Feeding Systems for Steel and Iron Castings

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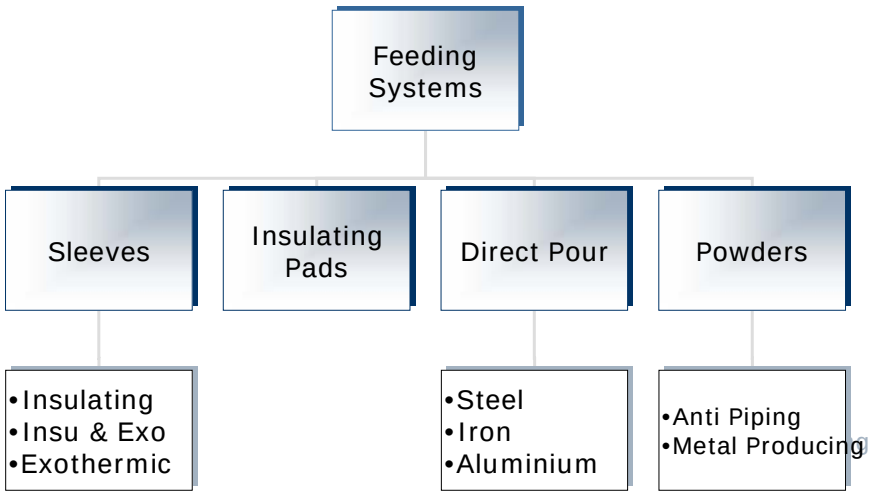
Feeding Systems



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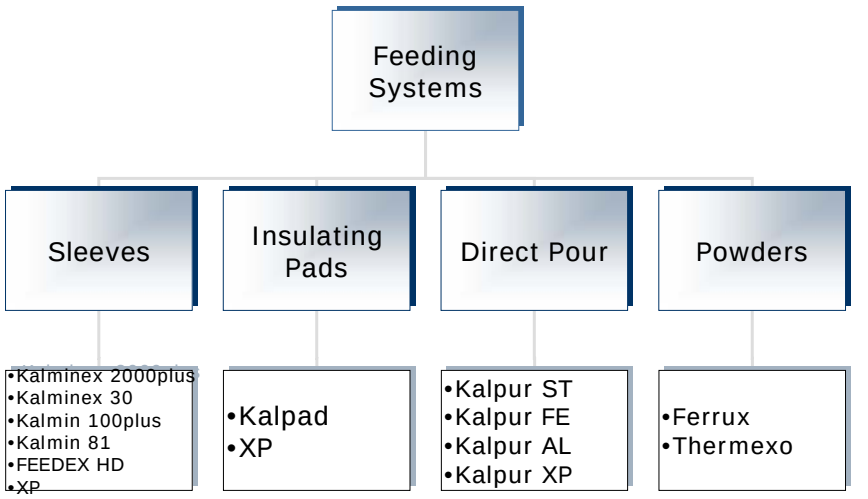
Feeding Systems



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Application Guidelines

Risering

WHY FEEDING SYSTEM ?

- When castings solidify from pouring temperature to room temperature, it's volume reduces.
- The reduction in volume in liquid to solid stage generate shrinkage porosity at the location where metal solidify last.
- So, FEEDER is required to make casting SHRINKAGE free by taking out likely shrinkage (in casting) into it (feeder) by solidifying later than casting section.

Solidification Time

- How to ensure that Feeder solidify later than Casting section ?
  - Possible if we know the criterion of metal solidification time.
  - Chvorinov developed the equation to calculate solidification time
  - T = kMc2
    - T = Solidification time in Minutes
    - K = constant, 2.0 – 2.4 (for steel)
    - Mc is Modulus of casting in cm.

