



Filtration of Iron & Steel castings

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- ❑ Filter types and their attributes
- ❑ Filtration Efficiency
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Reasons for Growth in Iron Filtration

Castings Today



- ❑ Rise in casting quality standards
- ❑ Increase in casting performance requirements
- ❑ The pressure to reduce casting production costs, by reducing scrap and/or improving yield
- ❑ The drive to reduce casting weight means wall sections have become thinner and more sensitive to inclusions
- ❑ There has been a major increase in automatic pouring bringing higher metal velocity which in turn results in increased turbulence

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Filters for Achieving Quality



- ❑ Filtration has become a state-of-the-art casting production technique
- ❑ The use of filters is essential for the production of highest quality castings
- ❑ Filters simplify foundry scrap diagnosis by separating metal and mould factors more clearly
- ❑ Filters applied in a consistent way using relatively simple application rules give both a significant technical and economic benefit

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Filters for Achieving Quality



- ❑ Filter use raises the **WHOLE** quality level of casting production
- ❑ Use of filters will more than repay the expense of their application and purchase by reducing the costs of:
 - casting production
 - finished component
 - casting machining

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Effects of Filtration

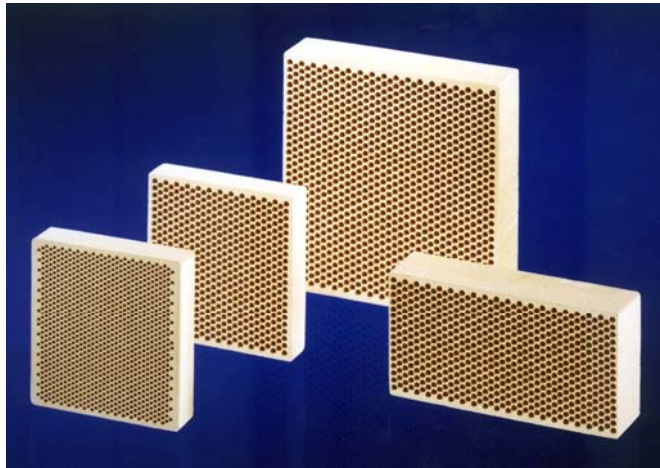
- Foundry:
 - Reduced scrap level
 - Improved scrap diagnosis
 - Improved overall casting cleanliness
 - Increase in overall casting quality
 - Improved yield
- Casting user or processor:
 - Improved machinability
 - Reduced machining allowances
 - Reduced machined scrap
 - Improved dynamic component properties
 - Reduced component production costs

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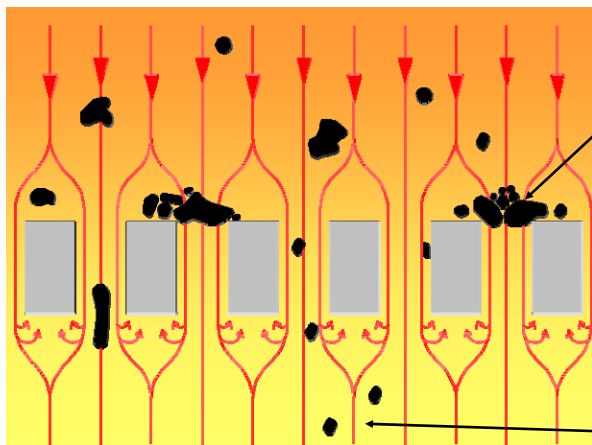
Filter Types and their Attributes

Pressed filters uni-dimensional filtration



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Mechanism of uni-dimensional filter types

