FOUNDRY DEFECTS (Some Tips)

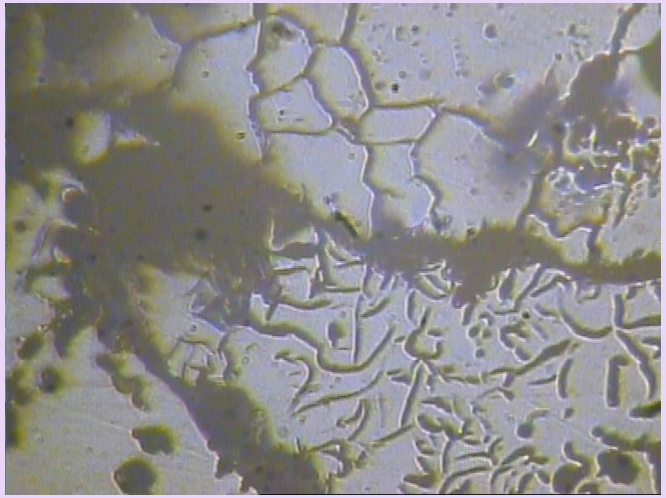
Practical Causes, Observations and Remedies

Prepared by: P. Arul Mozhi Devan

SLAG INCLUSION

OBSERVATION

Heavy Manganese Sulphide slag in between the slag flake graphite .Around the slag Nodularity fully deteriorated.



CAUSE

- A number of parts having slag inclusions and the location depends on the orientation.
- Complete slag removal is very difficult even in the melting furnace, ladles and in the pouring furnace. Insufficient filtering in the gating system , filter quality and choke (slag trap)in the gating system.
- Insufficient slag trap in the metal

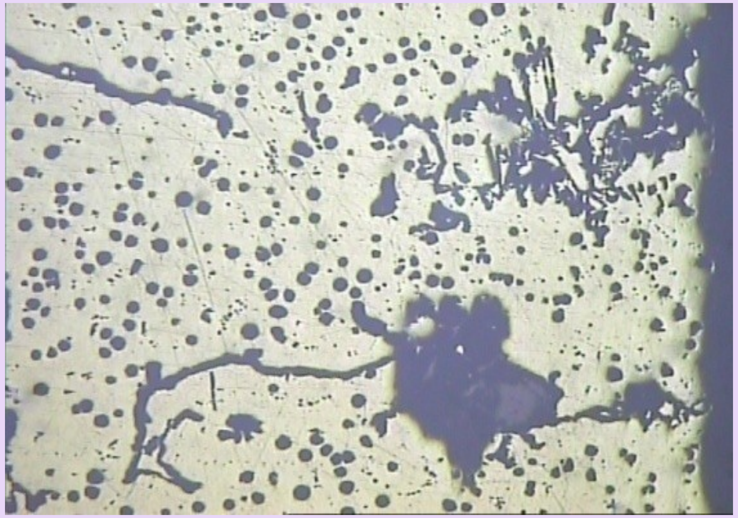
REMEDY

- Improved gatiing system to filter all slag in the gating system itself.
- Selection of filter.
- Too much ladle addtion and stream inoculation to be controlled..
- Improve the slag trap in the metal handling and pouring process.
- Maintain Mn 0.6 to 0.7% for grey

SLAG INCLUSION

OBSERVATION

Cupola slag mainly oxides of potassium, sodium and calcium and bsic in nature. So there is no deterioration of nodules around the slag.



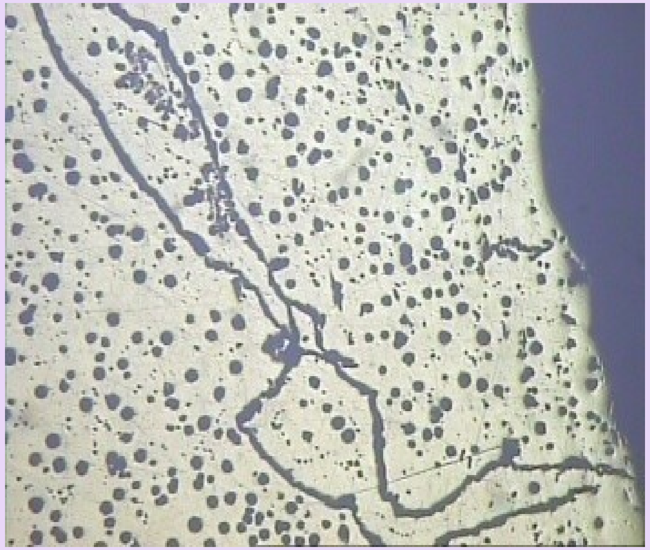
CAUSES

Cupola metal having more liquid slag.

REMEDY

- Slag off the metal before tapping into the ladle, from the ladle before transfer into the pouring furnace, and pouring spout.
- Metal height Mim.200 mm to be maintained in the pouring furnace.
- Metal level in the pouring spout to be maintained maximum(to the reference level) while pouring.
- Gating system have slag trap (choking) before filling the cavity and Filter can be used.

SLAG INCLUSION

OBSERVATIONS The Magnesium silicate slag as spread as stringers without any deterioration of nodules in and around the slag	
CAUSES Slag Inclusion (Dross). Due to turbulence, while filling the cavity , the Mg treated metal forms Magnesium oxide with the available air in the cavity and settle as slag.	**REMEDY** • Ensure the liquid metal filling is quite and through bottom filling. • Maintain Mim.1400°c as pouring Temperature to reduce the dross formation and to bring the dross to the top of the riser. Ensure pressurized gating system so that there is no air gap in the running system during metal filling. Maintain max.R.Mg.0.045%

SLAG INCLUSION

CAUSES:

The fracture surface on micro 100% flake graphite. In the pattern layout the tie rod arm boss at the bottom most point of each cavity and ingate provided above and away from the tie rod arm boss, at ball joint boss. This means that the first metal is most likely to reach and get at the tie rod arm boss and has got very little chance to get mix-up with the rising stream of fresh metal. The first metal of the first mould poured when restarted every time after a delay has got some chance to carry the slag from the spout

REMEDY:

A cold out provided at the tie rod arm boss to collect the first metal

Defect Observation:
Around the slag the Nodularity was detroited and flakes forms was found.

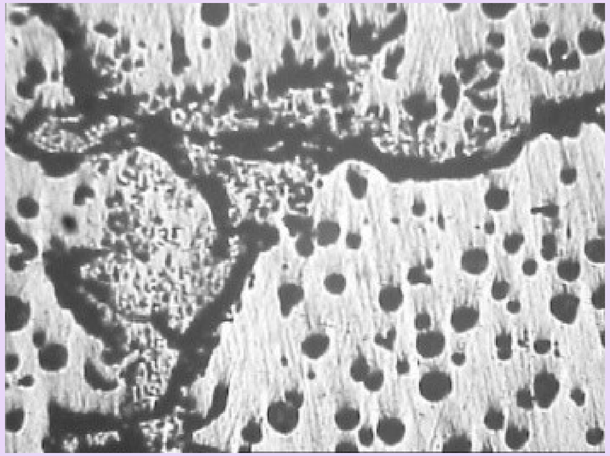
SLAG INCLUSION

More addition into the ladle or stream inoculation which contain calcium form liquid slag.Also wetted inoculation or rusty generate slag.

REMEDY

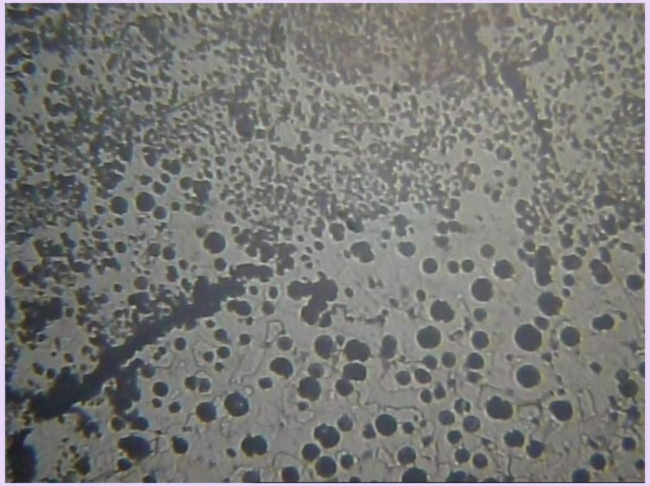
Ladle addition and stream inoculants are free from rust and moisture and free from any other contaminants   Ladle addition and stream inoculation to be controlled to minimum.

SLAG INCLUSION

CAUSES: Slag Inclusion) Poor refractory materials,furnace lining materials ,Ladle lining materials,presspour lining materials and Nozzle materials gets fused and forms slag in the metal .	
OBSERVATIONS: Nodularity not affected around the inclusions. Nodules count was found small in size and more.	REMEDY High Refractory materials to be used

SLAG INCLUSION

.CAUSE.Undisolved ferro-silicon inclusion.Machined surface showing shiny particles. Inoculation and alloying are essential processing and metal preparation stage but excess addition or incomplete dissolution leads to undissolved inoculants particle appear as "shiny" particles .



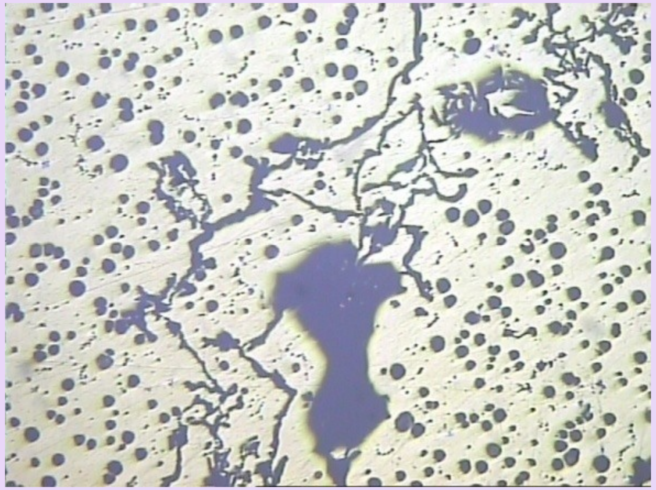
OBSERVATIONS:

Undisolved but disassociated Ferro-silicon precipitated as fine silicon during solidification and after machining it appears as shiny particles.

