



Pyrotek®

The EM-DF System

Electromagnetic Deep Filtration System



Introduction



Pyrotek has been supplying engineering and construction solutions for casthouses and foundries as well as primary aluminium producers for several decades.

The **C**eramic **F**oam **F**ilters (CFF) and filtration systems have been produced under the Pyrotek brand for more than twenty years. Since 1999, Pyrotek has been successfully producing and supplying filters under the Sivex brand name all over the world.

The **E**lectro**M**agnetic **P**umps (EMP), greatly improving casthouse performance and remelting abilities, have been designed, sold, installed and commissioned since 2005 by Pyrotek EMP Technologies Ltd., a subdivision of the Pyrotek MCR group.

The expertise gained by Pyrotek in both filtration and electromagnetism, have resulted in a synergistic effort to develop the **E**lectro**M**agnetic **D**eep **F**iltration (EM-DF) system.

The presenters



Joseph Whitworth

Project and Development
Engineer and Product Specialist
EM Filtration for Pyrotek MCR

Adj. Prof. Robert Fritzsch
Research and Development
Engineer for Pyrotek MCR
and IMA, NTNU Norway

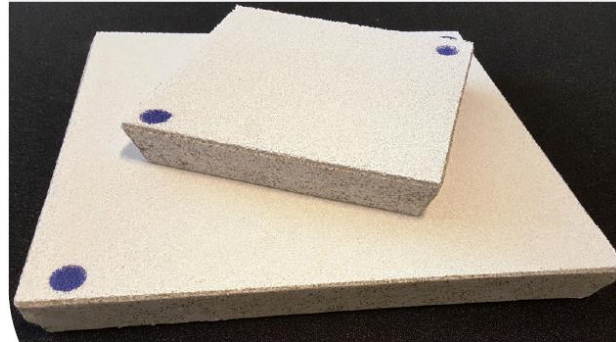
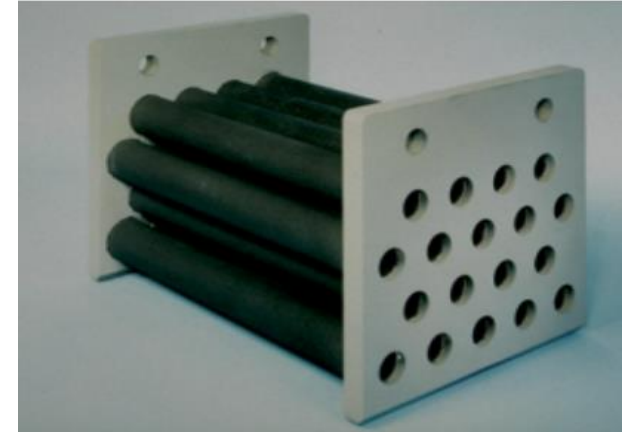
Filtration systems

Existing Filter Systems:

- DBF
- MCF
- CFF

Filter types:

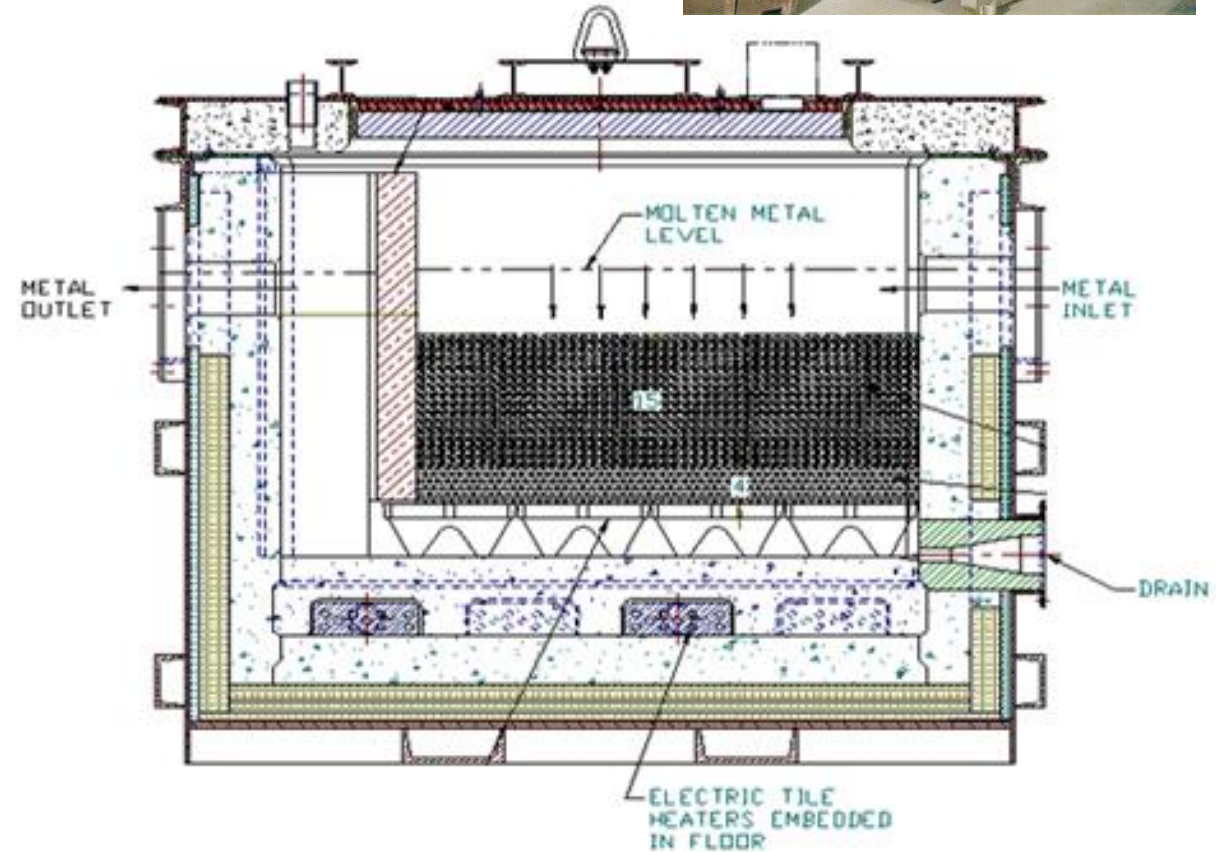
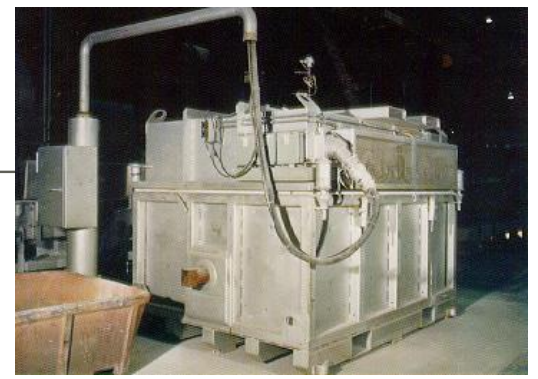
- Deep bed filters
 - Cartridge systems, pump filters, etc.
- Bonded particle filters
 - Regular, pump, casting and other filters
- Trough and cloth filters



Filtration systems

Deep Bed Filtration (Alumina Ball/Bed Filtration)

