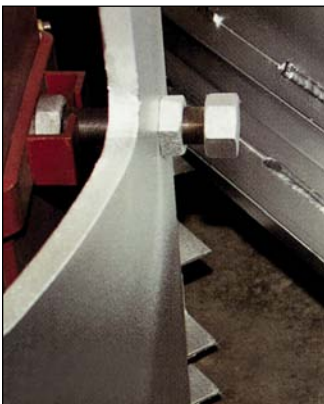
High Capacity Furnaces

Rolled Steel Shell Furnaces

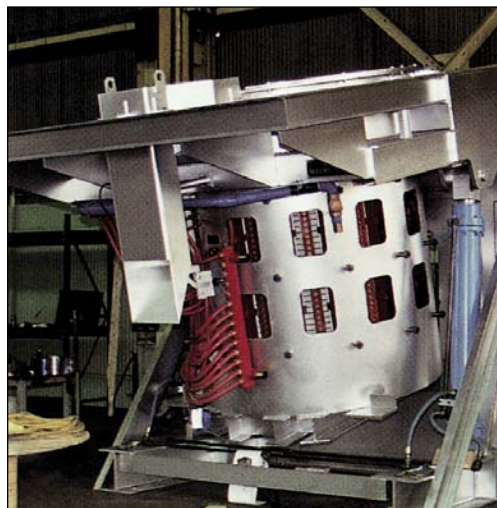
Furnace body is constructed from heavy steel plate rolled into a cylinder to provide strength for the entire furnace shell assembly. Flux return yokes are bolted directly through the furnace shell to support the power coil. The superior strength in the circular steel shell provides positive support for all the furnace components, especially when tilting for pouring. Forces are tied directly to the shell of the furnace, not through the coil and refractory, maximizing the refractory life. A heavy gauge aluminum bottom plate and a water cooled copper ring placed above the cooling coil prevent stray heating and minimize electrical losses.



Typical sizes range from 4 tons to 70 tons



Heavy plate construction insures furnace body rigidity and maximum safety.



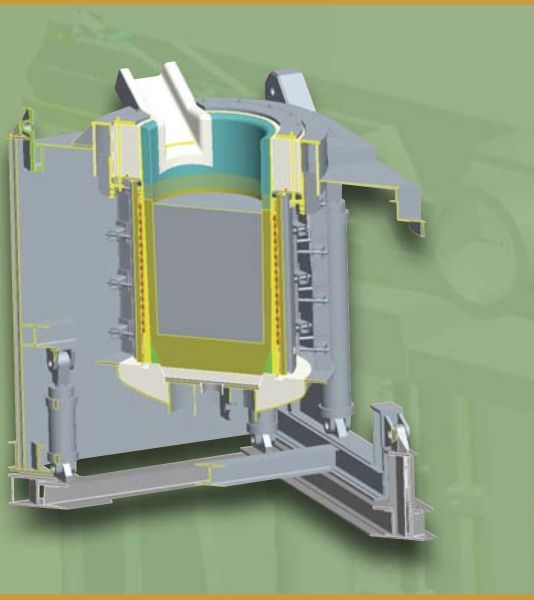
Rolled steel shell provides the strongest furnace construction. Ideal for vibratory batch charging or bucket charging systems. Furnace options include back-tilt, customized pour spouts or slag chutes, fume collection rings, refractory removal devices and other auxiliaries as required.



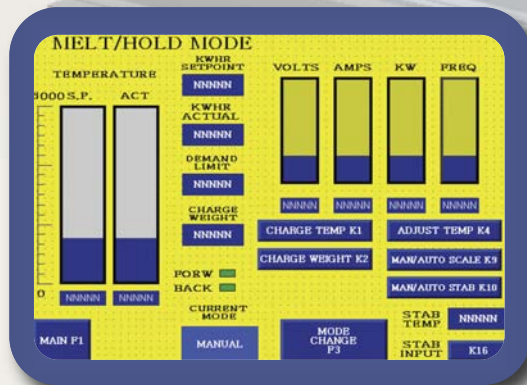
Rigid hollow bar coil design has studboards for positive turn spacing. Top and bottom cooling coils evenly distribute temperature gradients throughout the refractory to prevent overheating and to extend refractory life.

Open Steel Frame Furnaces

Ajax TOCCO's latest design for high power density coreless furnaces is the result of months of research into existing designs and a careful analysis of what is required in this "maximum duty" iron melting application. The stresses on the coil and refractory are very severe under typical "high power density" applications or those that exceed 600 kW per ton of furnace volume. In order to meet these demands, Ajax TOCCO has incorporated several key features into our design. These include a rugged open steel frame for durability and ease of access. In addition, we use only "hollow bar" copper tubing for coil integrity and tie rod construction to compress the coil within the steel frame insuring minimal movement of the coil and refractory.



Typical sizes range from 4 tons to 70 tons



25 ton vacuum furnaces incorporate "HPD" coil designs.