REMEDY

Stream inoculation is selected carefully with respect to size and composition.
Pouring Temperature Min.1390°C.
Quantity of inoculants is specified

SLAG INCLUSION

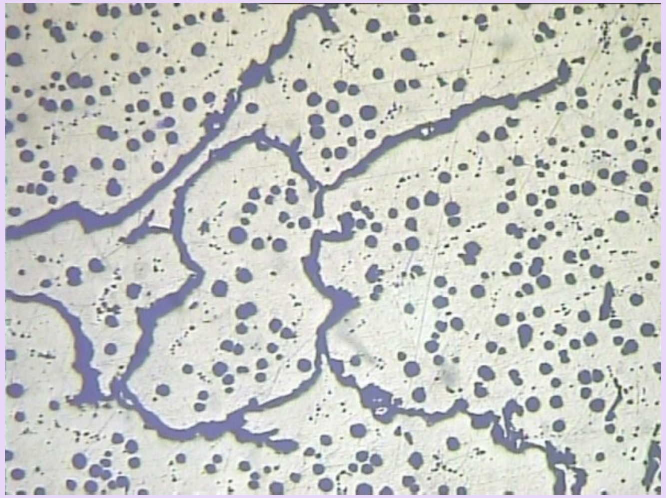
Slag inclusion In Using salt tube to break the heavy blockage of slag , agitated the mass slag into lose and then get entry into the mould	
Avoid the salt tube inserting,launcing with oxygen.Slag off at every stages before transfer into press pour.	This is a combinatiion of MnS,MgS,MgO and MgSiO3 -

SLAG INCLUSIONs

Filter inclusion Wrong selection of filters. Low compressive strength of filters. Filter broken while setting due to mismatch leading to crush.er (broken piece) inclusion or filter gets broken during metal pouring due to insufficient strength of filters	
REMEDY Approved source to be selected Core setter mismatch to be corrected. Filter compressive strength to be ensured	

SLAG INCLUSION

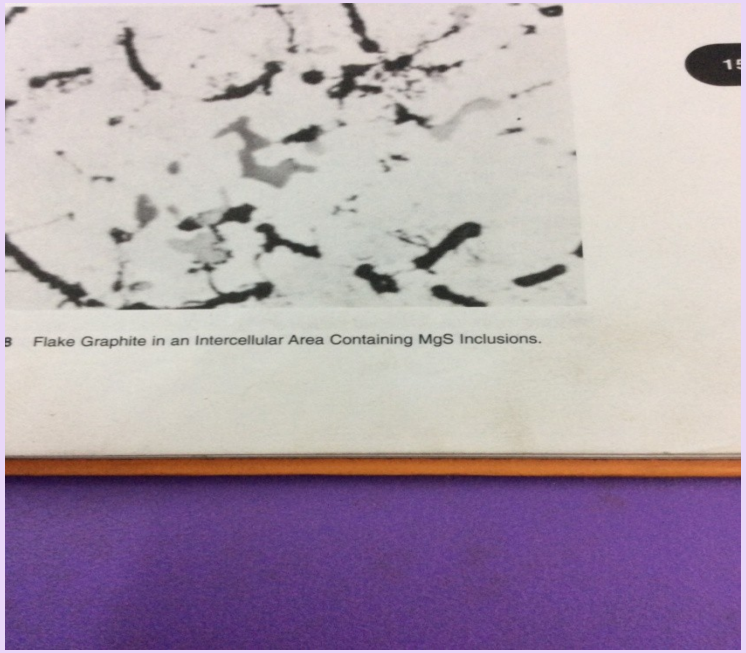
Magnesium Silicate inclusion. This layer type inclusion is MgSio3.As seen in the photo there was little or no chemical reaction between this compound and carbon, hence the absence of a gas envelope in the surroundings. The oxygen laden inclusions disturbed the spherical graphite structure very little. Indeed they seem to have acted as nuclei for a relatively large number of spheroids in the immediate neighborhood. In fact the majority of the inclusions exhibits a graphite layer next to itself indicating again a graphite nucleating effect. This is due to poor gating system leads



Observation:	REMEDY
Oxide inclusion. No Nodularity derioration.Nodule count is more than other locations. Nodule size is small.This slag appear as sting in irregular shape	Improve the gating system so as no turbulance. Control the R.Mg to max.0.05%. Ensure slag off before pouring into moulds and maintaining min.200 mm metal height in the discharging spout. While pouring fill the pouring cup within two secs. And maintain the level till pouring

SLAG INCLUSION

Intercellular graphite inclusions. Ductile iron freezes with a cellular sructure.The last iron to freeze between the cells is the richest in elements which cause degenerated graphite,carbides or other non metallic inclusions.The inclusions are caused by high level of tramp elements and can be very detrimental to mechanical properties.ntercellular Flake graphite inclusion..



REMEDY

-
Improve the gating system so as no turbulence, Control the Magnesium to max.0.05%.Ensure slag off before pouring into moulds. Control the tramp elements from the source itself.

SLAG INCLUSION

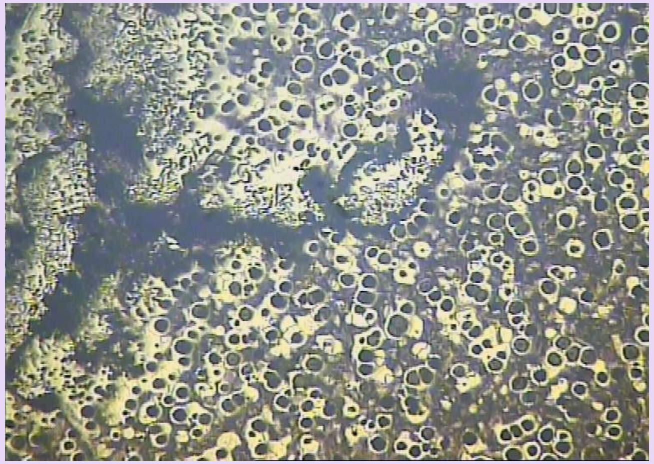
CAUSE Slag Inclusion: Erosion of Nozzle (Liquid Slag) leads to slag inclusion. Low refractoriness material of Nozzle or too high pouring Temperatue or presence of acidic in nature / elements like Sulphur presence in the metal.(Most probaply in Grey Iron Castings)	
•REMEDY: Use high refractoriness material for nozzle,control pouring temperaturre,and periodic replacement of Nozzles	

SLAG INCLUSION

S

PROBLEM

•conversion Grey iron to S.G.iron.That means high sulphur content iron in the press pour while conversion form MgS and MnS that may get entry into the cavity during pouring.



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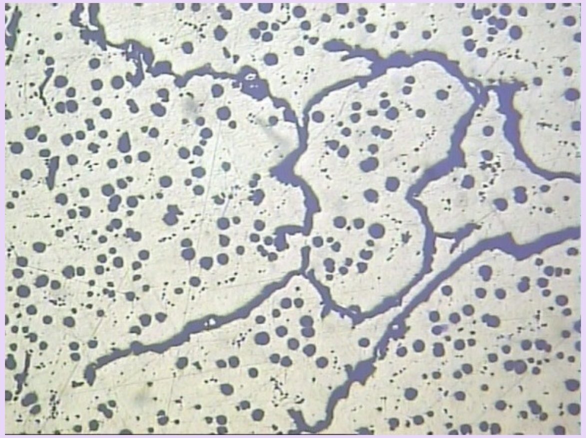
During conversion self items to be produced at least 3 treatment with 20 to 25% more Mg to dilute the Sulphur present in the metal and inside the ladle to saturate with MgO so as Mg. fading will be extended

SLAG INCLUSION

Slag Inclusion (Dross)
Convertor slag . Due to pure Mg. treatment ,the sulphur and the oxygen in the metal react with Mg. and form MgS,MgO,MgSiO3.These are liquid slag and chances are there to get entry into the mould cavity irrespective to filter and gating system.



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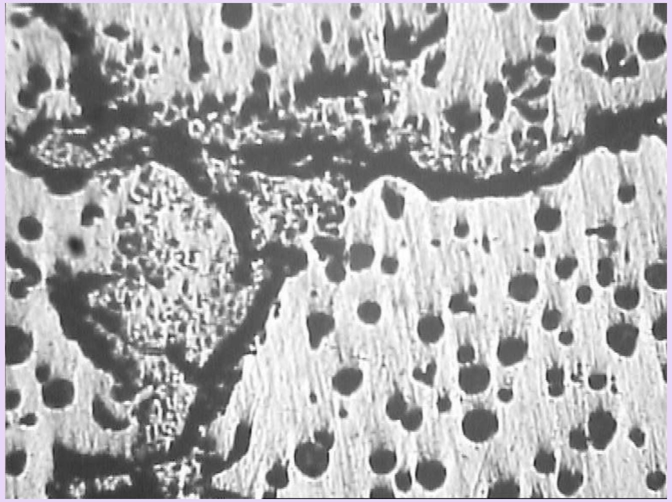
SLAG INCLUSION

S

Slag Inclusion
Conversion grey iron to sg iron .That means high sulphur content and Manganese content in the press pour while conversion form MgS and MnS that may get entry into the cavity during pouring. Poking with steel rod when spout gets blocked or lancing with oxygen generate MgO,MgSiO3 slag.



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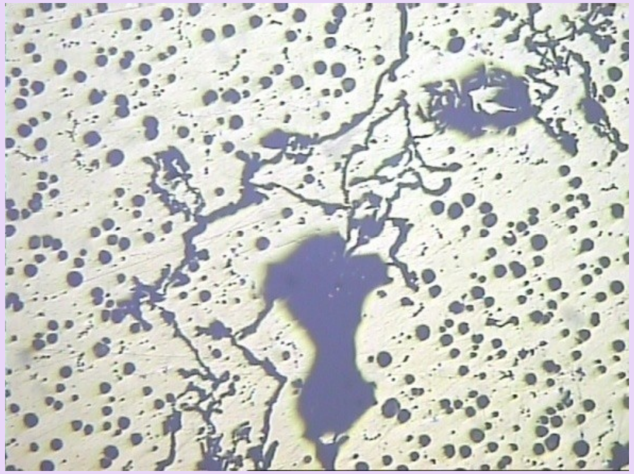
During conversion self items or suitable parts to be produced at least 3 treatment with 20 to 25% more Mg to dilute the Sulphur ,chromium etc.

M

1 Shrinkage or porosity in the hub centre which was found isolated section and it cannot be feed fron OD.

SLAG INCLUSION

Slag Inclusion
Using salt tube to break the heavy blockage of slag , agitated the mass slag into loose and then get entry into the mould



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Ensure the Slag off at every stages before transfer into press pour.and salt tube inserting,launcing with oxygen are to be controlled.

SLAG INCLUSION

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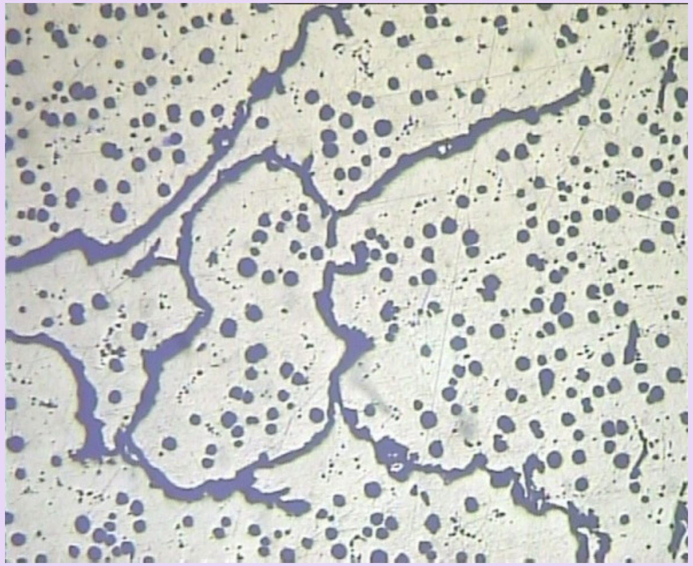

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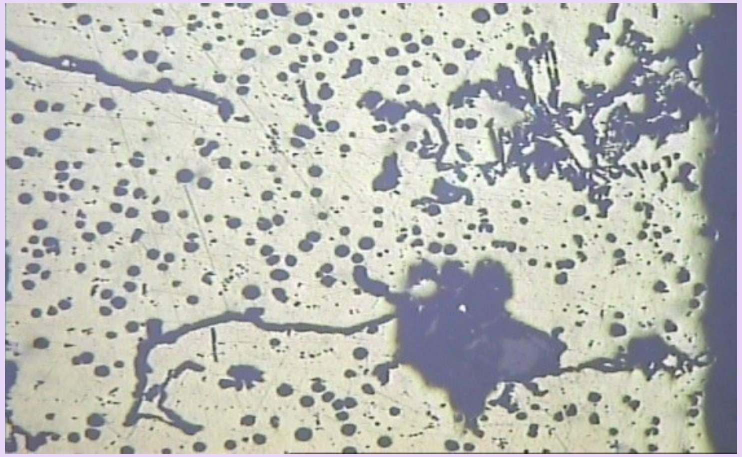
Improve the gating system so as no turbulence, Control the Magnesium to max.0.05%.Ensure slag off before pouring into moulds.