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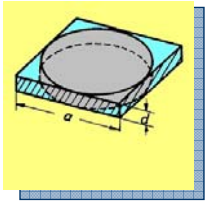
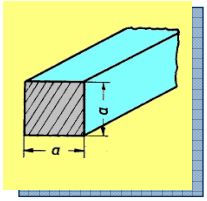
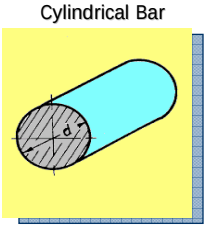
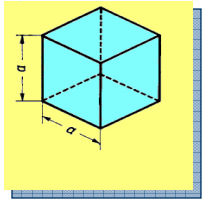
MODULUS of Casting

- **Mc = Volume / Cooling surface Area**

Disk/plate where a ≥ 5d	bar	Cylindrical Bar	cube
			
Mc = d / 2	Mc = a / 4	Mc = d / 4	Mc = a / 6

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Steps in Rise Calculation

- Modulus Calculation of the casting section where riser to be placed.
- Decide – First Hand riser size.
- Decide number of risers required.
- Calculate Feed Metal requirement of the section.
- Finalise riser size.
- Calculate neck – for side riser

Modulus Calculation & Rise Size

- Decide type of sleeve to be applied.
- Calculate Riser Modulus (Mr)
  - Mr = 1.2 x Mc
- Refer the Datasheet and select the sleeve size having equal or higher Effective Modulus

Nos. of Risers Required

- Use Following formula to decide Nos. of risers.

$$n_f = \frac{\text{Casting length or mean circumference L}}{\text{Provisional feeder diameter (d) + Feeding distance factor (FD) x thinnest section through which feeding occurs (T)}}$$

$$n_f = \frac{L\ (mm)}{d\ (mm) + FD\ (mm) \times T\ (mm)}$$

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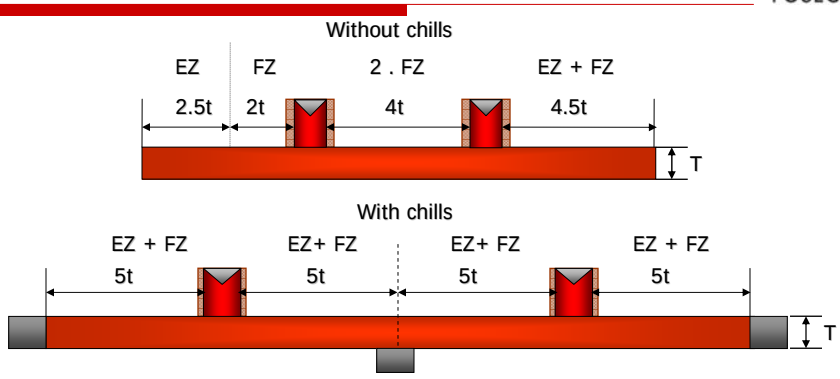
Feeding Distance Factor



$$n_f = \frac{L\ (mm)}{d\ (mm) + FD\ (mm) \times T\ (mm)}$$

It is important to note how feeding distance can be increased with the use of chills

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Feeding Distance Factors

Steel (0.25 % C)	4.0	Al Bronze	5.0
Steel (0.20 % C)	5.0	Ni Al Bronze	2.0
Steel (0.60 % C)	4.5	Sn Bronze	3.0
Malleable iron	5.0	Flake graphite iron (GGL)	
		GGL, CE = 3.0	6.5
Al (99.99 %)	10.0	GGL, CE = 3.4	7.7
Al Cu 4.5	6.0	GGL, CE = 3.9	8.8
Al Si 7	6.0	GGL, CE = 4.3	10.0
Al Si 12	10.0		
Al Si (6 - 13)	5.0	Spheroidal graphite iron (GGG)	
		GGG, CE = 3.6	6.0
Cu (pure)	8.0	GGG, CE = 4.2	6.5
Cu Ni (30 % Ni)	2.0	GGG, CE = 4.3	7.0
		GGG, CE = 4.4	9.0
Brass	5.0		

Calculation of Feed Metal Required

- The Feeder must satisfy criterion of modulus as well as Feed Metal Requirement.
- Feeder must have sufficient metal volume to feed the casting section under it.
- Required Feeder weight can be calculated by using following equation.

$$W = \frac{\text{Casting Section Wt. (Kg) x Ally Shrinkage \%}}{\text{Volumetric Feeding Efficiency of riser \%}}$$