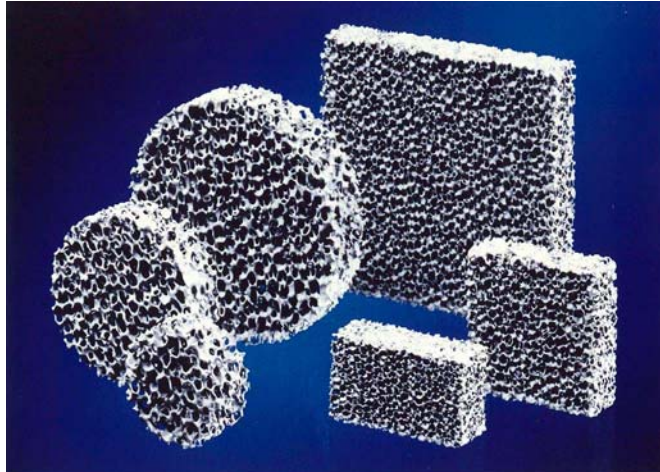


Mainly surface filtration

Particles smaller than minimum hole diameter are not retained

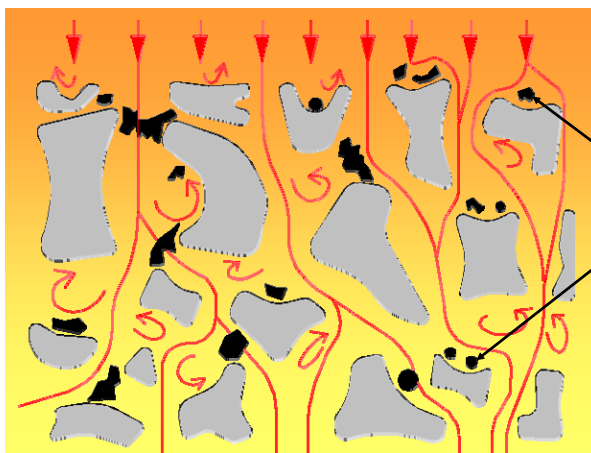
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Foam Filters, Multi-dimensional Filtration



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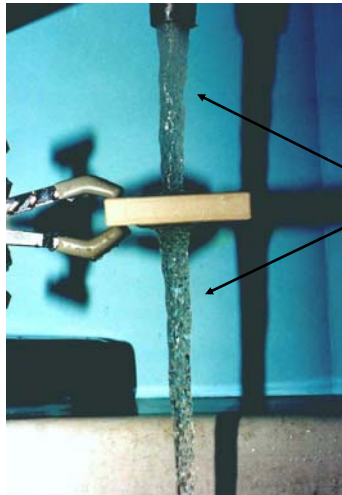
Mechanism of Multi-dimensional Filtration



Surface, cake and deep bed filtration

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Aerated water flow Through - Pressed Filter

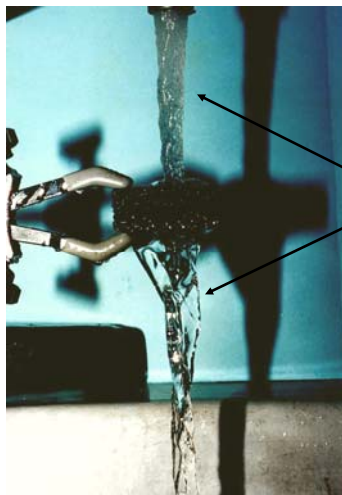


Air in - air out !

The filter has no effect on the entrained air bubbles

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Aerated water flow Through – Foam Filter



Air removed!

The filter slows the flow of water so much that the entrained air can escape.

This is the mechanism which reduces flow turbulence and gives the foam filter its high filtration efficiency.

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Comparison of 3 Main Types



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FILTRATION EFFICIENCY



Introduction

- SEDEX filters are being used in India since the early nineties.
- Today both pressed and foam filters are available in India.
- Many tests have been conducted by Foseco in India and Germany to evaluate the filtration efficiency.
 - Pressed, extruded and foam filters were evaluated.

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Test Casting Design

- 2 test plates are poured using filters.
- The top face is machined to check the inclusion levels.
- Plate size used : 400x200x25.
 - Sufficient area to evaluate the inclusions on top face.