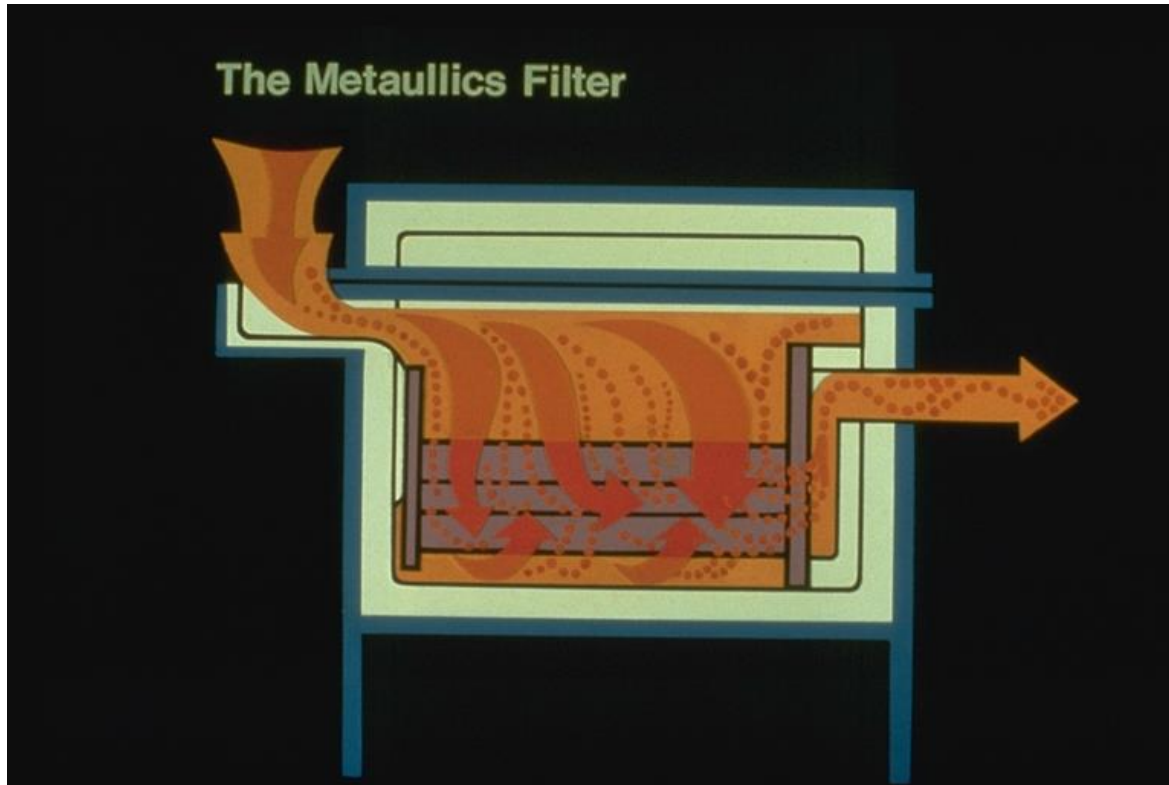
- Molten metal flows through the alumina mesh and balls
- Long preheating time of >12 h
- Bed and alumina balls size is determined by the metal casting rate and aimed alloy cleanliness
- Large footprint is needed
- Filtration capacity up to 5000 MT
- Remains filled with liquid metal after each cast (Energy intensive)



Filtration mechanism: Depth Filtration

Filtration Systems: Metaullics Cartridge Filter (MCF)

Bonded Particle Filtration System – BPF used in Metaullics Cartridge Filter (MCF)



Filtration mechanism: Cake Filtration

- Bonded Particle tubes, (Al_2O_3)
- Silicon carbide endplates
- Cartridge bundles vary in the number of tubes and their grid size.
- Each tube is open on one end, allowing metal to exit.
- Filtration occurs via the large tube surface and the low velocity.
- High lifetime and performance of filters, requires continuous heat.

Filtration systems

Ceramic Foam Filtration

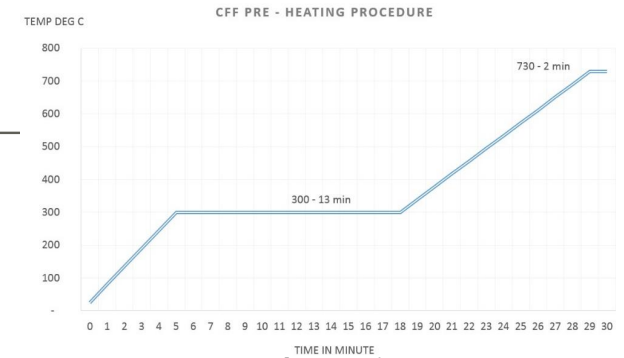
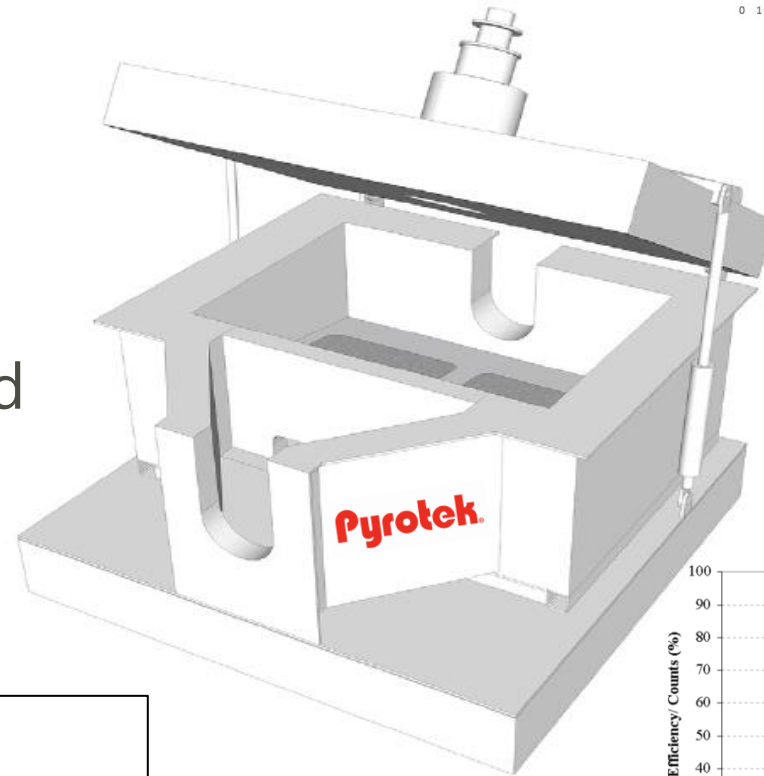
- Single, dual stage, double (twins) solution are available
- Preheating time 10-90 min
- Range of cell size 10 – 80 Grade
- Filters are replaced and box is drained after each cast
- Filtration capacity depends on metal cleanliness and casting velocity

Filtration mechanisms:

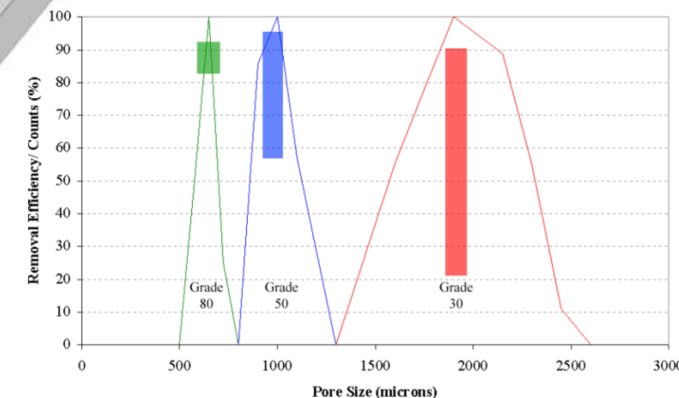
Cake filtration

&

Depth filtration



Preheating curve recommendation for a regular burner for a 23 inch regular phos. CFF



Why further improve filtration technology?