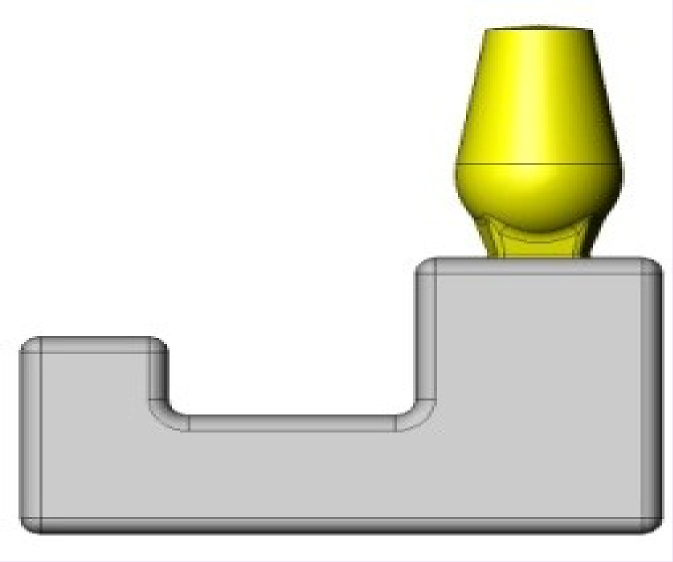
SLAG INCLUSION

. Slag inclusion Cupola metal having more liquid slag	 .
	Slag off the metal before tapping into the ladle, from the ladle before transfer into the pouring furnace, and pouring spout. Spout height Mim.200 mm to be maintained

SHRINKAGE / POROSITY DEFECTS

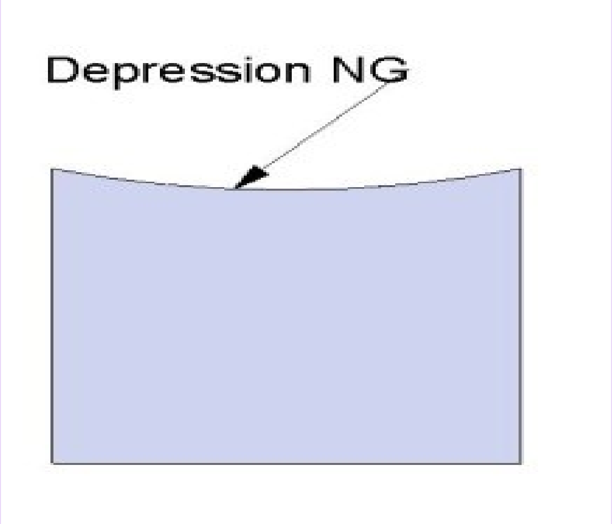
•Riser Neck Shrinkage at the ABS location • Riser at the ABS has the limitation for the neck area due to small space available	
Shift the riser location to the other area	

SHRINKAGE / POROSITY DEFECTS

Sh Shrinkage at junction Insufficient feeder volume	.
	Feeder volume increased

SHRINKAGE / POROSITY DEFECTS

Depression like shrinkage defects by premature freezing of the riser or the casting - riser contact area.
The defect appears at the heaviest section which remains hot longest during solidification.



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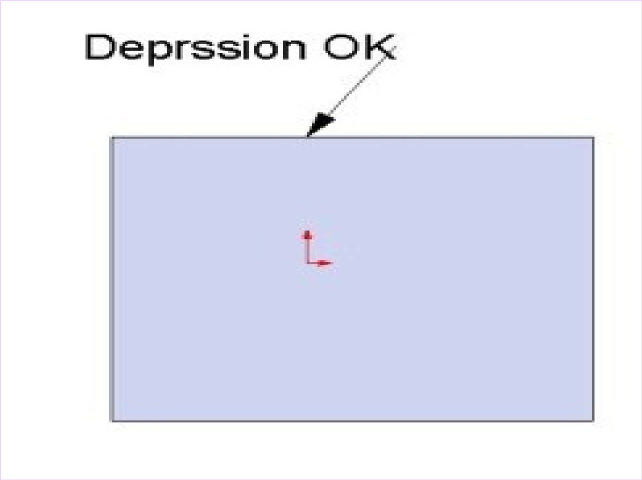
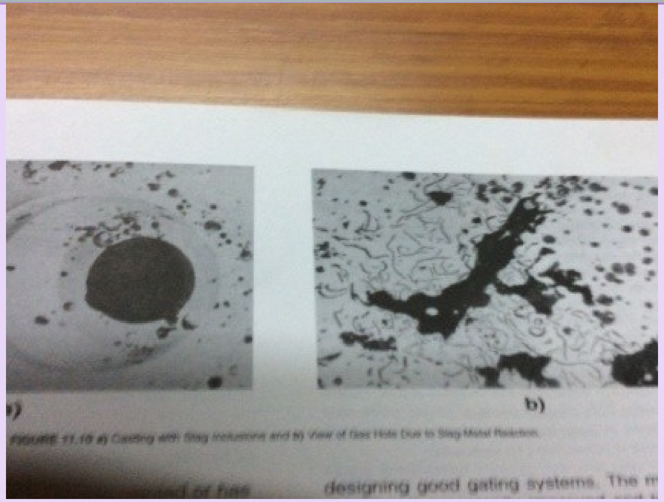
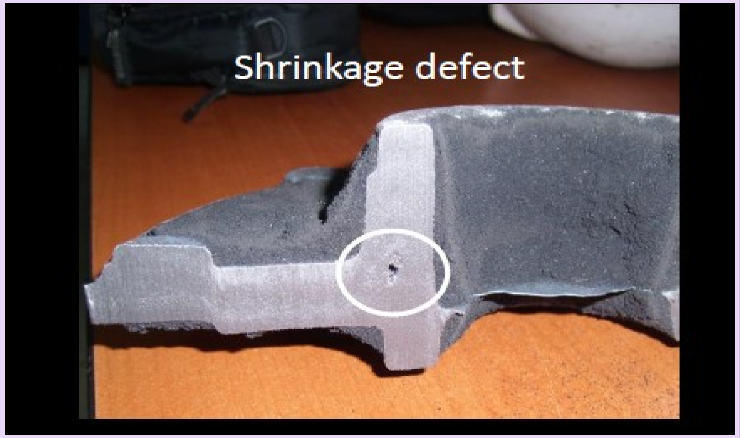


Either to increase the riser contact modulus, the riser size or prevent the top of the riser from freezing.

SHRINKAGE / POROSITY DEFECTS

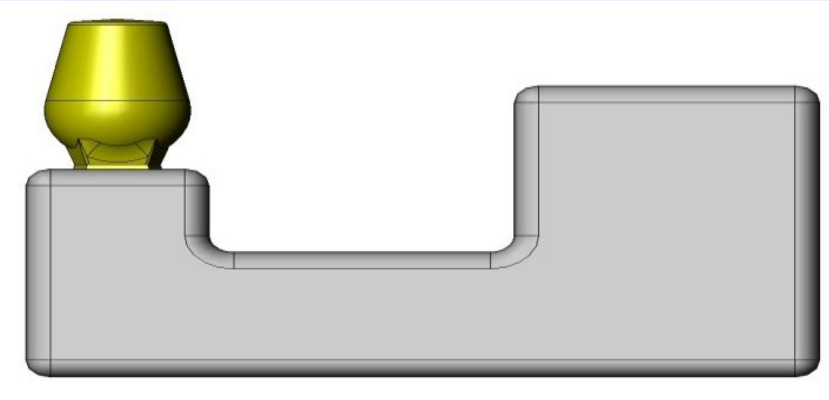
If there is a considsesrable heat concentration in one or more segments of the casting (hot spot) the secondary shrinkage may appear in the form of holes rather than porosity.	. 
	Modifying the gating system so as to make uniform heat concentration. Improve mould hardness.

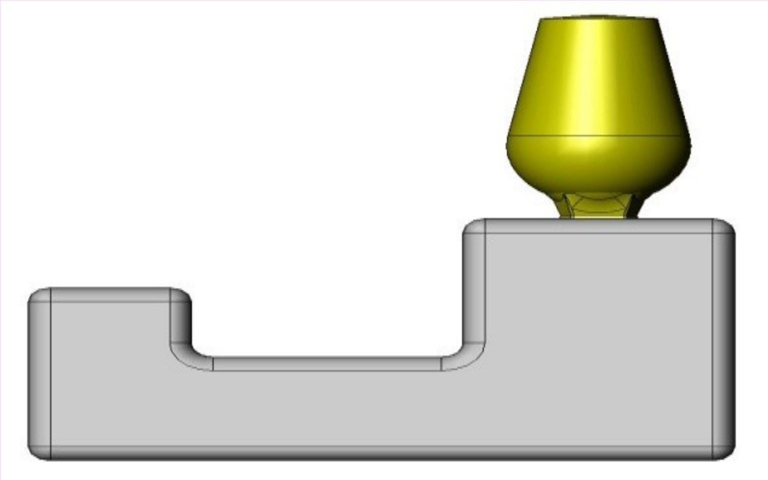
SHRINKAGE / POROSITY DEFECTS

Shrinkage or porosity due to isolated heavy sectioins	
	Control the chemistry free from contamination. Control the pouring Temperature. Slightly modify the section so as to make the section more or less uniform

SHRINKAGE / POROSITY DEFECTS

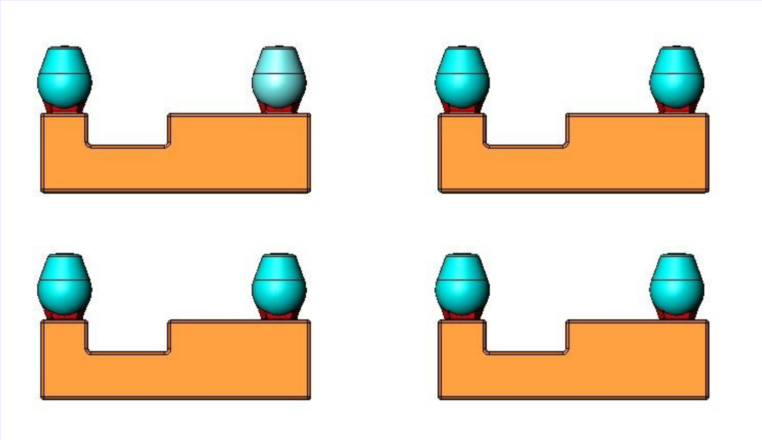
Selection of feeder location wrong





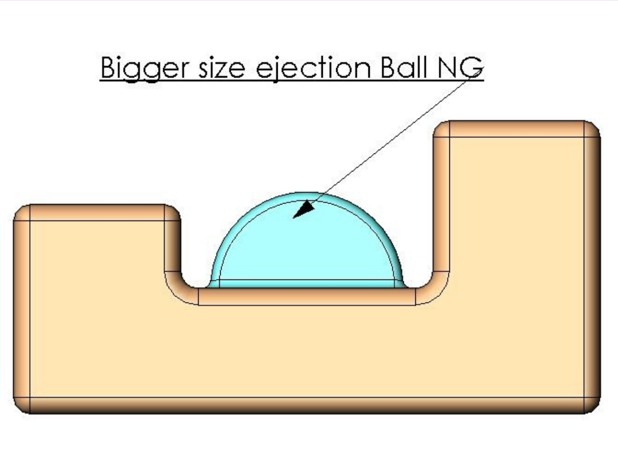
Orientation changed for better feeding

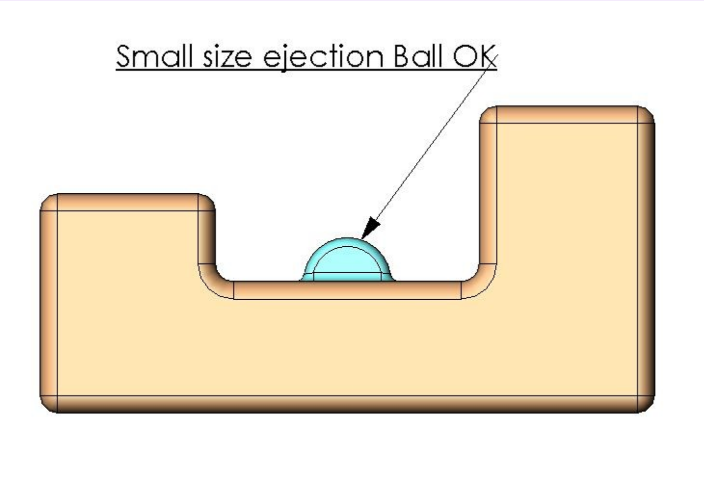
SHRINKAGE / POROSITY DEFECTS

Top cavities having more or less no Ferro-static height and easily subject to process variation like pouring temperature, pouring time etc.,leading to this type of shrinkage.	
	Pouring cup diameter increased. Monitoring of process parameters like chemical composition, pouring temperature, pouring time and mould hardness etc.