DRAG PATTERN

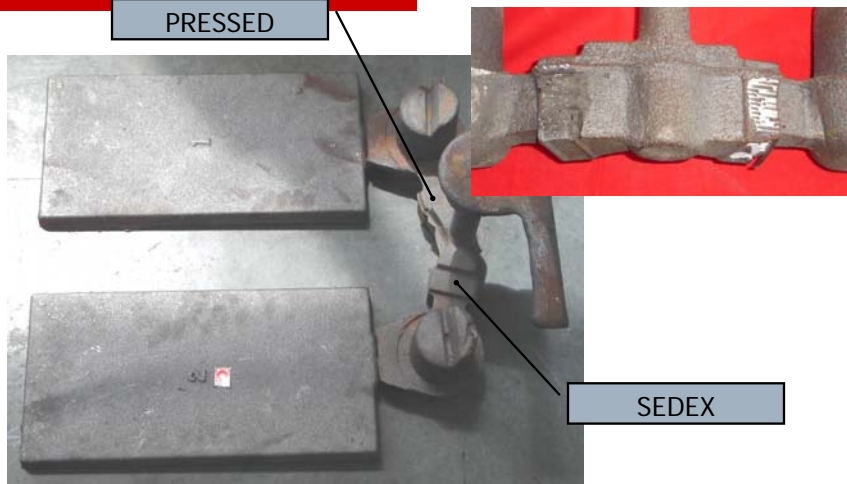
COPE PATTERN



CASTINGS' BUNCH

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Castings' Bunch

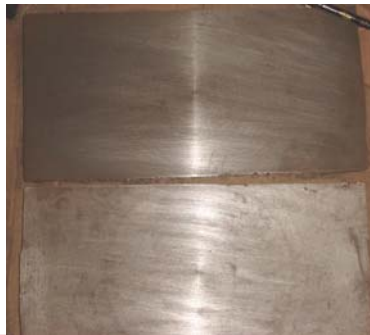


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Machined Castings



- ❑ Castings were machined from the top face.
- ❑ Machining was done until the face is fully machined (without any cast marks).
- ❑ Approximately a machining of 1.5 to 2mm was done on each of the plates.

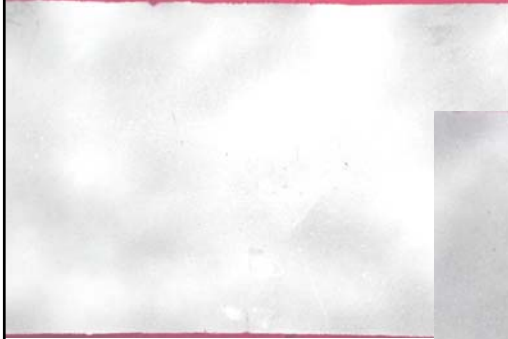


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Comparison



SEDEX 50X50X22(10PPI)



PRESSED FILTER

Comparison



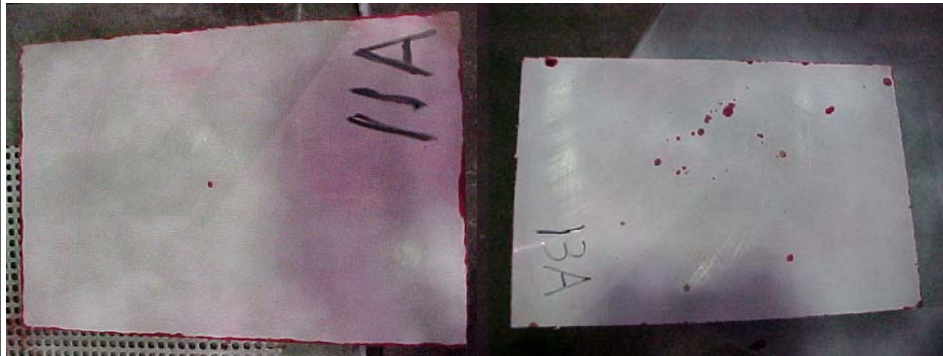
SEDEX 50X50X22(10PPI)



PRESSED FILTER

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Plate test with Stelex ProO



STELEX Pro FILTER

No FILTER

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Conclusion



- ❑ The filter location is close to the feeders/castings hence the possibility of re-oxidation is minimal.
- ❑ The inclusions seen in the castings are either from the metal or sand.
- ❑ Dye penetrant test indicates significantly fewer inclusion defects in castings filtered with SEDEX.
- ❑ This test proves that SEDEX's filtration efficiency is far better than pressed filters.
- ❑ The pressed filters with parallel channels are unable to trap and retain inclusions from the molten metal.