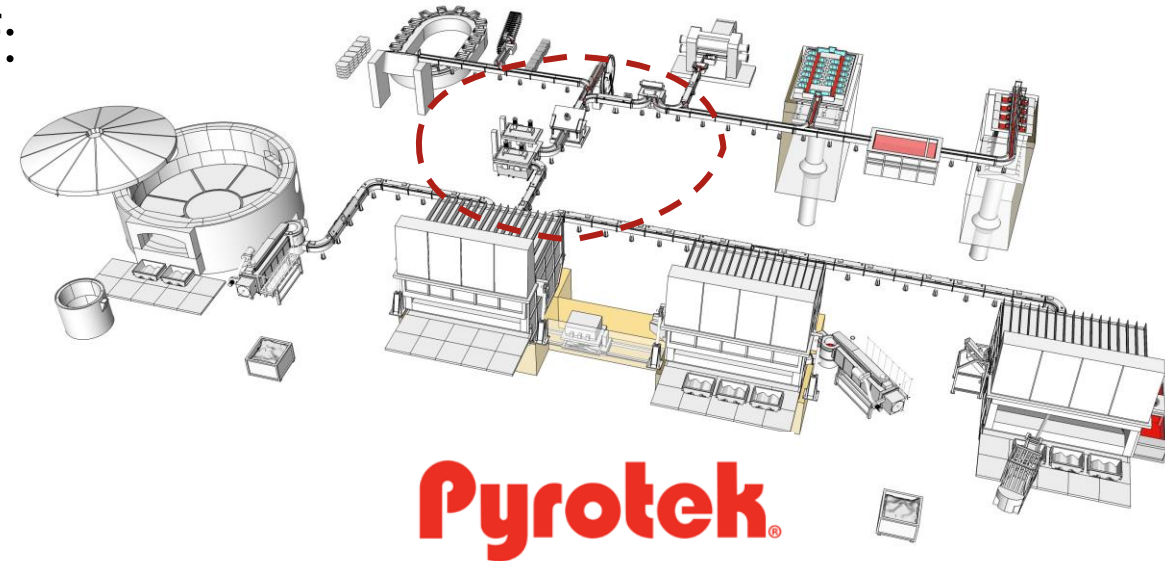


To generate a robust filtration process that can handle the existing challenges.

The resulting metal quality is a fine balance of:

Holding time, fluxing, degassing,
grain refinement and filtration.

➤ **Filtration is the final step before casting!**



Why further improve filtration technology?



To generate a robust filtration process that can handle the existing challenges.

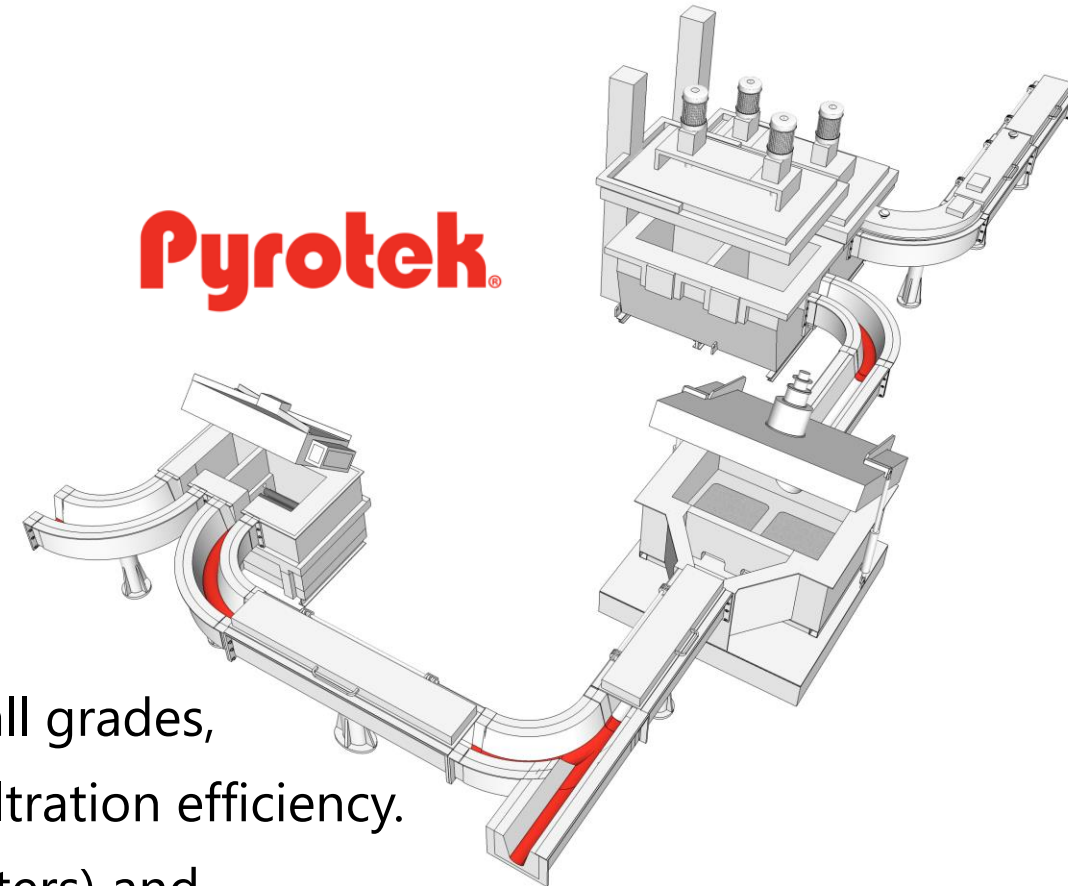
The resulting metal quality is a fine balance of:

Holding time, fluxing, degassing,
grain refinement and filtration.

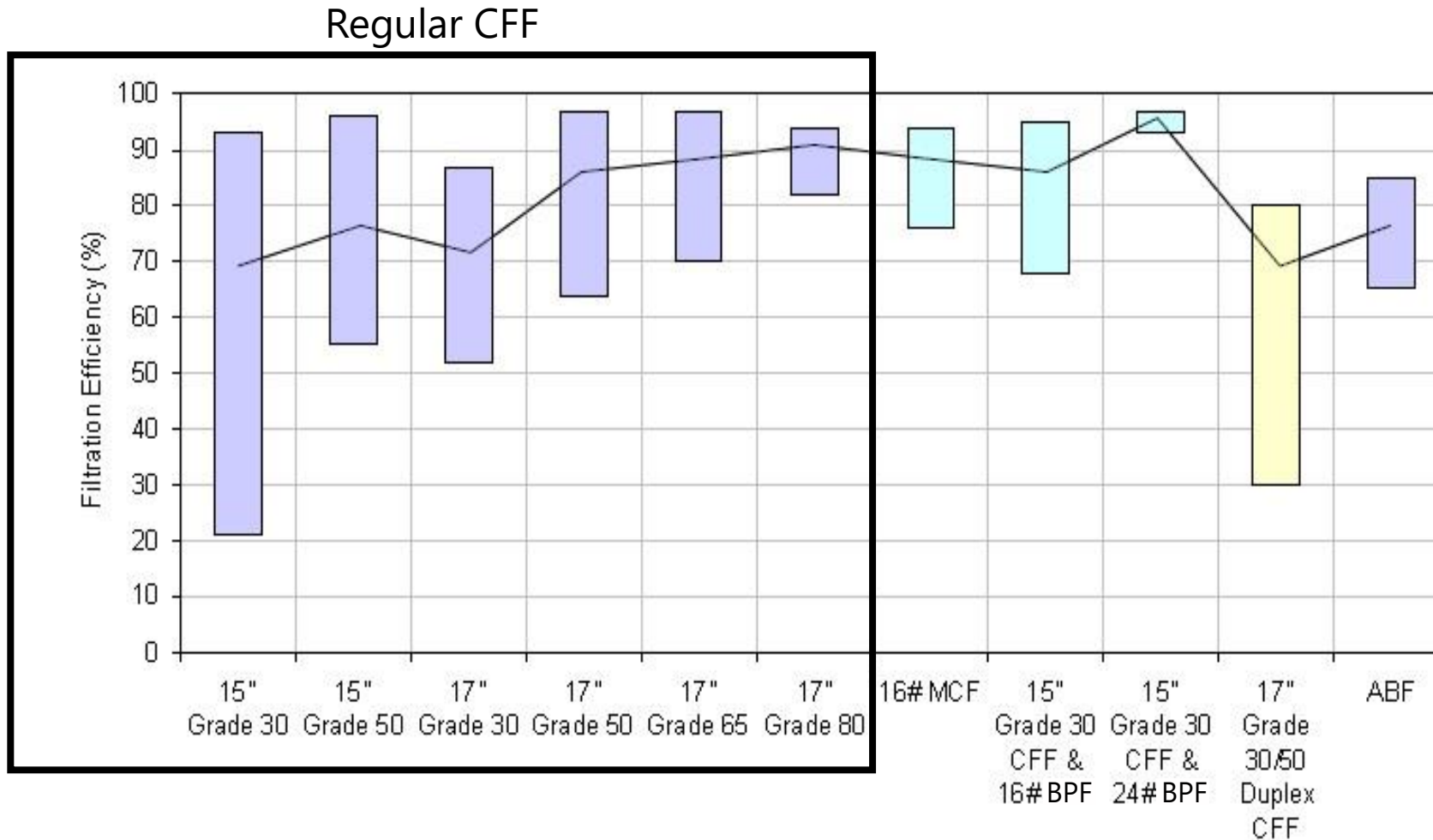
➤ **Filtration is the final step before casting!**

The goals of our engineering efforts are:

1. To reduce the standard deviation of the used filters of all grades,
2. To achieve reliable and stable priming and consistent filtration efficiency.
3. To work towards superior filtration efficiency (thicker filters) and
4. To provide higher flexibility for casthouses.