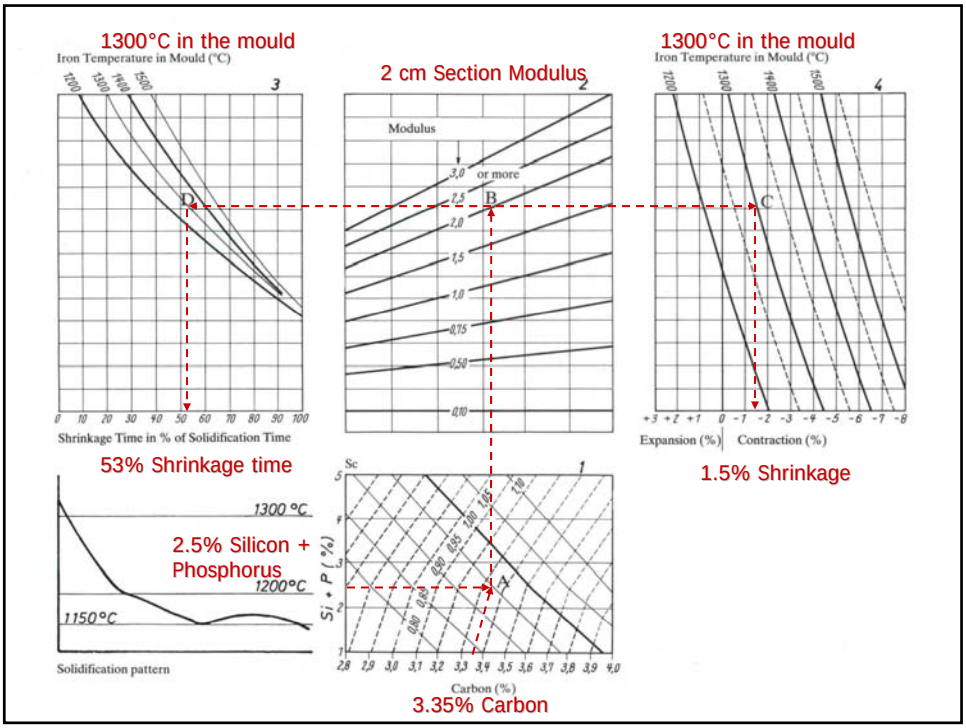
Calculation of Feed Metal Required

- Alloys shrinkage % is given in next slide
- Volumetric Feeding Efficiency depends on many factors like
  - Geometry of the casting
  - Metal grade
  - Sleeve thermal efficiency
  - Moulding media
  - Pouring temperature
  - Design of feeder sleeve etc.
- In normal condition it can be considered as 33% for Kalminex 2000plus sleeves

Shrinkage of principal casting alloys

Casting Alloy	Shrinkage %
Carbon Steel	6.0
Alloyed Steel	9.0
High Alloy Steel	10.0
Malleable Iron	5.0
Aluminium (99.99%)	8.0
AlCu4Ni2Mg	5.3
AlSi12	3.5
AlSi5Cu2Mg	4.2
AlSi9Mg	3.4
AlSi5Cu1	4.9
AlSi5Cu2	5.2
AlCu4	8.8

Casting Alloy	Shrinkage %
AlSi10	5.0
AlSi7NiMg	4.5
AlMg5Si	6.7
AlSi7Cu2Mg	6.5
AlCu5	6.0
AlMg11Si	4.7
AlZn5Mg	4.7
Cu (pure)	4.0
Brass	6.5
Bronze	7.5
Al Bronze	4.0
Sn Bronze	4.5

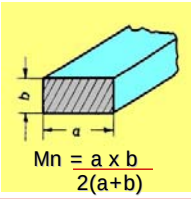


Finalise Sleeve size

- Select the final sleeve size from the datasheet which satisfy following both requirements
  - Modulus &
  - Volume requirement

Riser Neck Calculation (steel)

- For top feeders, no determination of Feeder Neck is required. If possible, sleeve with BC should be used.
- Side riser neck required to be calculated
  - Mn = 1.1 x Mc
- For square/rectangle neck following formula can be used



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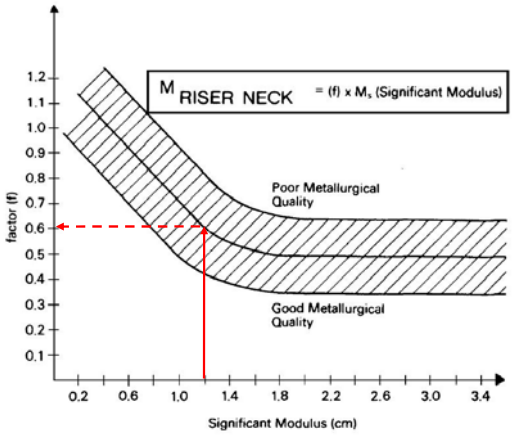
Riser Neck (Iron Castings)