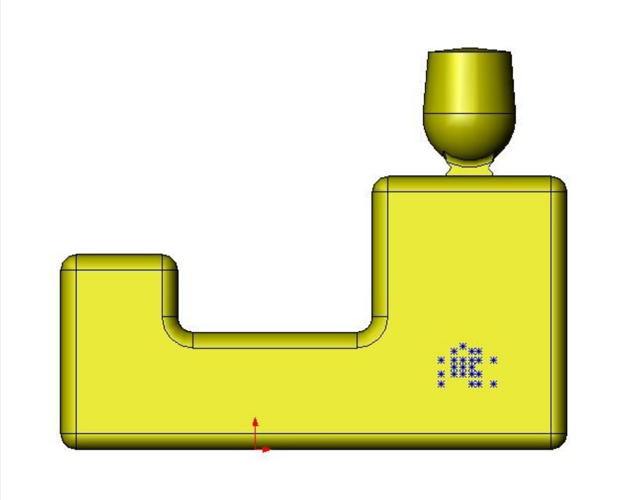
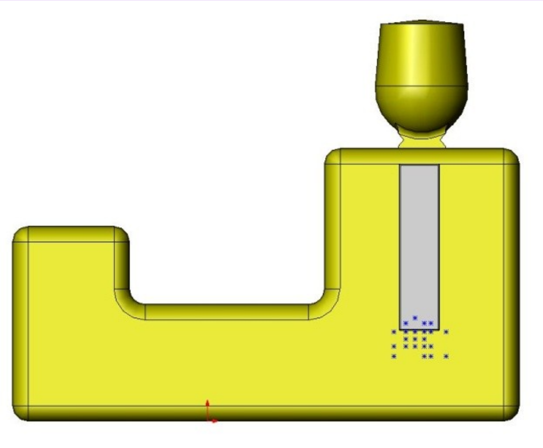
SHRINKAGE / POROSITY DEFECTS

Since bigger size ejection ball provision leading to less sand thickness keeping the location hot during solidification.



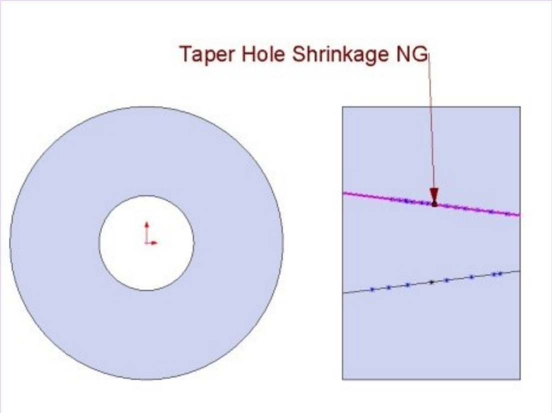


Bigger ejection ball is replaced by a small one

Porosity (secondary shrinkage)on the arms reducing Tensile Strength and elongation Insufficient feeding and not uniform cooling	
•Connectivity improvement from riser neck to porosity affected zone. •Hot or cold riser provided at the boss.	

Shrinkage or porosity

Tapper Hole porosity
.Insufficient feeding or not uniform cooling due to isolated section.
Heavy flash around the boss.



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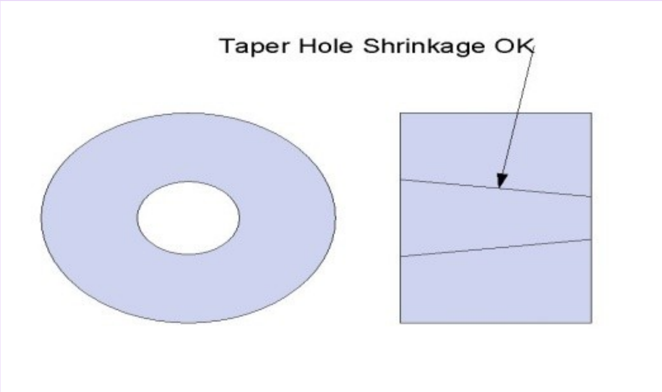
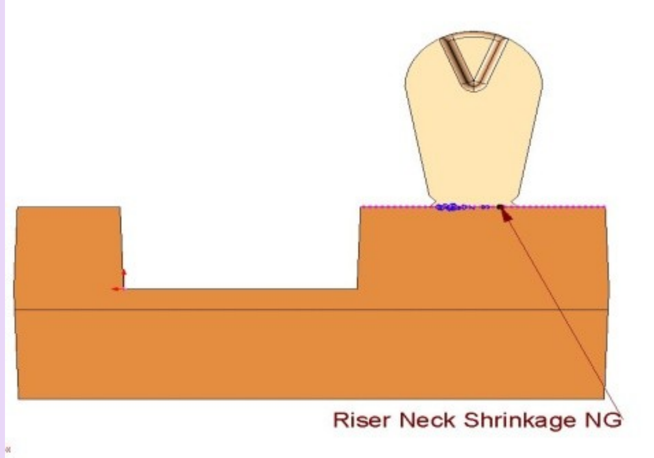
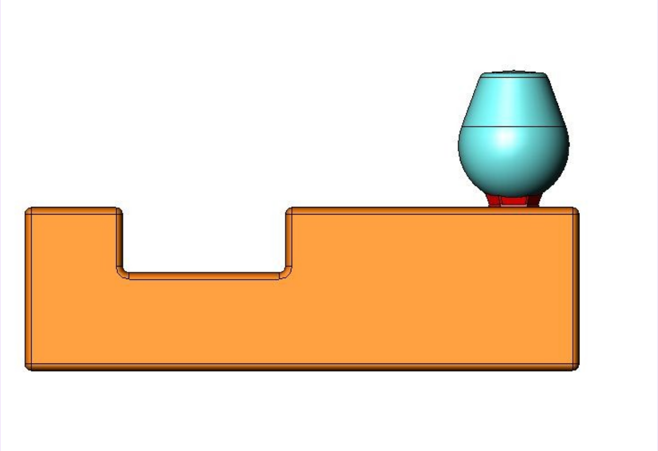


, Gatiing modified.
Provision of hot or cold riser at the tie rod arm boss.

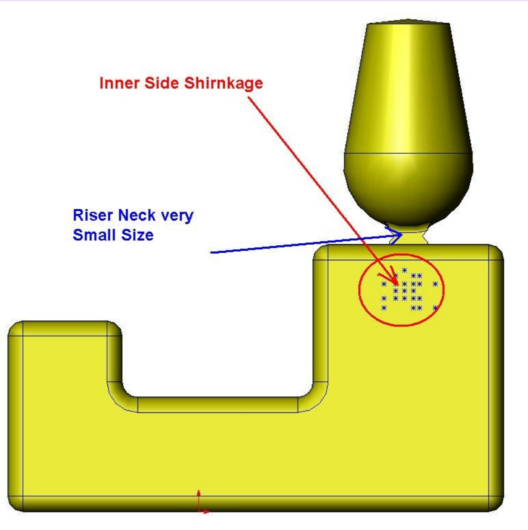
Shrinkage or porosity

Riser neck shrinkage Too large riser neck than required. Soft ramming around the neck due to narrow pockets. Hot zone around the neck make neck solidification slow.	 .
	Riser neck AREA TO REDUCED to the process variation. Improve air vents around the neck for better ramming. Reduce hot zone around the neck.

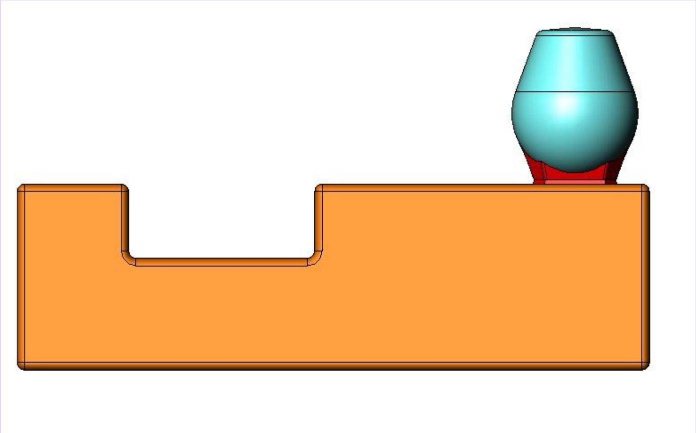
SHRINKAGE OR POROSITY

Internal shrinkage below riser necK

Too small riser neck.
Low pouring temperature.
Excess residual Mg.
Low carbon equivalent



- Riser neck optimized.
- Control of residual Mg. and carbon equivalent



SHRINKAGE OR POROSITY

Shrinkage: at the junction of arms around the bore where feeder is not feasible.	
In such cases a sleeve is provided at the bore based on the shrinkage location and section thickness of the castings so as to shift the shrinkage to the sleeve and vanished in machining or shift the shrinkage inside the arm so as not revealed in machining.	

Shrinkage or porosity

Porosity observed below the cold risers.	.
Increase the riser neck area based on the shrinkage level.	

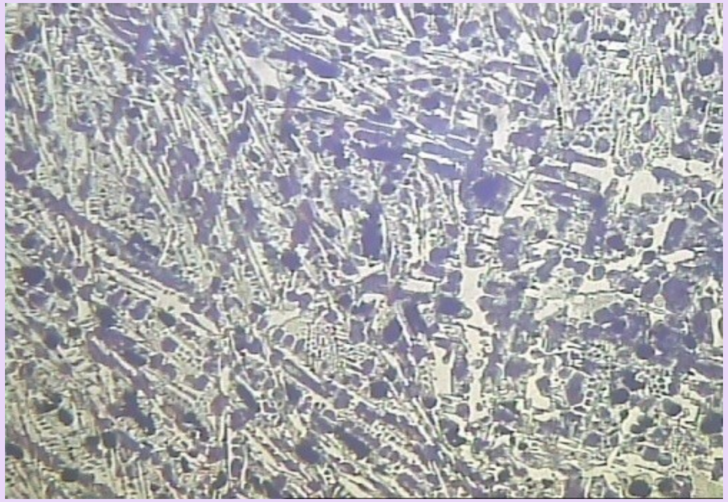
Shrinkage or porosity

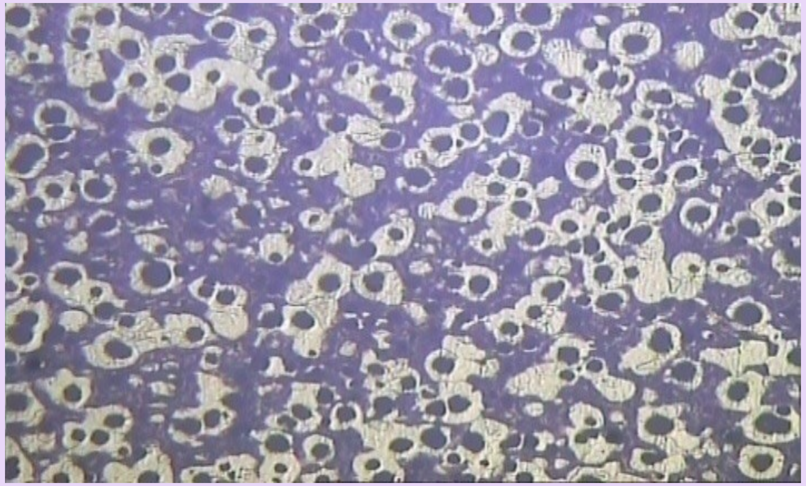
Differential cases where we cannot take the parting line across the part due to flower or ribs on the DD gear side the porosity revealed on the OD or ID after machining on the speedometer side or on the DD gear side or both sides.	.
This type of isolated sections we cannot eliminate the porosity but we can minimize the porosity by controlling the process parameters and we can shift the porosity so as not to reveal after machining by providing chills. By improving the metallurgical quality of metal we can <u>minimize</u> the porosity problems.	