Why further improve filtration technology?



- " = inch
- # = grit
- CFF = Ceramic Foam Filter
- MCF = Metallics Cartridge Filter
- BPF = Bonded Particle Filter
- ABF = Alcan Bed Filter

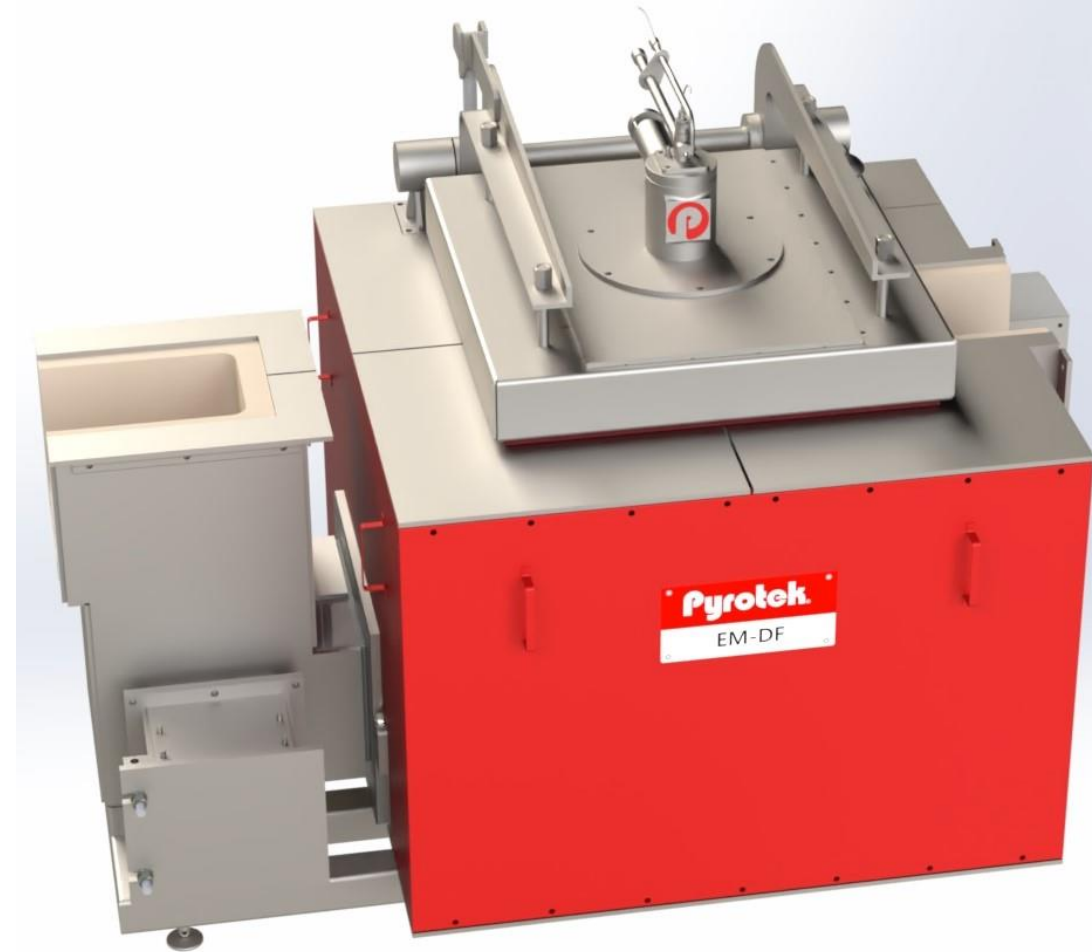
Electromagnetic (EM) Filtration Solutions



Pyrotek MCR offers the first EM filter priming solution:

The **EM-DF**

- Has been proven to fully prime single and multiple high-grade filters.
- Showed controlled priming by electromotive/Lorentz force, dynamic velocity, and static metal head.
- Is only applied during the priming stage and to support the draining of metal from the filters.
- Filtration operation with no active field, guaranteeing stable filtration operation at consistent performance.

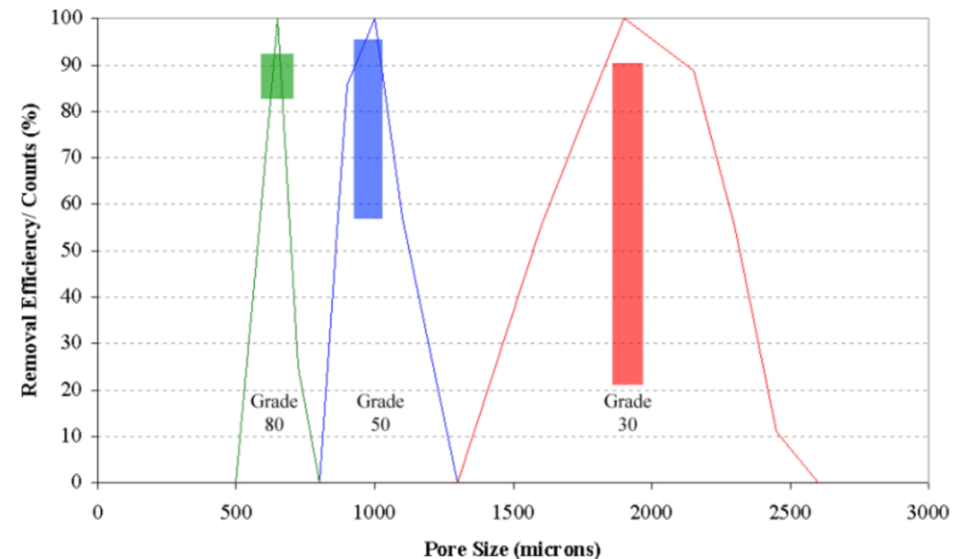
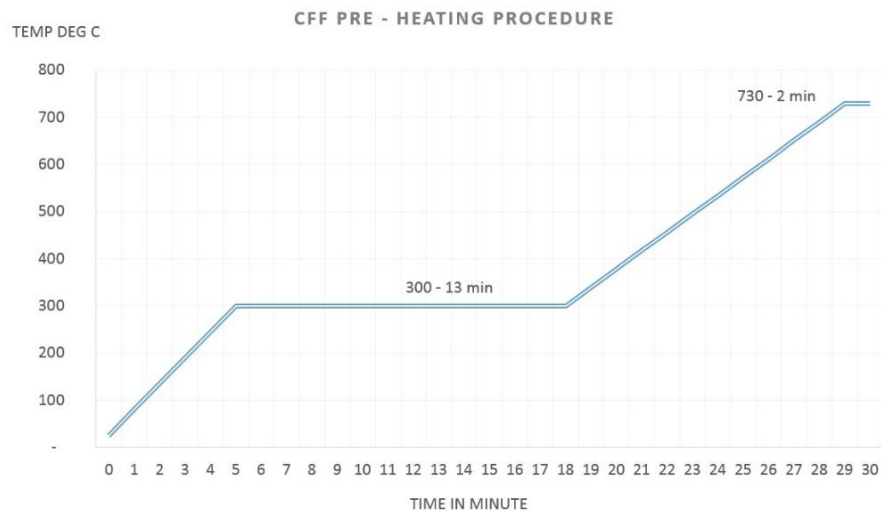