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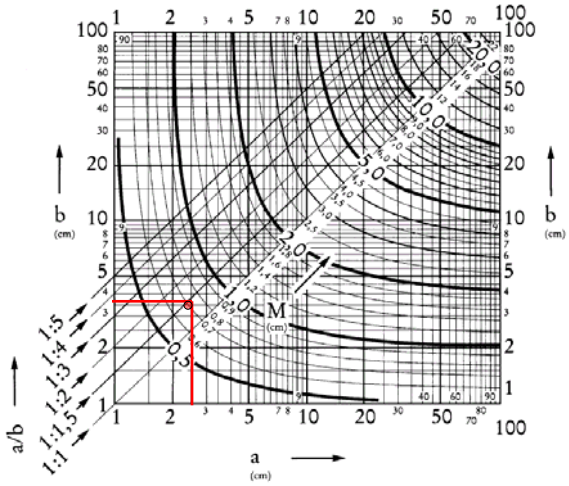
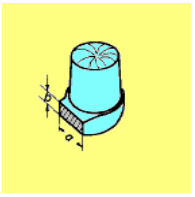
Riser Neck Shape





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Feedex HD

Foundries need

- Do away with padding and avoid unnecessary grinding
- More space for maximum cavities
- Maximum yield
- To achieve all of the above
  - A feeder to meet the modulus and volume demand and to be placed directly on the hot spot.

FEEDEX HD

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Feedex HD

- Sleeve material and shape designed to -
  - Give the highest modulus with a low volume of metal.
  - Ignite rapidly even in reducing, green sand atmosphere.
  - Have a high strength to withstand squeeze pressure of most molding lines.
  - Form a hard residue on burning so, no fear of sand contamination.

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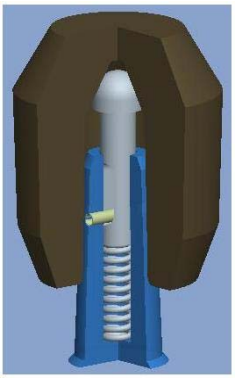
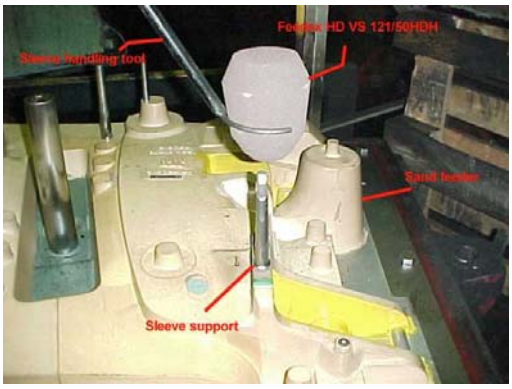
Simple Application





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Exhaust Manifold

- Casting name : Exhaust manifold.M
- Casting weight : 5 kg.
- No of castings per mold : Eight.
- Metal grade : GGG 40.
- Poured weight : 73 kg.
- Yield : 54.8 %.
- Product used : Feedex HD V 8 one per casting, Sedex 50x75x22/10 PPI

Key benefits :

- Shrinkage free mounting holes.
- Reduction in expensive machined scrap from 20% to 1.5 %.
- No reduction in number of cavities per mould.

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Improved Productivity and Yield

- Casting name : Spring Bearing
- Casting weight : 32.6 kg.
- No of castings per mold : Eight.
- Metal grade : SGIron
- Molding : Automatic green sand
- Poured weight : 330 kg.
- Yield : 79 %.
- Foseco product used :
  - **Feedex HD VS 339/50HDH**
  - **Sedex 100x150x22/10**

Key benefits :

☒ Yield improvement from 48 to 79%
☒ One cover core per casting eliminated.
☒ Pouring time reduced from 32 to 20 S