CARBIDE PROBLEM

Fully carbide in the casting

Inoculant (Ferro-siiicon powder)not responding to Nucleation due to low Aluminium content 0.01 to 0.05%(special grade for steel)





Normal grade Ferro-Silicon powder contains 1.0 to 1.2% Aluminium was used.

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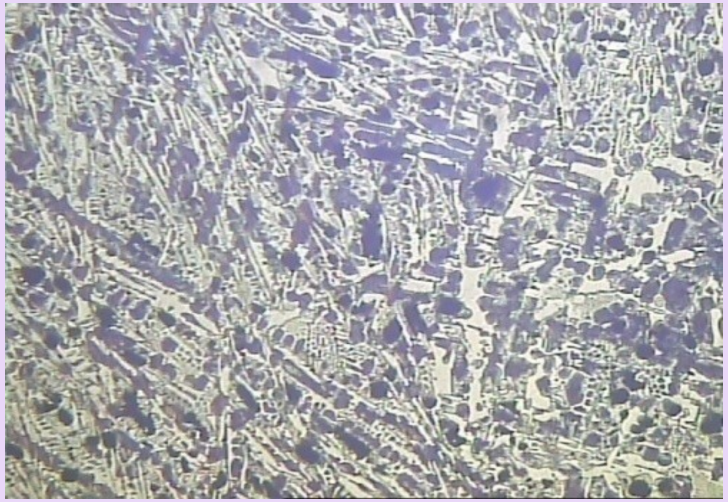
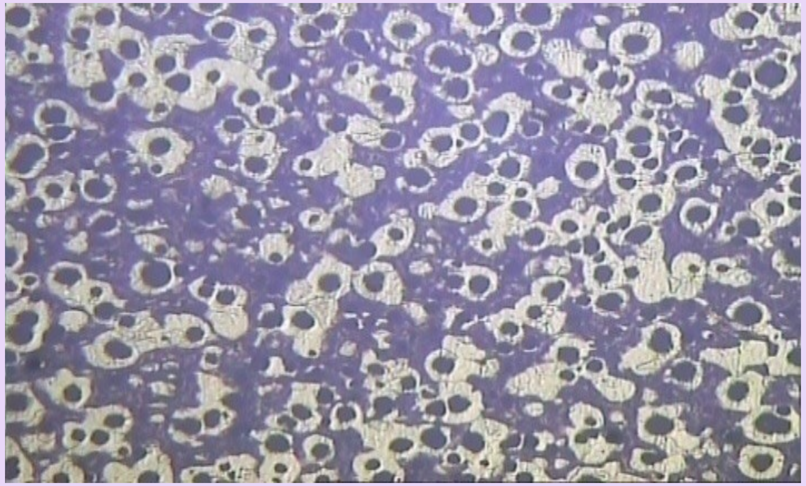
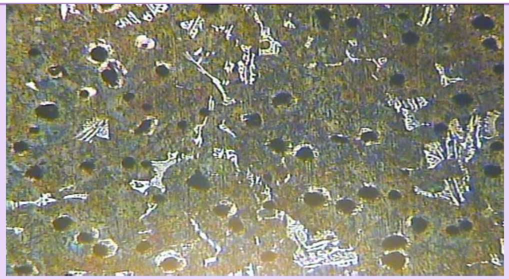
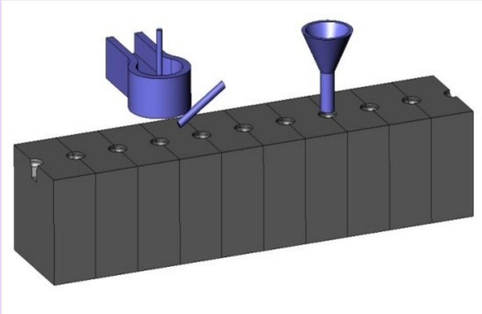
Fully carbide in the casting Inoculant (Ferro-siiicon powder)not responding to Nucleation due to low Aluminium content 0.01 to 0.05%(special grade for steel)	
	Normal grade Ferro-Silicon powder contains 1.0 to 1.2% Aluminium was used.

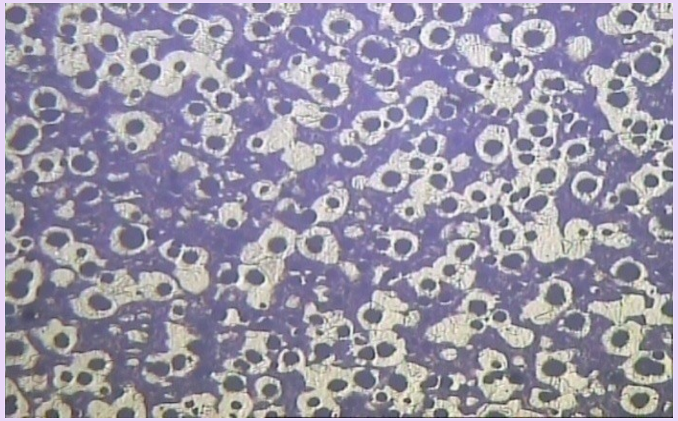
CARBIDE PROBLEM

<u>Presence of carbides on the castings</u>



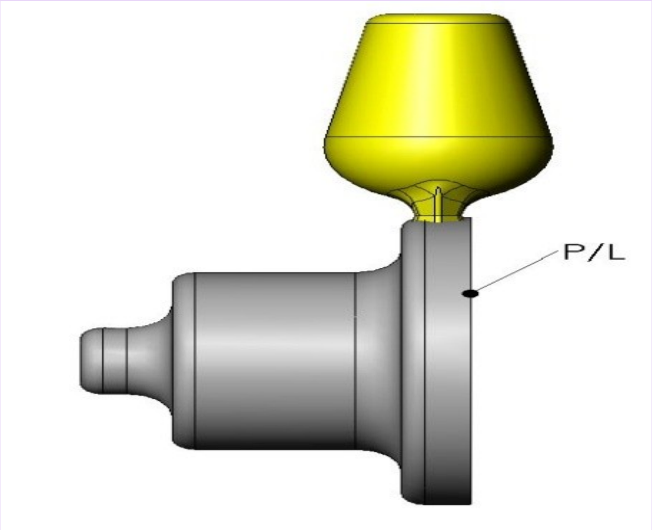
Since stream inoculation synchronized with joystick which is used for opening the nozzle to pour liquid metal into moulds. Nozzle leak metal did not initiate the pouring or inoculation to the first metal.



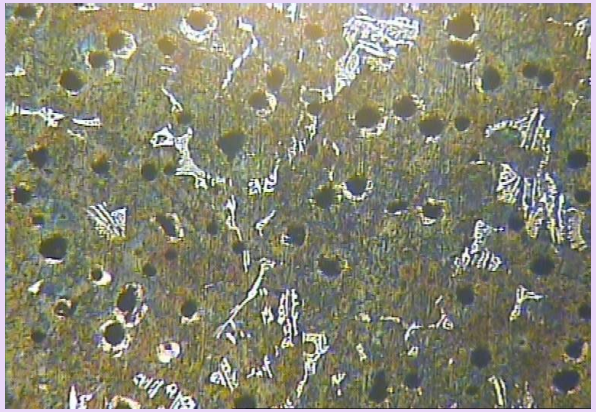


Continuous inoculation and
In mould Inoculation introduced

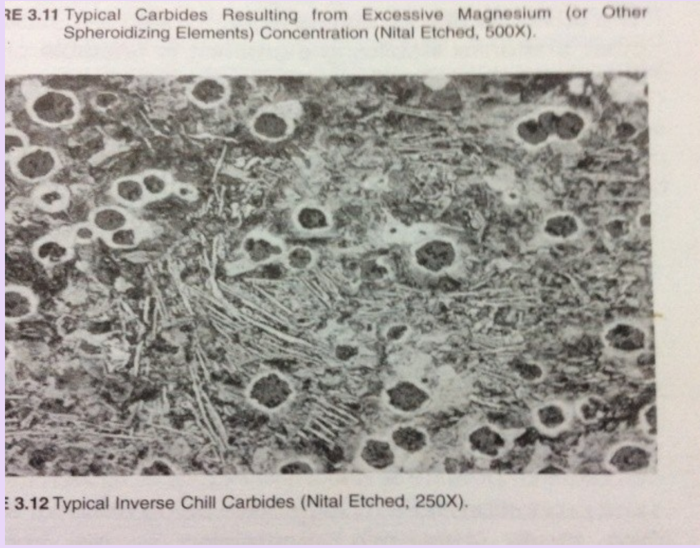
CARBIDE PROBLEM

Presence of carbides in the speed of meter Hub I.D That particular Hub I.D gets filled lastly with first entry metal (metals gets cold) and feeding distance is more from the feeder.	
	Fast pouring ensured by reducing the pouring time from(10 to 11 Secs.) to (7 to 8 Secs.). **Metal \quallity to be ensured**

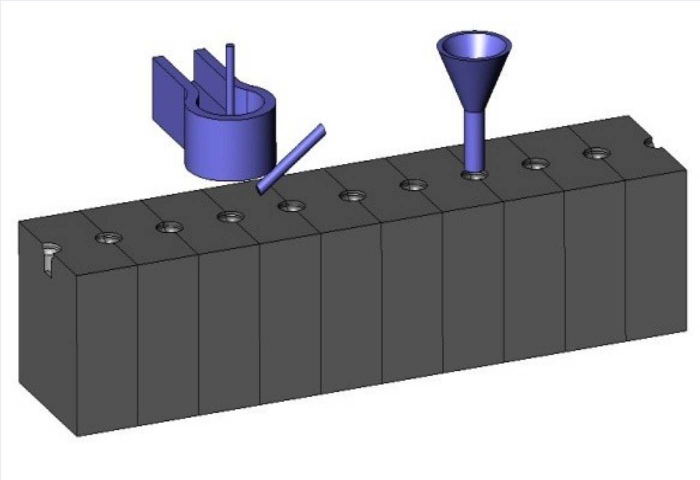
CARBIDE PROBLEM

Presence of carbides on the castings Excess metal transferred into press pour filled the discharging spout and then filled the mould cavity without imitating pouring. and hence no inoculation.	
•A small tank (3 to 5 Kgms capacity) on the mould introduced to collect the first metal	.

CARBIDE PROBLEM

Inverse Chill. Presence of carbides in the thermal centre of the castings. Excess Residual Magnesium or Manganese,Cromium,Vanadium etc. accompanied with high pouring Temperature more than 1410°C at the heavy sections.	
	Control of Residual Magnesium and Manganese,Cromium Vanadium etc. and pouring Temperature Max.1400°C And improve the inoculation process & quality of inoculant.

CARBIDE PROBLEM

Presence of Carbides on the castings Inoculation pipe blockage partially due to spill metal during pouring.	
	One Quality control person specifically assigned to monitor inoculation continuously in addition to the review of the pouring recording C.D.