Filtration system bottleneck: Priming method

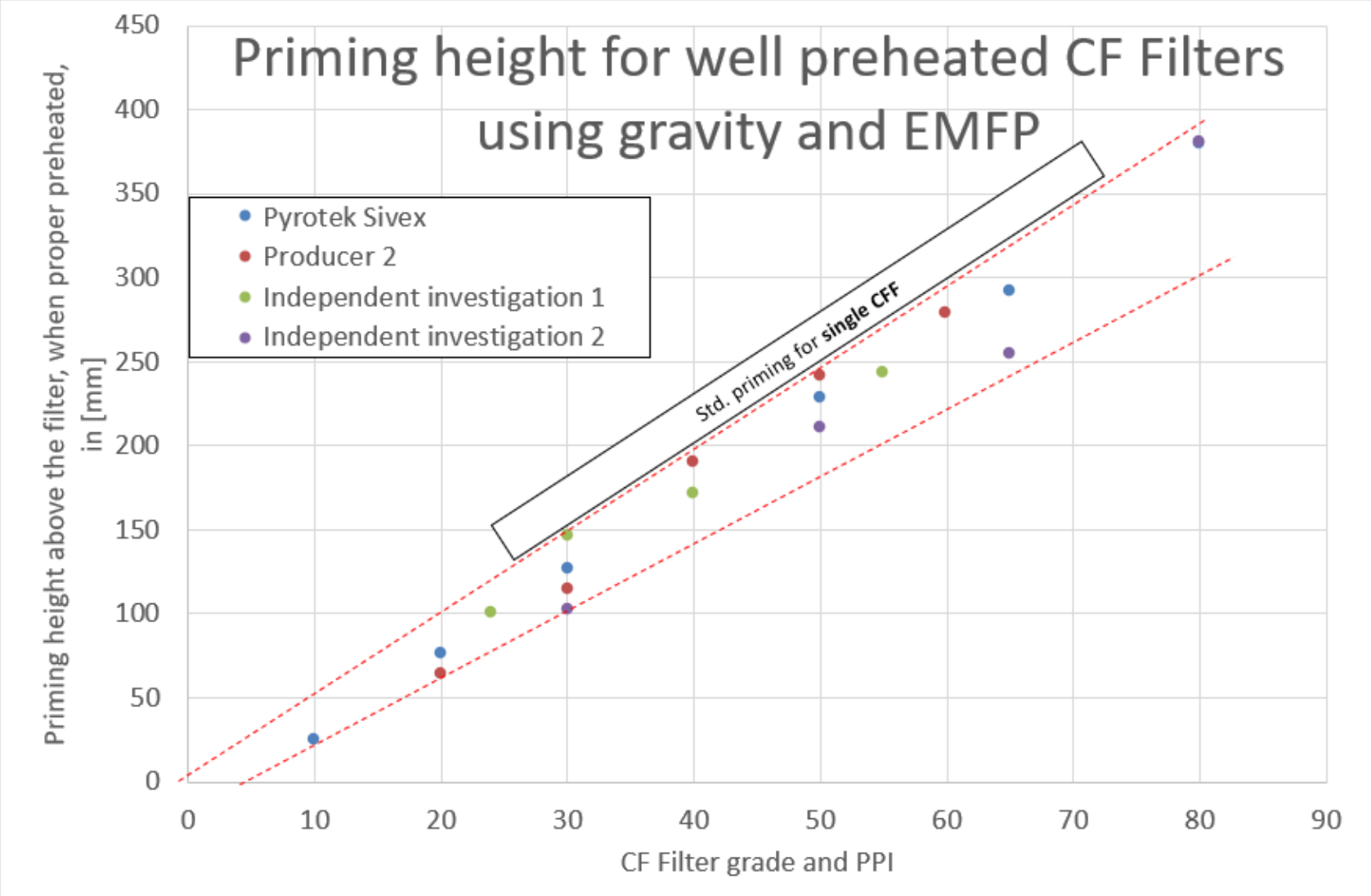


Classic casthouse method

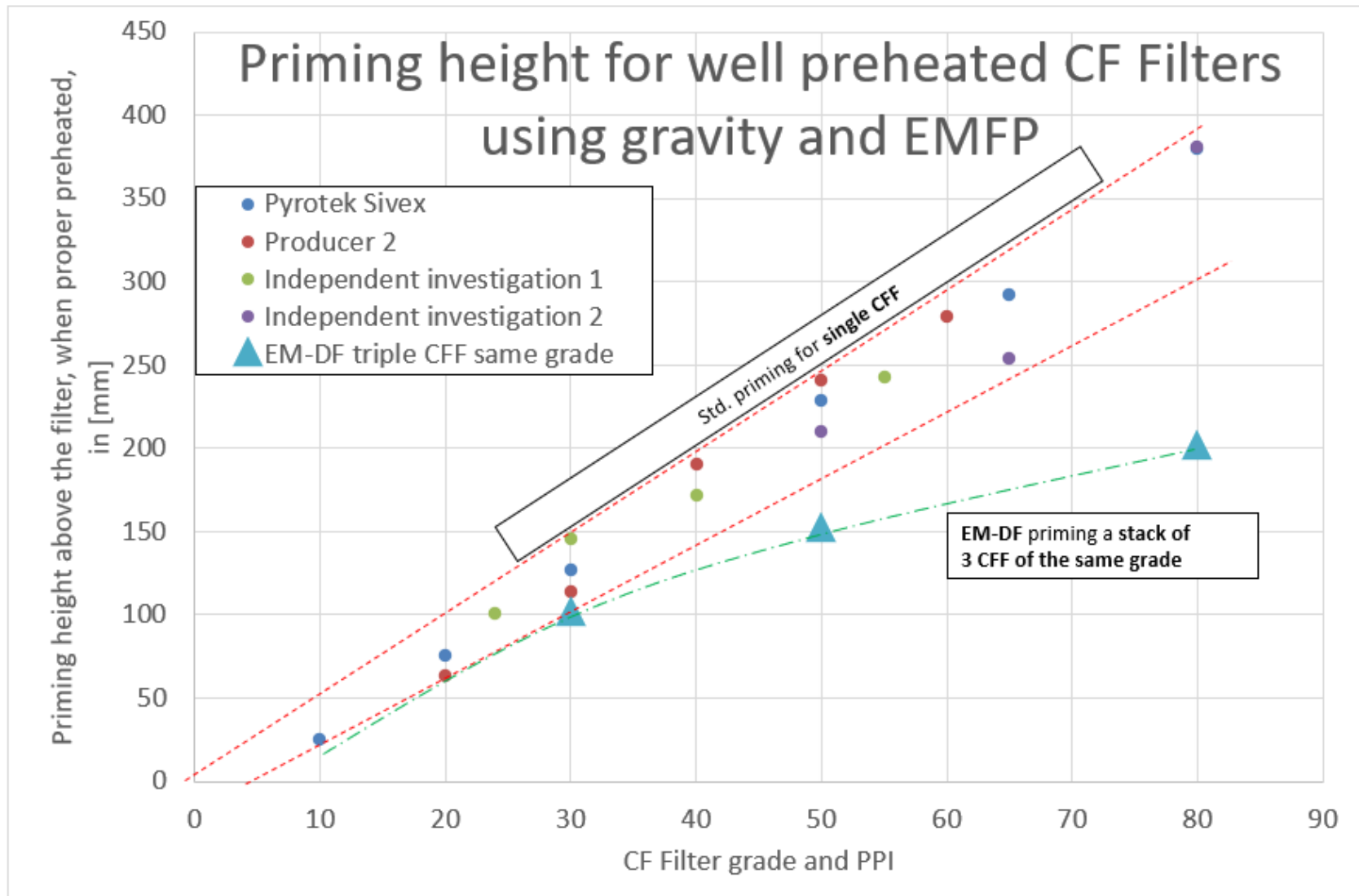
- Preheating the filters by hot air or gas burners to $<700^{\circ}\text{C}$.
- Priming only by metal head / gravitational forces.
- No flow control through the filter, throughput controlled by casting rate.
- Filtration efficiency has a chance for variation by priming quality and metal velocity.