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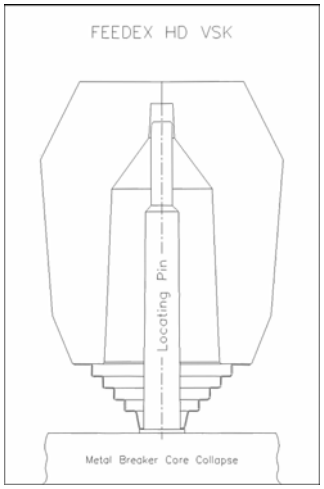
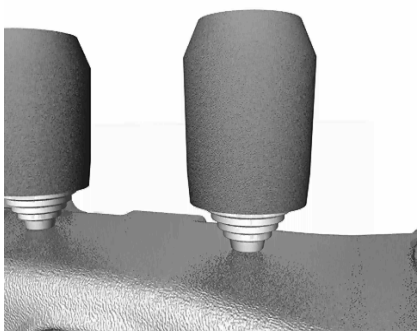
Core Collapse Mechanism





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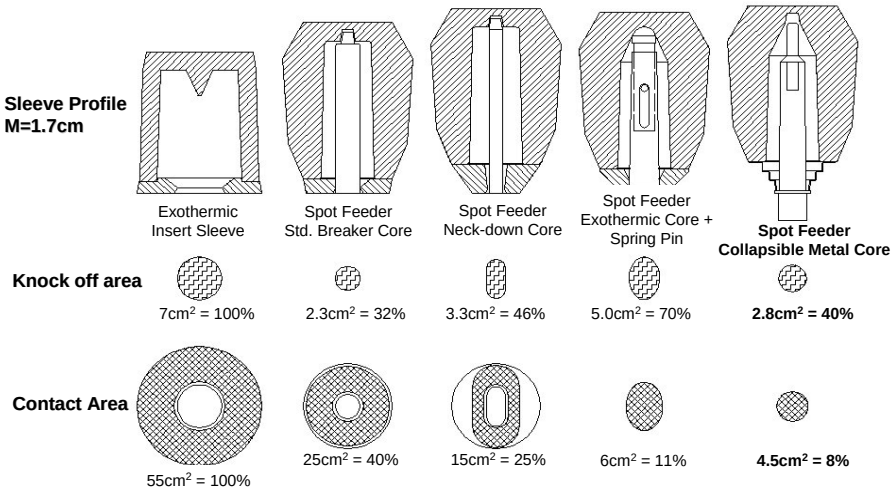
Comparison of Knock-off Areas



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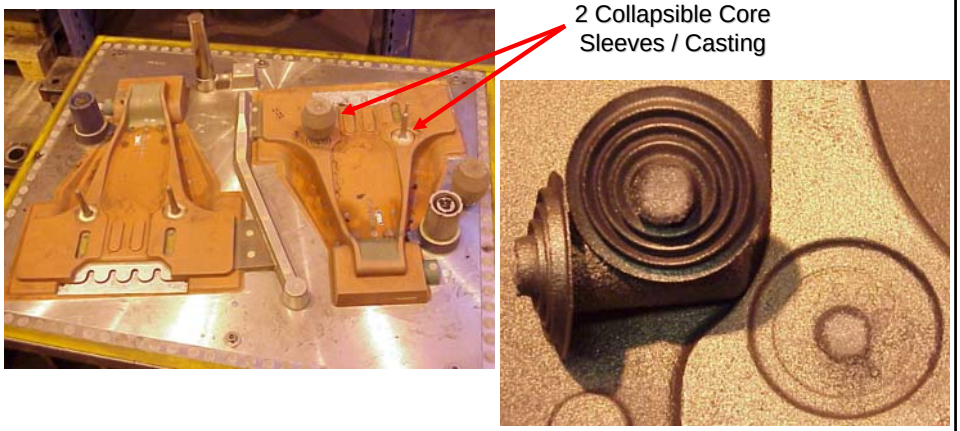
Truck Bracket



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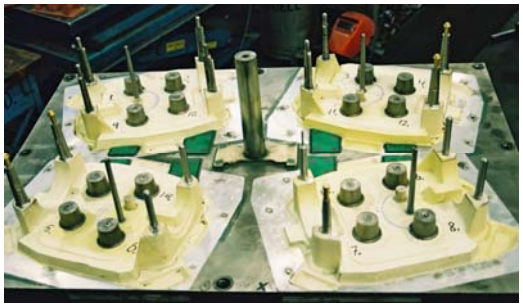
Truck Differential Housing



Cope Pattern

Casting after Feeder removal

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Consistent Performance

- Casting name : Hydraulic Hammer
- Casting weight : 129 kg.
- No of castings per mold : Two.
- Metal grade : Austenitic DI
- Molding : Green sand
- Poured weight : 325 kg.
- Yield : 79 %
- Foseco product used :
  - **Feedex VSK 770/33 M**

Key benefits :

- Very small contact area.
- Improved yield.
- Reduced production costs.