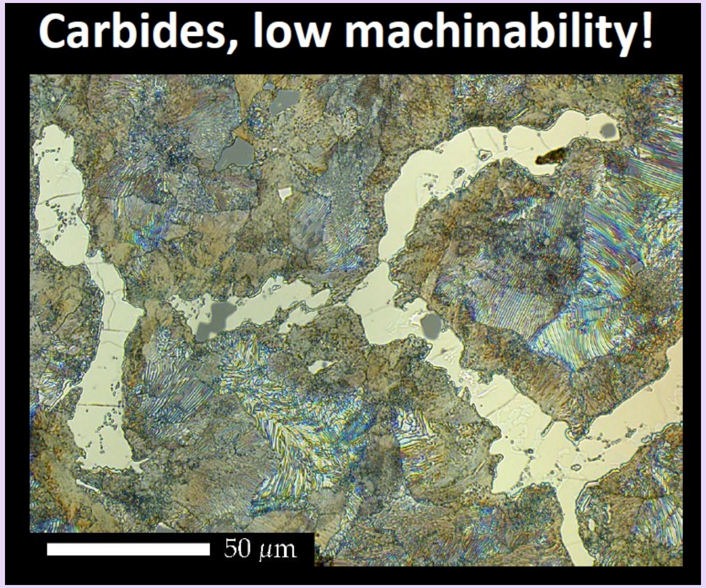
CARBIDE PROBLEM

Precence of carbide at the bottom most boss

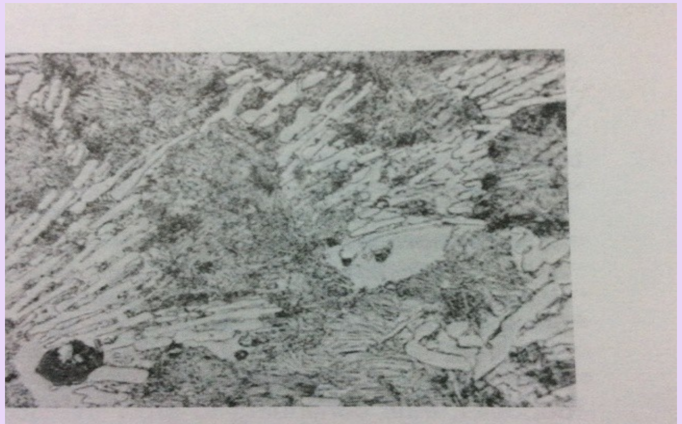
Even though the operation of joystick initiate the inoculation 1.3 Seconds earlier before the metal starts filling Nozzle leakage metal start filling the mould without initiating the inoculation.

In mould inoculation introduced first and then stream inoculation is made continuously.

CARBIDE PROBLEM

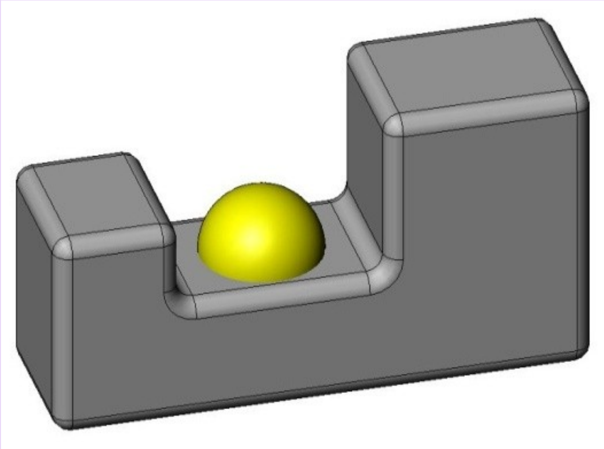
precence of carbides. Machinablity problem Excess residual Magnesium,or Manganese or cromium and low silicon coonjtent	
	Convertor chamber to be kept clean to avoid excess Mg consumption.,Control of other carbide promoting elements like cromium,Manganese etc. And control of silicon content

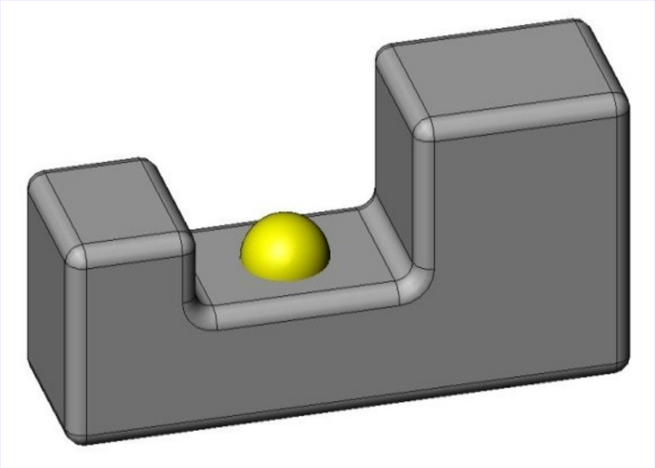
CARBIDE PROBLEM

<u>Presence of carbides on the castings</u> Excess of residual Mg.due to transferred metal not mixing uniformly because of excess floating slag and / or very low level metal in the presspour unable to get average.	 Carbides Resulting from Excessive Magnesium (or Other ...idizing Elements) Concentration (Nital Etched, 500X)
After transfer pressurizing and vent the metal so as to mix properly. Periodic vat cleaning or vat replacing will be planned	

SAND INCLUSIONS

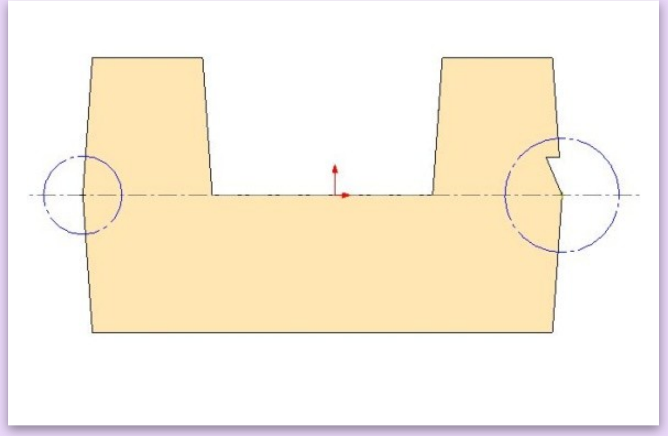
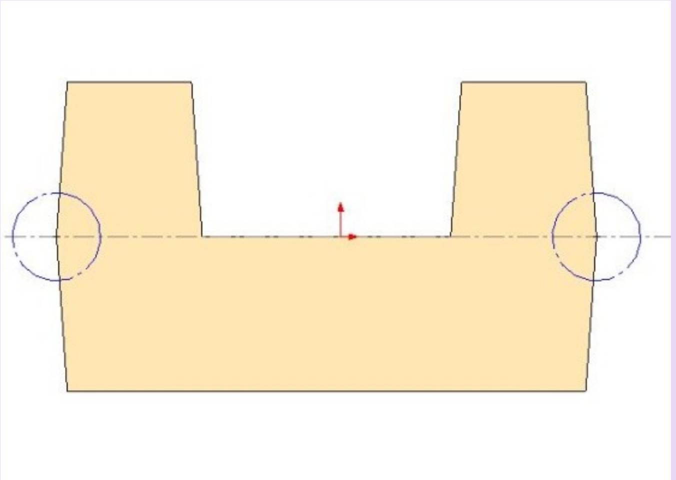
Wrong selection of bigger size ejection ball leaving less wall thickness of sand get sheated up quickly and eroded



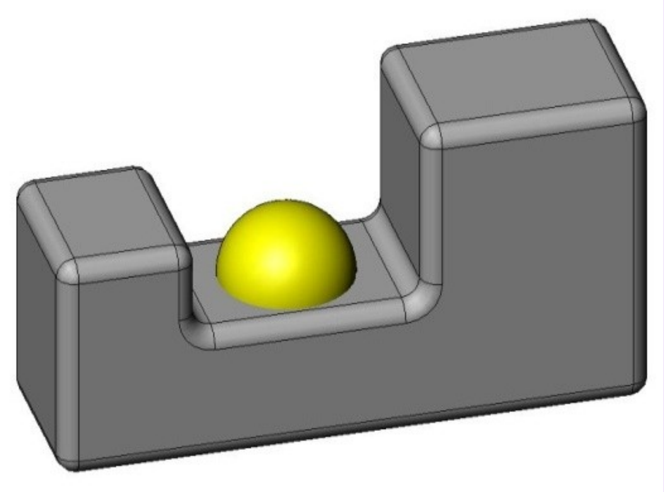
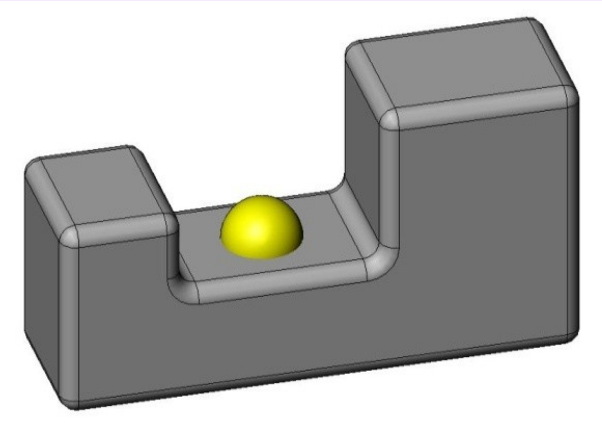


_Correct selection of ejection ball and enough sand thickness ensured to avoid quick heating and erosion.

SAND INCLUSIONS

Sand inclusion due to tooling under cut .	
	Tooling under cut corrected

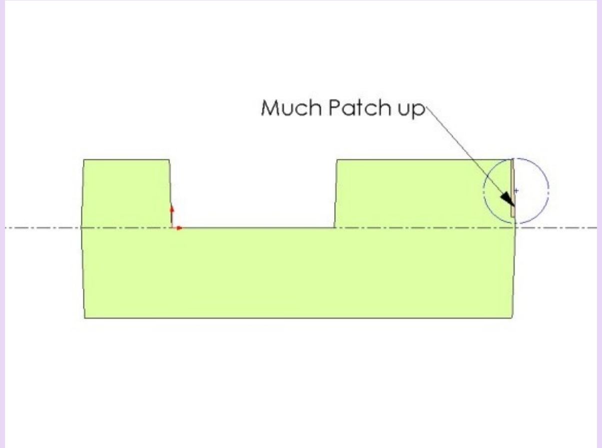
SAND INCLUSIONS

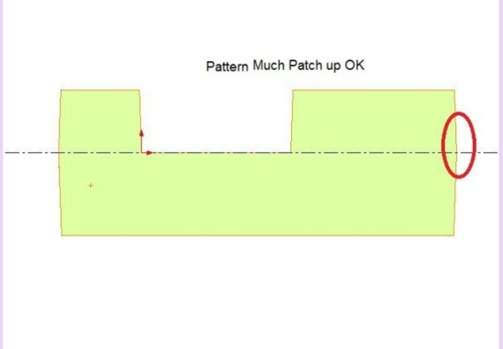
Wrong selection of bigger size ejection ball leaving less sand thicknes	
	Correct selection of ejection ball leaving more sand thickness

SAND INCLUSIONS

CAUSE

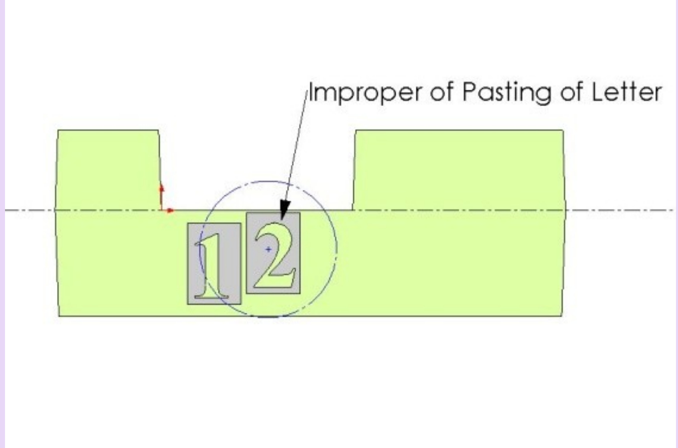
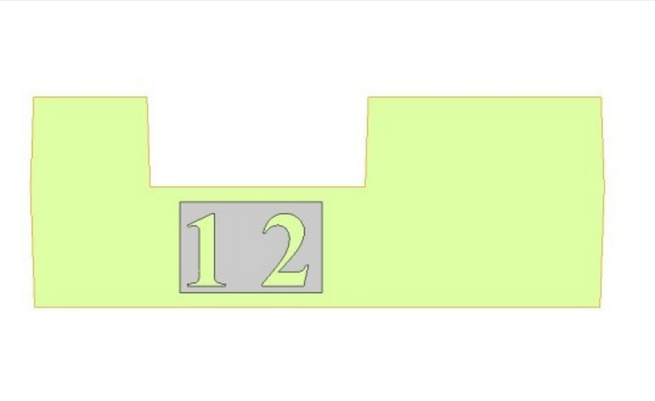
Too much patch-up on the tooling