Filtration bottleneck: Priming methods



Filtration: Priming methods and the EM-DF



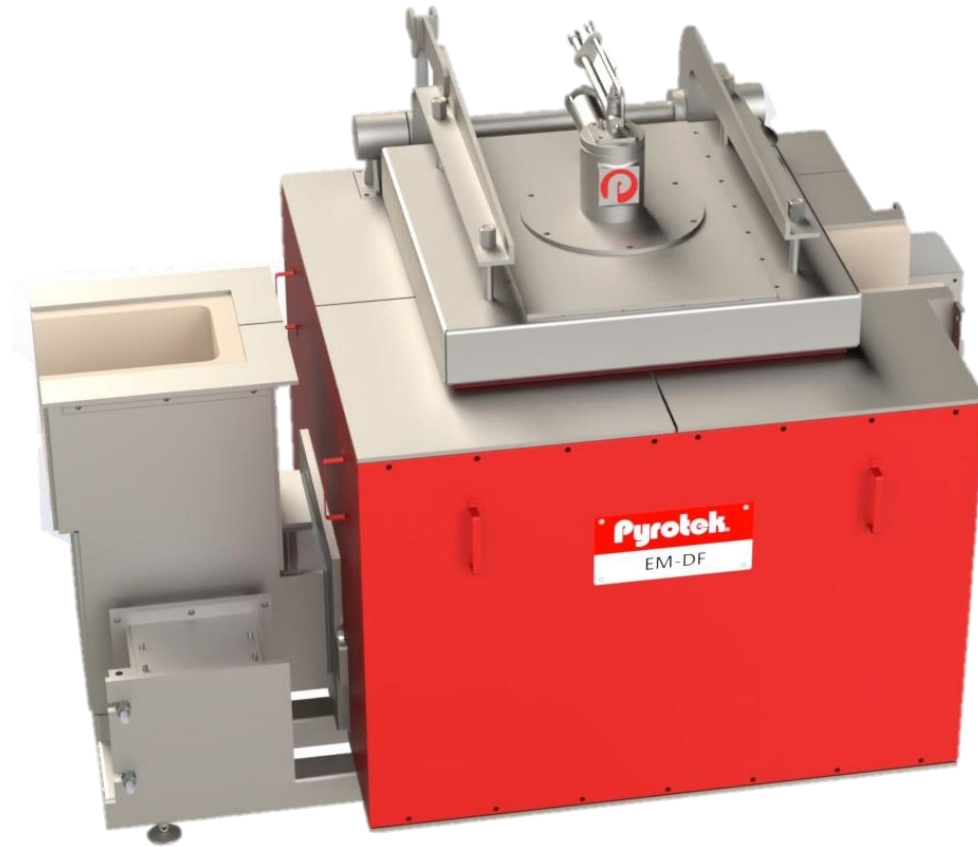
Priming and filtration



Why is improving the priming efficiency of a filter the current bottleneck and a key parameter?

With a **better priming process**, we can increase the number of filters and therefore the thickness of the filters.

This **increases the total filtration efficiency and consistency**.



Benefits of EM-DF

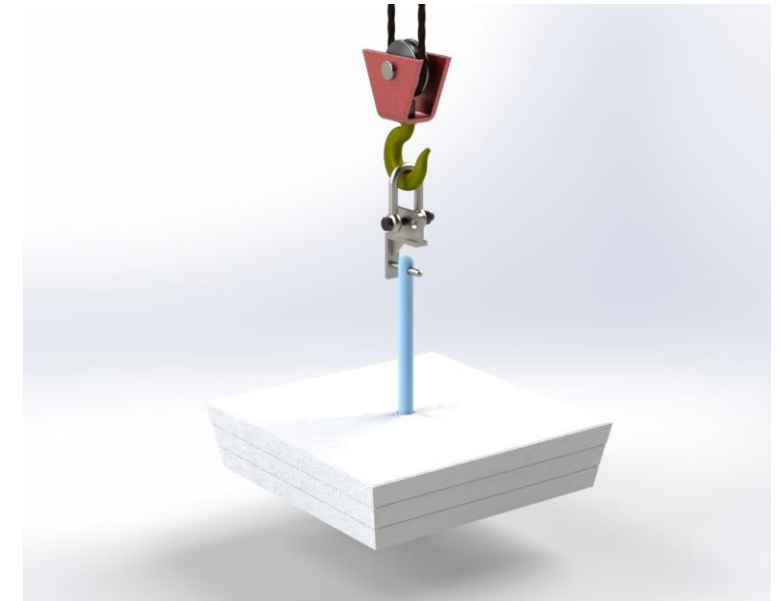


- Ability to prime multiple CFFs of different grades and a single CFF of a higher grade.
- Reduced metal head height for priming.
- Lower running costs and greater flexibility than a typical DBF system.
- Ability to drain entrapped metal from the CFFs upon completion of the cast.
- Ability to provide full automation.
- Proven repeated operation in a production environment.
- Less risk of failed casts due to floating/unprimed CFFs.
- Easy to operate and low maintenance.