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Product Attributes



Attributes	Foam	Pressed
Dimensional Accuracy	Moderate	High
Cold Strength	Moderate	High
Effectiveness	High	Moderate
Particle retention size	Fine	Mainly coarse
Effect on velocity	High	Moderate
Turbulence reduction	High	Minimal

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Application Guidelines

Application principles for for horizontally parted moulds



- Select filter porosity according to type of iron to be filtered
- Use the complete filter entry face for filtration
- Provide generous exit face support
- Whenever possible, position filter(s) close to the mould cavity
- Locate all the runner bars in the drag (lower) mould half
- Keep the runner system as short and direct as possible

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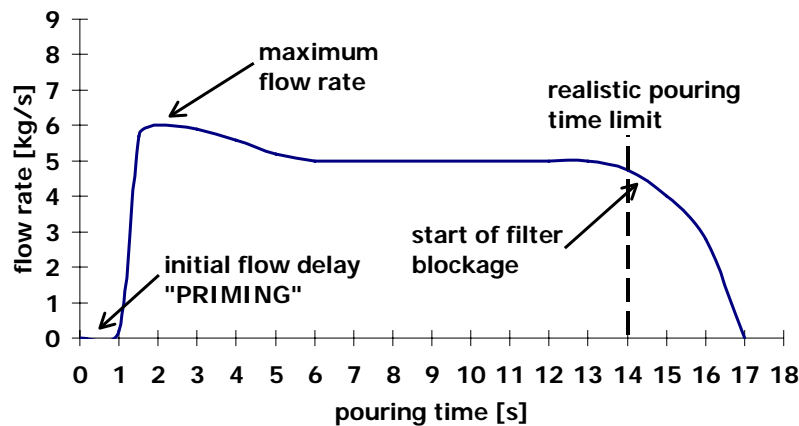
Application principles for for horizontally parted moulds



- Apply the filtration gating ratio:
$$\text{Sprue area} : \text{Runner area} : \text{Ingate area}$$
$$1,0 > 1,1 > 1,2$$
- Pay special attention to the gating system behind the filter, ensure it is:
 - well moulded
 - smooth and clean
 - with generous radii
- Evaluate scrap castings which still occur following filtration, the remaining scrap can be further reduced by careful study of the causes.

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Profile of metal flow through the filter



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Filter capacity - Metal FLOW



A filter must satisfy two capacities

a) Flow capacity -

- How quickly metal passes through the filter, this is relatively constant in kg per cm², to obtain required overall flow rate sufficient filter area has to be provided.
- To check whether the selected filter area is sufficient, divide the filter area by the calculated or actual choke (down sprue area (1)):
 - For grey cast iron this ratio must be >2:1
 - For ductile cast iron this ratio must be >3:1
 - For alloyed cast irons and Inmold this ratio must be >4:1

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Application principles - Filter capacity - Metal QUANTITY



- b) Metal filtration capacity
- That is the total weight of metal which the chosen filter area can successfully pass before blockage occurs

$$\frac{\text{total weight to be filtered}}{\text{selected filtration capacity factor}} = \text{required total filter area in cm}^2$$

- This can then be converted into the number of filters which are to be applied to filter the mould.

Example:

$$\frac{110 \text{ kg ductile iron}}{1,5} = 73,4 \text{ cm}^2 \text{ of filter area}$$

- Giving following filter options; 3x50², 2x50x75 or 1x75x100.

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Steel Filters



STELEX ZR*

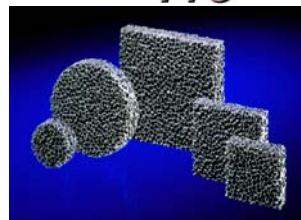


Area of application:
Ferrous and Stainless steel & Alloys steel

Maximum
application temperature:
1680°C

Main component :
ZrO₂

STELEX* Pro



Area of application:
Ferrous and steel alloys

Maximum
application temperature:
1680°C

Main component :
Al₂O₃ + C

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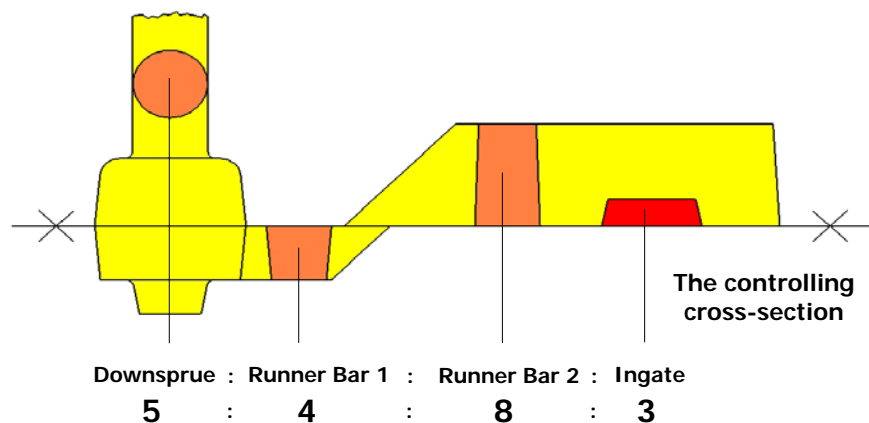
Where ZR & Where PrO ?