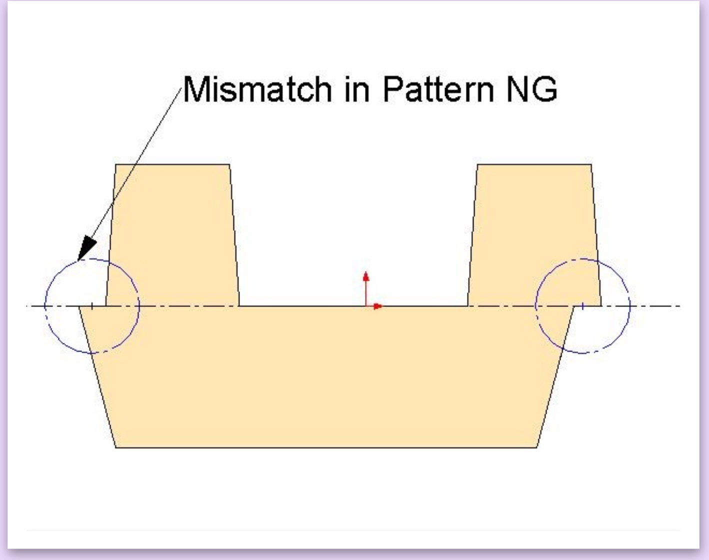
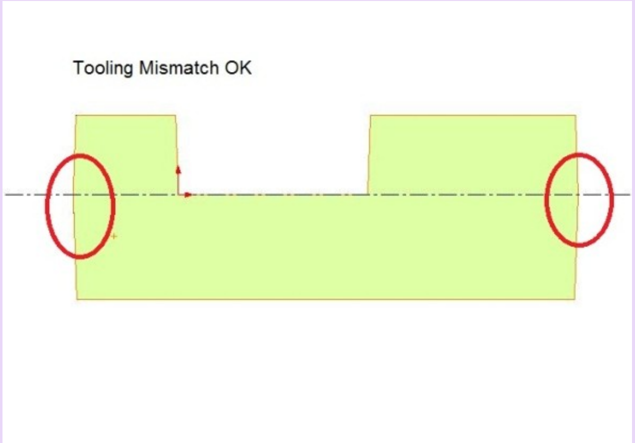


Minimise the patch up wpork on the tooling.
After method prooving Cromium or Nickel plating can be done.

SAND INCLUSIONS

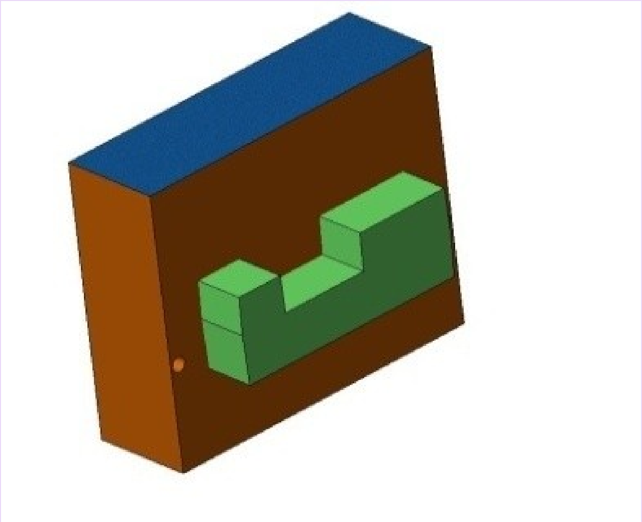
Improper pasting of letters.	
	Proper pasting of letters.

SAND INCLUSIONS

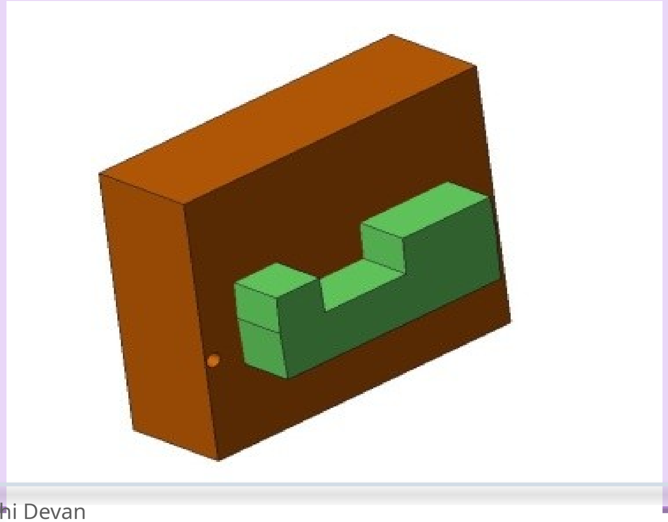
Mismatch on the tooling	
	Mismatch corrected

SAND INCLUSIONS

Pattern plate top worn-out

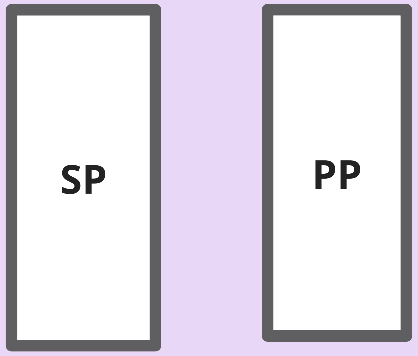
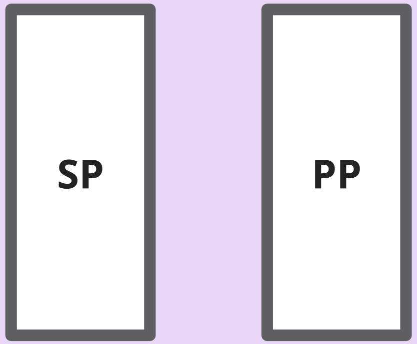


Pattern plate top worn-out



Pattern plate top height corrected by milling and replacing a strip or replacing the pattern plate.

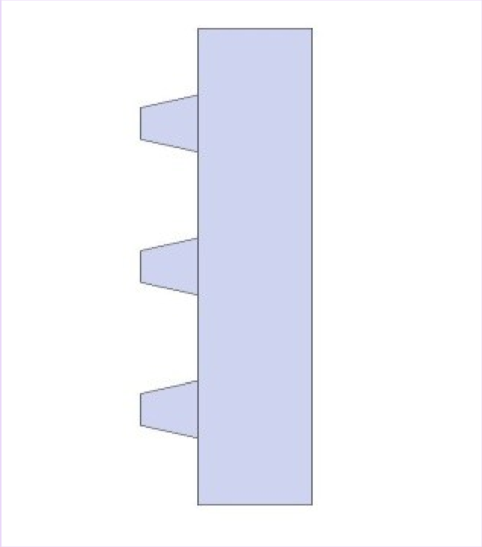
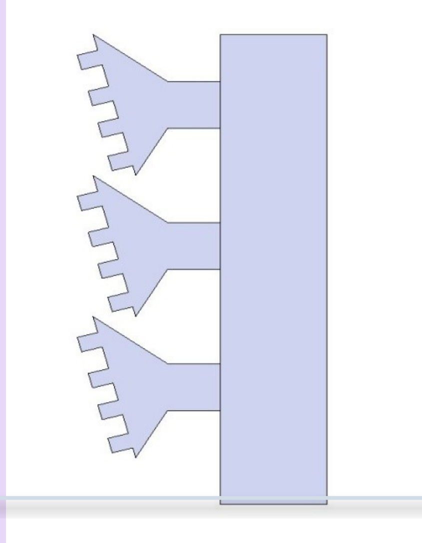
SAND INCLUSIONS

Pattern plate face parallelism out of range or due to heater plate face uneven worn-out	
•. 	Pattern plate parallelism corrected and heater plate replacement by new one.

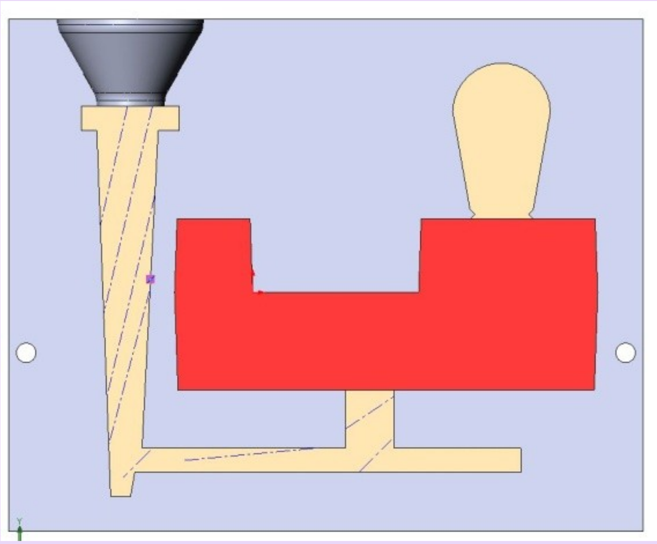
SAND INCLUSIONS

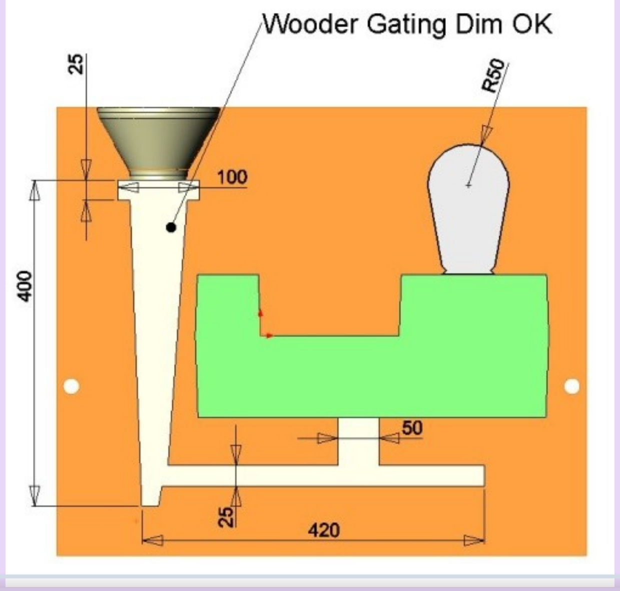
Narrow corner in tooling or deep pockets leads to soft ramming.	
Corner radius and air vents for improving the ramming will improve the ramming.	

SAND INCLUSIONS

Excess air pressure is used as air cleaning and air nozzle not designed properly.	
	Air pressure controlled. Standard nozzle to be used

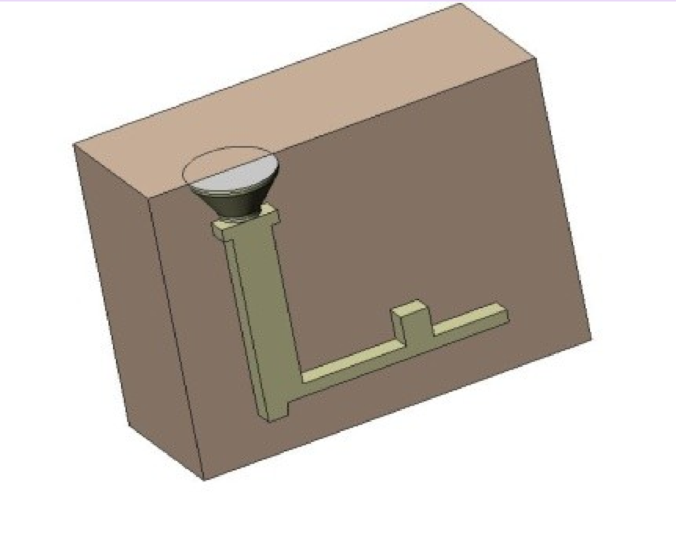
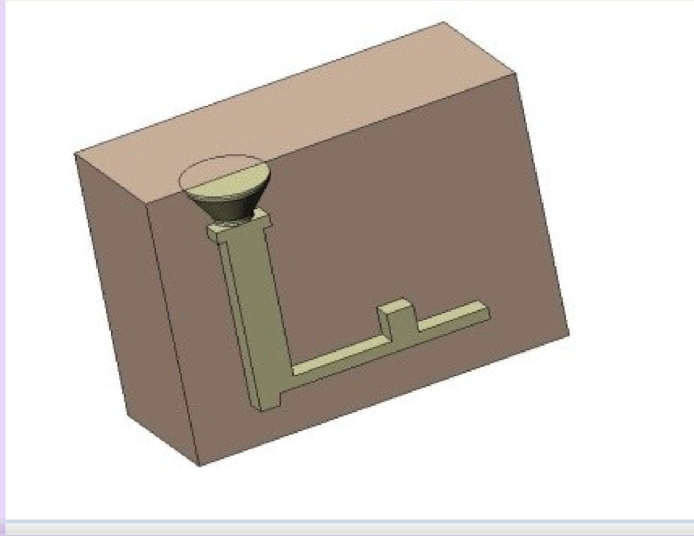
Worn-out wooden gating system haviing line maarks and hence sand sticking.