Power Supplies

Power to Spare

Ajax TOCCO Magnethermic has lead the way in developing and improving induction power supplies. Our line of frequency converters ranges from 50 Hz to 450 kHz to cover your application needs. Our Pacer® series provides the maximum flexibility to the foundryman with the widest conductance range in the business. This assures the ability to maximize power into the melt under any furnace condition – from cold charge to fully molten.

The Pacer M is Ajax TOCCO's line of single bridge, multiple inverter power supplies which allow for floor space savings and reduced installation costs. In addition, multiple inverter units allow the foundryman a cost effective means of melting and holding in multiple furnaces, increasing utilization on the foundry floor.

The Pacer T offers the same “Pacer” advantages with the latest IGBT devices for inherently more reliability, especially at higher frequencies.

Ajax TOCCO also offers other power supplies for specific applications such as lab and specialty metals melting. These include the Inductron II, the air-cooled TOCCOtron AC, and the LP Pachydyne.

Ajax TOCCO's newest DSP (digital signal processing) logic provides advanced power supply control. All power supply functions and setup are accomplished through an available HMI display. Diagnostics, including waveforms, can be viewed through the HMI or sent to a remote PC for troubleshooting.



Pacer® II



Pacer® S-10



Pacer® T



Inductron® II



Low Profile Pachydyne®



Pacer® M



TOCCOtron® AC

Auxiliary Systems

Water Systems

In order to complete the coreless melting system, ATM provides auxiliary components such as primary power switches and transformers, capacitor banks, hydraulic subsystems, fume exhaust hoods, scrap charging systems, deslagging units, refractory removal devices, and a wide range of water cooling systems.



Closed or Open Loop Water-to-Water Heat Exchangers



CPX Pumping Systems



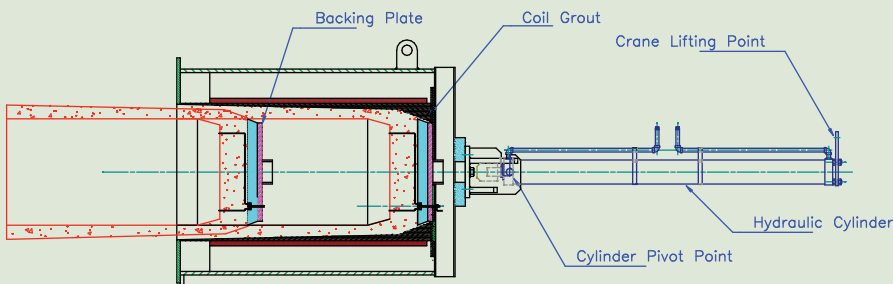
Side Mount DI Systems



Closed Loop Air-to-Water Heat Exchangers

Refractory Removal Devices: Push-out or Extractor

Ajax TOCCO refractory removal devices quickly and cleanly remove the spent refractory. A minimum of dust is generated. Utilizing the extractor device, spent refractory is contained in the vessel and easily hauled away from the furnace for disposal.



Ajax TOCCO is a full service company serving the world's melting industries.

Leader in Induction Technology

Ajax TOCCO Magnethermic, one of the oldest and most experienced manufacturers of induction heating and melting equipment, recognizes the need to continually improve induction technology and discover better ways to utilize the induction process to serve industry. Our continued drive in induction technology and research has made us the world leader with more firsts than all other induction manufacturers combined.

Research & Development

Ajax TOCCO maintains full-time research and development teams having complete facilities for metallurgical, electronic, and mechanical testing. Our facilities feature induction and testing equipment for the latest developments in electronics technology and process development.

Process Control

Ajax TOCCO is a leader in the development of process control systems and designs for the induction process. One example is our Magnecom melt management system that allows for automatic sintering of new linings and full control over the melting cycle. Another is our new "Utilization Manager" which allows foundry management to track melting utilization based on available power and time. Our experience enables us to provide these technologically advanced systems which specifically meet our customer's present and future needs.

Technical Training

Ajax TOCCO is committed to helping its customers get the most from their investment. To achieve this, Ajax TOCCO offers extensive training programs, available to all customers. These include in-house training at Ajax TOCCO, on site schooling, web training, web troubleshooting, and a comprehensive aftermarket care program.

Worldwide Service

Ajax TOCCO customers span the world. Our customer care initiative insures that Ajax TOCCO Service Engineers worldwide are trained, experienced technicians capable of determining and handling even the most difficult of problems, many of which can be solved with telephone assistance. A Service Engineer is never more than hours away.

Repair Centers

Ajax TOCCO maintains a network of repair centers and service facilities located around the world. If your need is for field service, inductor and transformer repairs, parts, or preventative maintenance there will be an Ajax TOCCO facility nearby to assist.



Call 1-800-547-1527, 24/7 for Service Assistance.



Authorized OEM for AIH, Ajax Magnethermic®, and TOCCO®

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