- STELEX ZR
 - Stainless steel and Alloy steel with carbon lower than 0.15%.
- STELEX PrO
 - All steel metal grades with carbon more than 0.15%.
 - Heavy weight SGI and Grey iron
 - Even for metal grades with carbon lower than 0.15% after study of carbon pick up.

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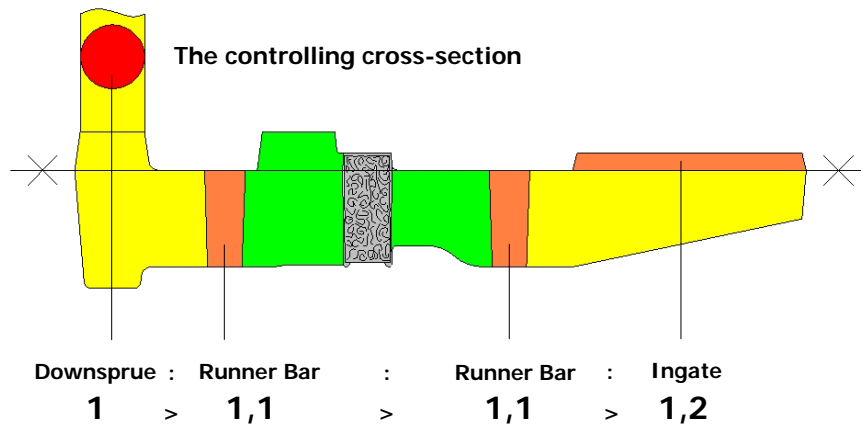


Conventional gating system



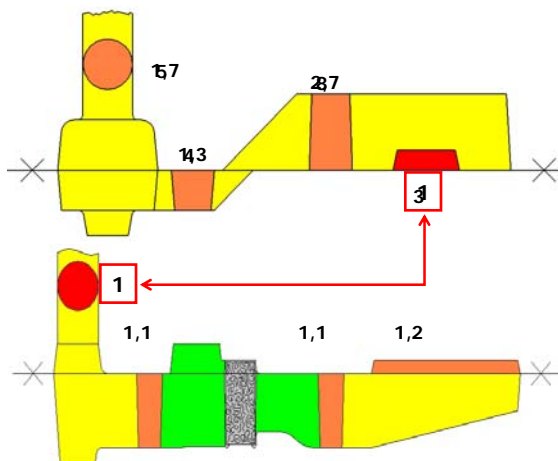
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Horizontal gating system with filter



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Runner system types Conventional and system with filter