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Need for XP

FOSECO

- As castings become demanding, feeding becomes more difficult.
- Intricate casting shapes are difficult to feed with conventional means.
  - Need for odd shapes and
  - un-conventional applications.
- New, high productivity molding lines need more consistent dimensions and better surface finish.
  - Disamatics.
  - Flask-less molding where close-over applications are used.

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XP Products

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Possibilities with XP

- Sleeves.
  - Both simple and complex shapes.
  - Direct pour applications.
- Pads.
  - Including casting profiles.
- Feeder necks
  - In case of limited casting area or easy knock-off

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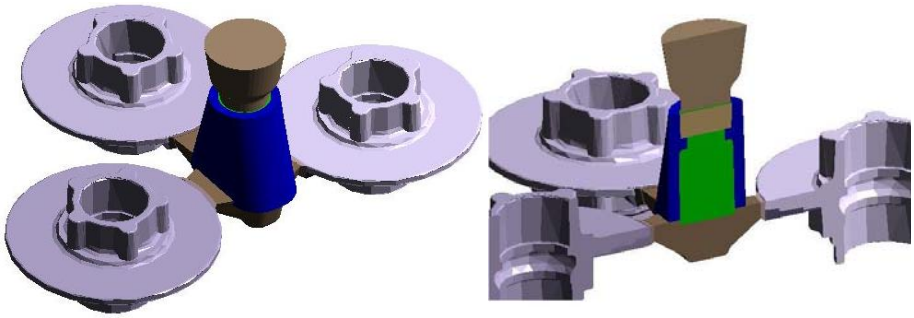
Kalpur XP



	Designed Practice	Proposed with XP
Casting weight	5x3=15 Kg.	
Poured weight	32 Kg.	28.5
Yield	47 %	54 %
Savings		3.5 Kg.

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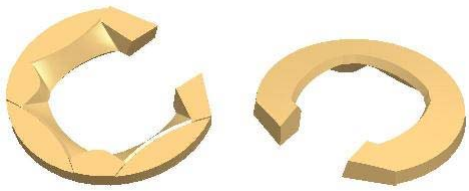
Insulating pads



- **Kalpad XP**
- Eliminates metal pads on castings.
  - Saving fettling and or machining time.
  - Increases solidification time of neck.

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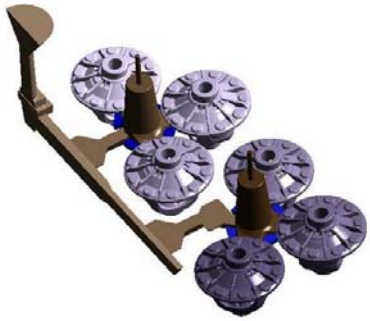
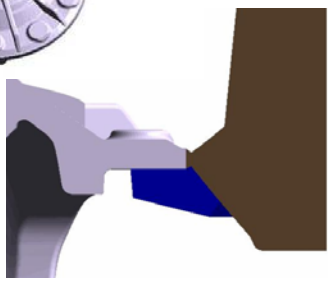
Kalpad XP





- Eliminates metal pads on castings.
  - Saving in machining time of pad.

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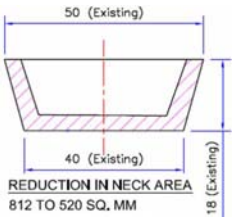
Insulating necks

- Reduces neck size
- Ease in knock off where large necks are normally used.
- In castings where limited area is available for neck connection.



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Special Breaker Core

- Special core to place sleeve directly on the 'hot-spot'.
  - Effective feeding!
  - Avoids padding.
  - Improved yield.

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Thank You for your attention!
Questions ?