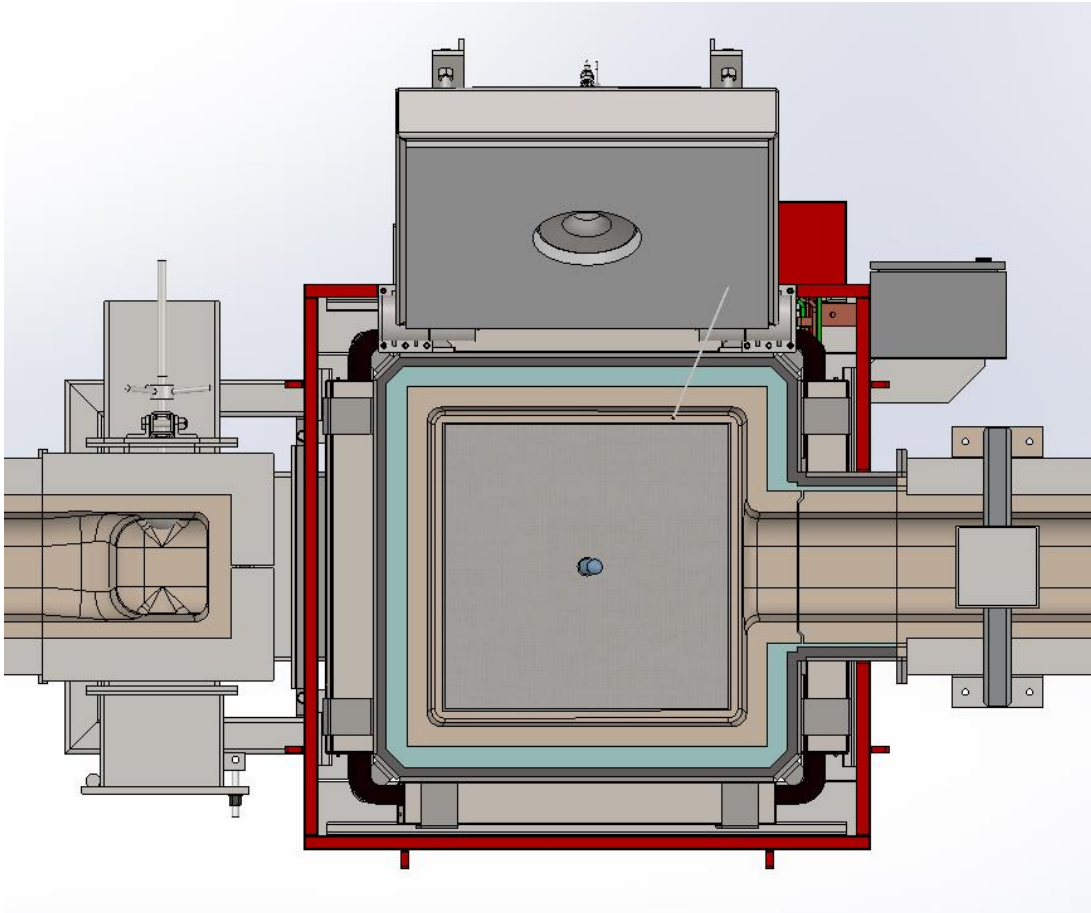
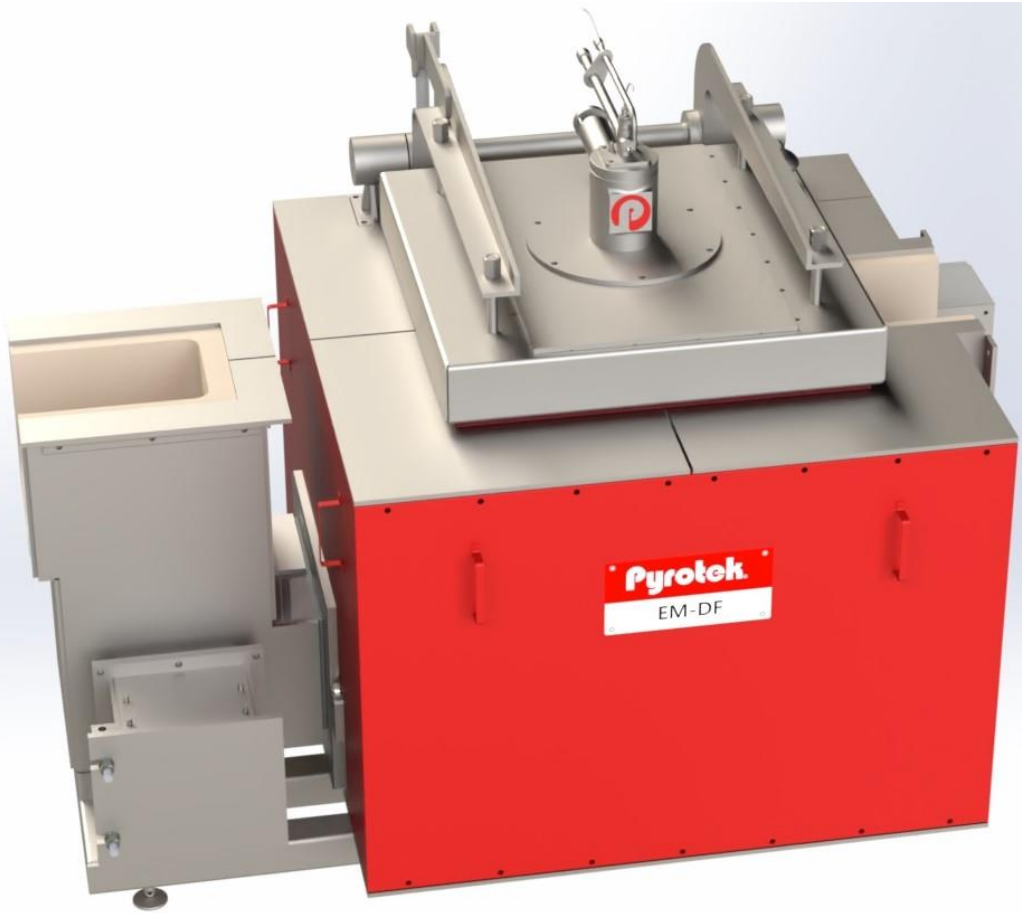
Equipment Supply



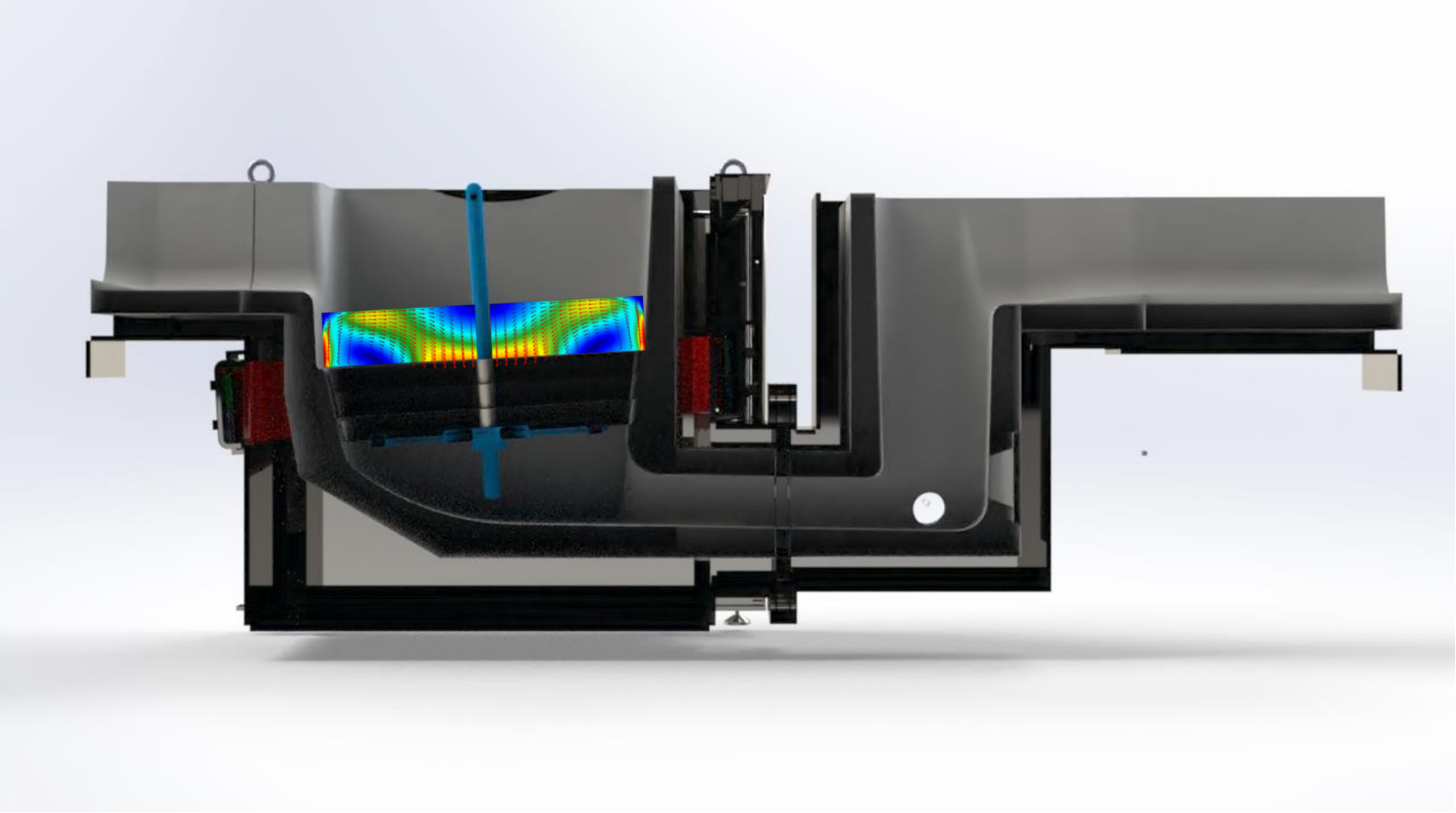
- EM-DF – Electromagnetic Filter Primer
- Pyrotek Flat Flame Burner
- Power Panel
- Closed Loop water cooling Equipment (Water set & Air Blast Radiator)
- Filter lifting tools
- Filter assembly table