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Casting Defects



Defects which
filtration
can remove

Slag
inclusions

Inoculant
inclusions

Gas
defects

Turbulence

Defects which
filtration
cannot remove

Filter
blockage

Filter
inclusions

Graphite
flotation

Penetration

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Case Studies

Engine Block



**4 cylinder 320D diesel engine
block M47 TUE**

Common rail injection system

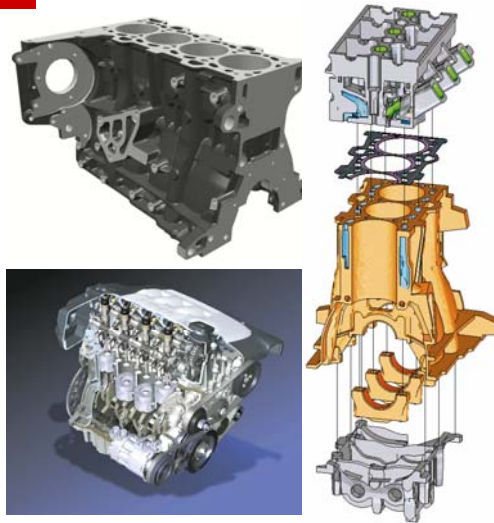
Capacity - 1995 cm

Power - 110 KW or 150 HP

Block weight - 54,6 Kg

Engine weight - 158 kg

**Maximum injection pressure -
1600 bar**

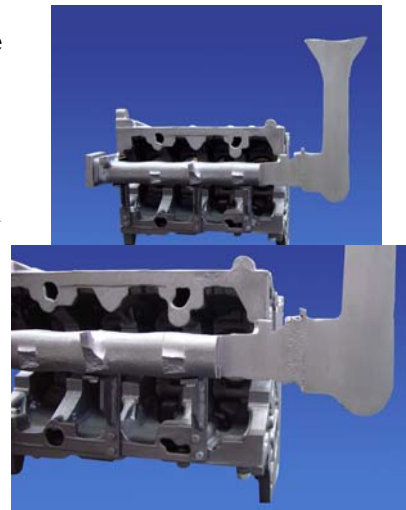


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Engine Block



- ❑ Filter placed at 90° across the sprue in front of the runner bar which runs through the core package.
- ❑ Ingated through the bearing radius (not the bolt pads), a small slag chamber in front of the filter was added later.
- ❑ The ingate area behind the filter was increased to reduce velocity and mould filling turbulence.



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Engine block



Original production details:

- ❑ Pour weight – 140 kg.
- ❑ Casting 54,6 kg.
- ❑ Pour time – 10 to 12 seconds.
- ❑ Filter – 1x66² mm, 12,7/300csi extruded filter.
- ❑ Foundry scrap – 5 to 8%, a mix of inclusions, gas porosity, and shrinkage, consequence of turbulent mould filling.

Revised production details:

- ❑ Filter – 1x75² mm, 22/20 ppi SEDEX ceramic foam filter.
- ❑ Foundry scrap reduced to 1-3%.
- ❑ More-even mould filling and improved surface finish were observed.
- ❑ Inclusions, gas porosity, and shrinkage were largely eliminated.

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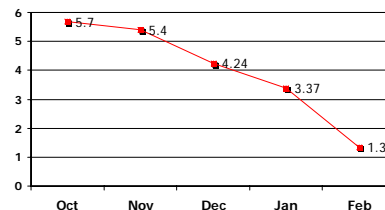
6 Cylinder Block



- ❑ Casting weight: 156 Kg.

- ❑ Improvements:
 - Cleaner castings
 - Lower scrap after machining

- ❑ Foseco Products used:
 - SEDEX 40x40x15/20 (5 Nos.) per casting.



2001 – 2002 M/c Shop Inclusion defects

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Reduction in Re-work



No Filter !!!



STELEX*
PrO

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Reduction in Rework



STELEX*
PrO



No Filter !!!

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Reduction in Rework



Hook Casting
134 kg (295#)
Low-Alloy Steel



>50% reduction in weld repairs compared to castings filtered with STELEX ZR filters

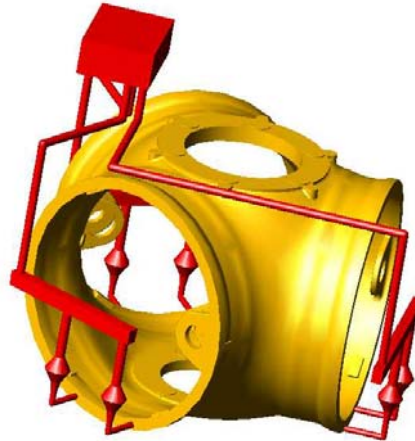
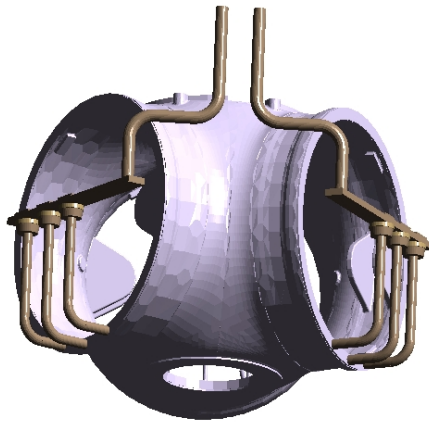
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Ceramic filter print for In-line filtration



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Wind Mill SGI Casting



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Thank You for your attention!
Questions ?