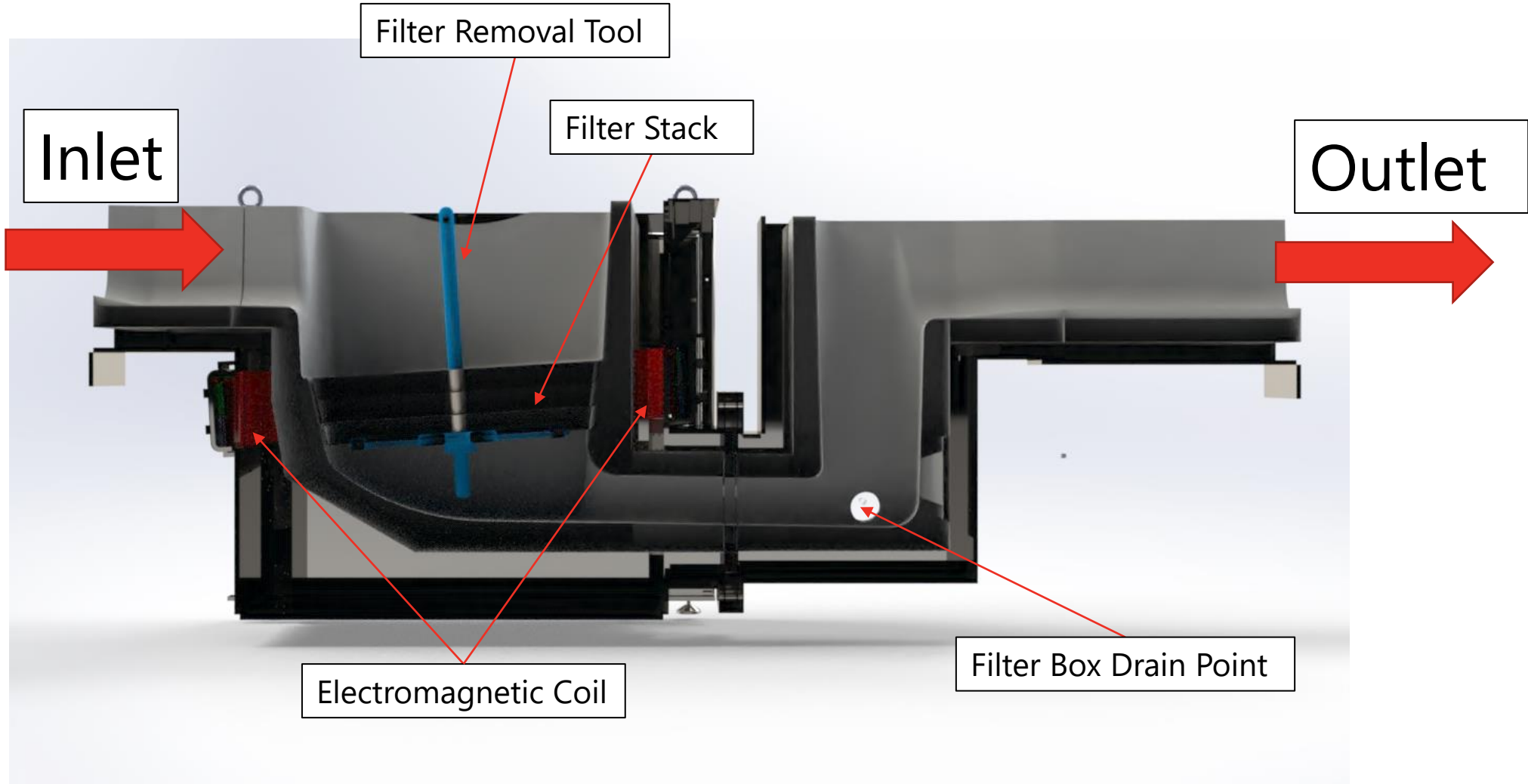
Design



Design



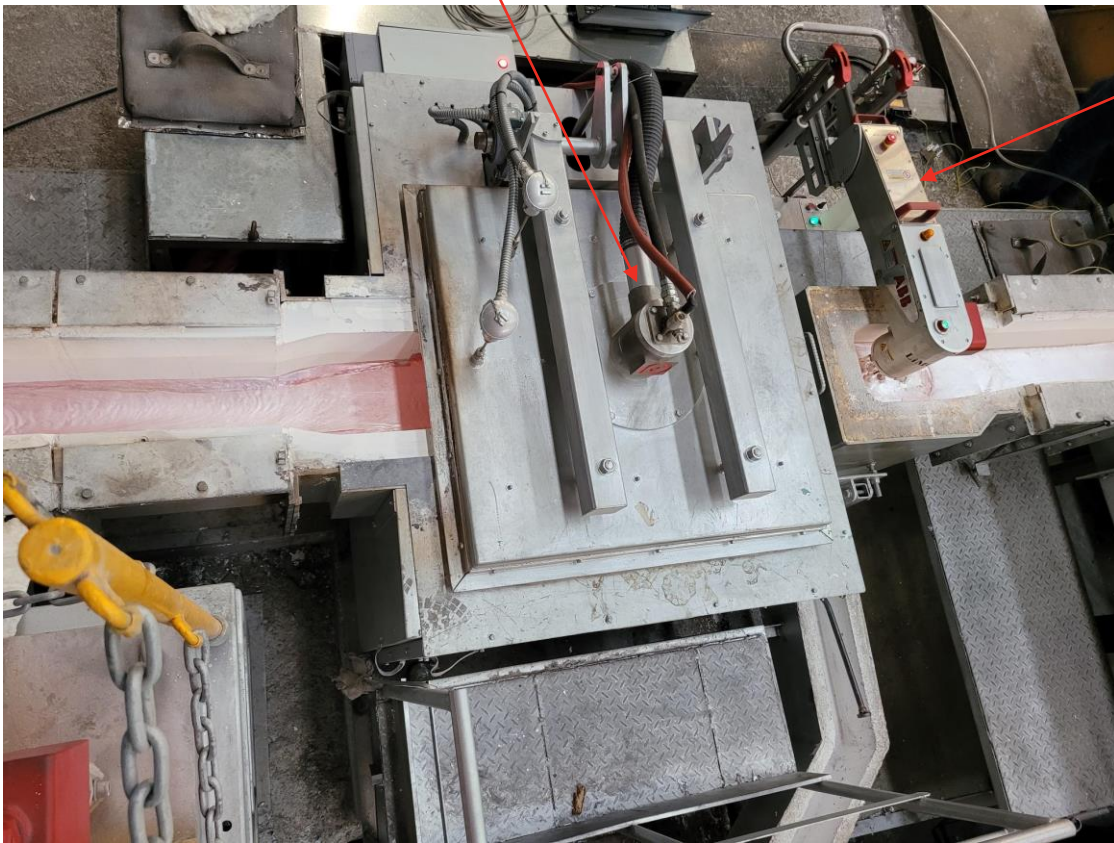
Design



Design



Inlet

PYROTEK FLAT FLAME BURNER

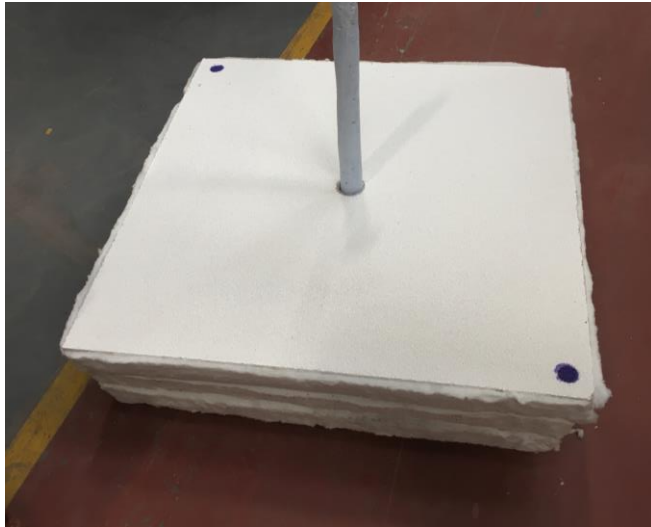
METAL QUALITY ANALYSER
(NOT SUPPLIED WITH FILTER BOX)

Outlet


Filter removal and placement tool



The patented tool is used to locate and remove the filter stack



It also helps to guide the EM flux from the coil into the center of the filterbox

Filter removal and placement tool





Questions?

Pyrotek[®]