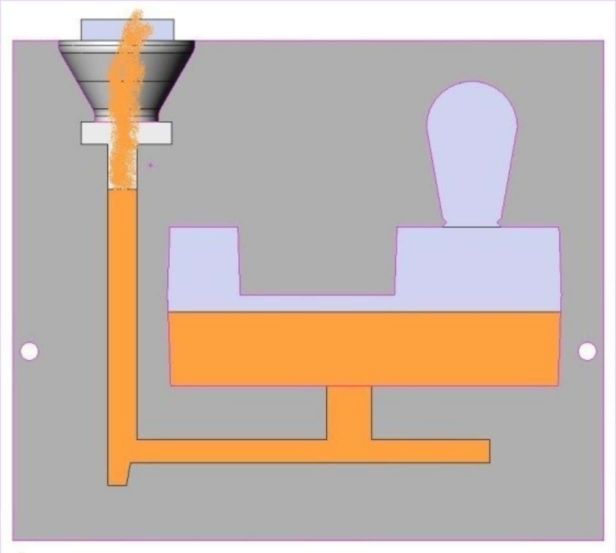
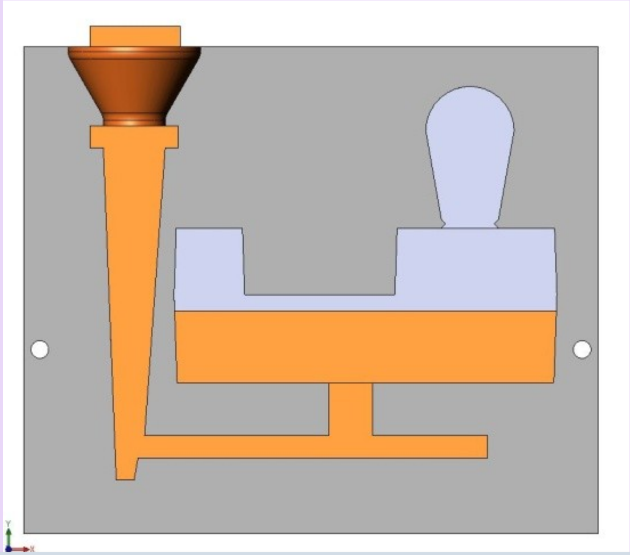


Wooden gating system is replaced by metal.

SAND INCLUSIONS

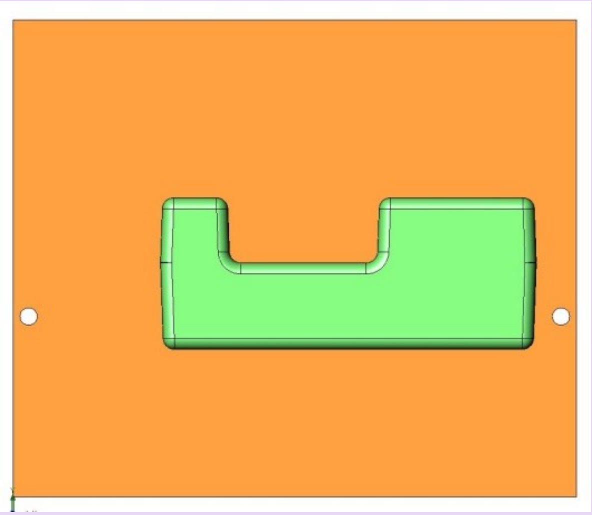
Pouring cup top worn-out due to sand shooting directly hit on it.	
	<u>Periodical change of pouring cup or top 10 mm only replaced.</u>

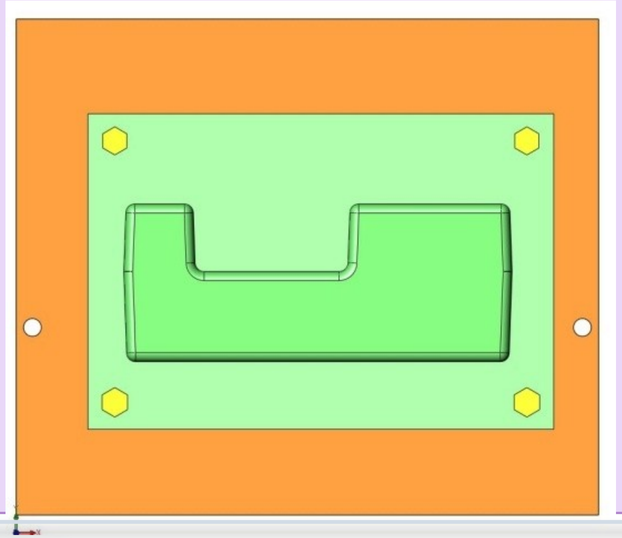
SAND INCLUSIONS

The gating system is not kept full hence not allowing the sand particles to float to the upper surface of pouring cup and runner. Incorrectly sized gating area make it impossible to keep the gating system continuously filled with metal. Too high content of inactive fines makes gthe sand weak and brittle. Sand tears off or crack during molding	
	Standard gating ratio to be followed

SAND INCLUSIONS

In case of separate tooling tool mounting hole loosened.



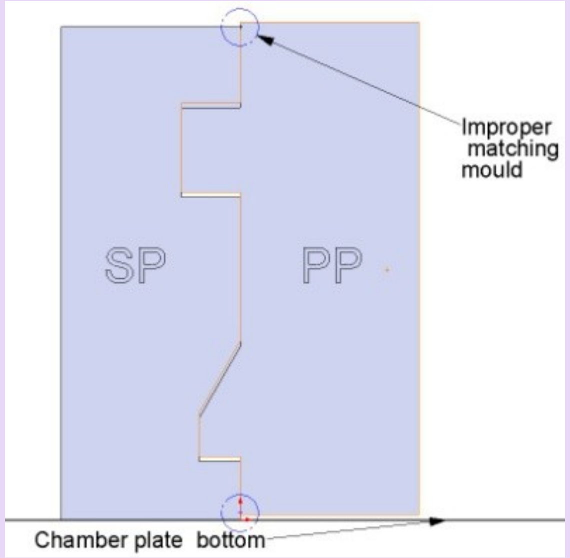
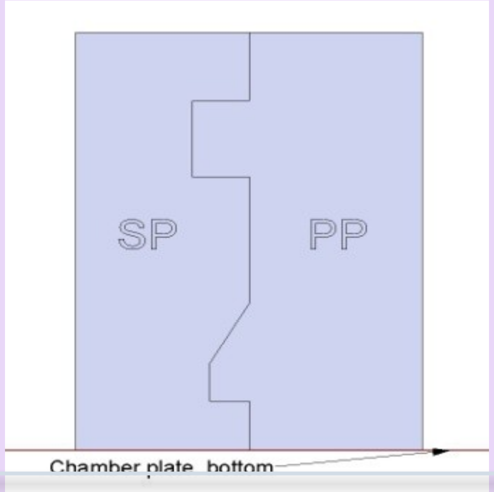


Tightened the bolts & nuts.If possible provide lock nuts.

SAND INCLUSION

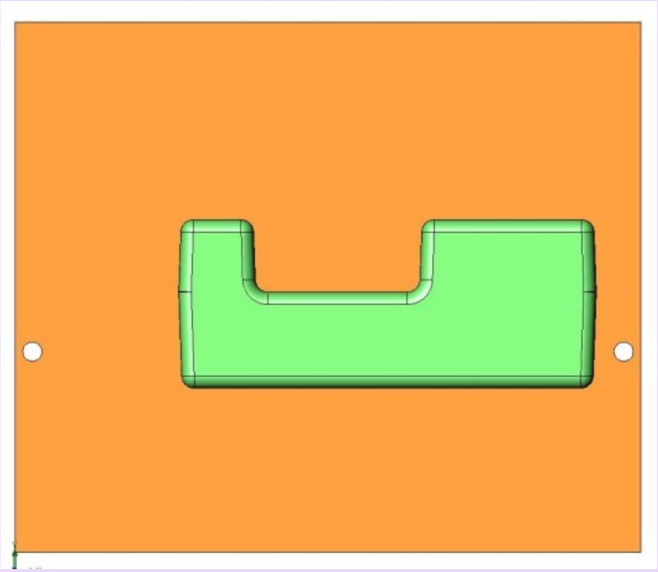
Loose sand grains falling on the castings due to various reasons like mismatch, bush wornout,bottom plate worn-out etc.	.
Provision of crush pins on the pattern plate tolerate such type of unalignmentcaused by the above said reasons	

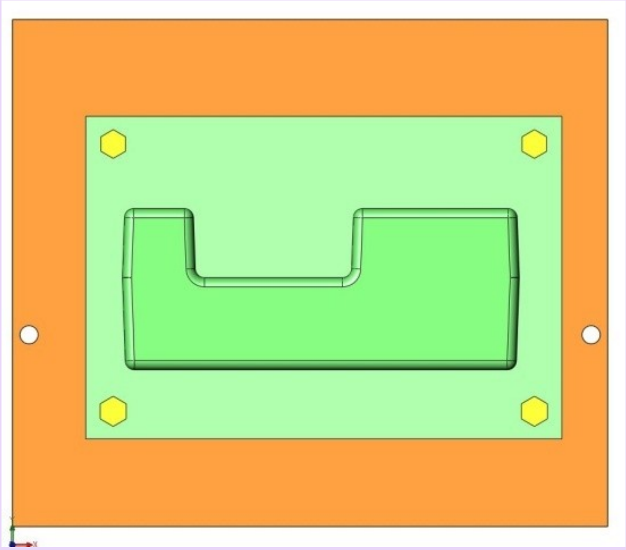
SAND INCLUSIONS

Improper matching of the contour of the print on sp and pp plate.	
	<u>Identify the mould crush after closing and then opening and crushing pad to be provided to avoid sand falling</u>

SAND INCLUSIONS

Improper tightening of bolt and nuts on the tooling.





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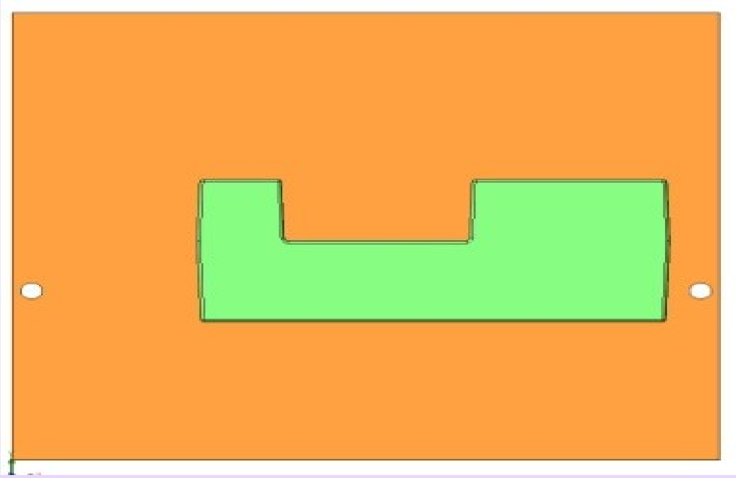
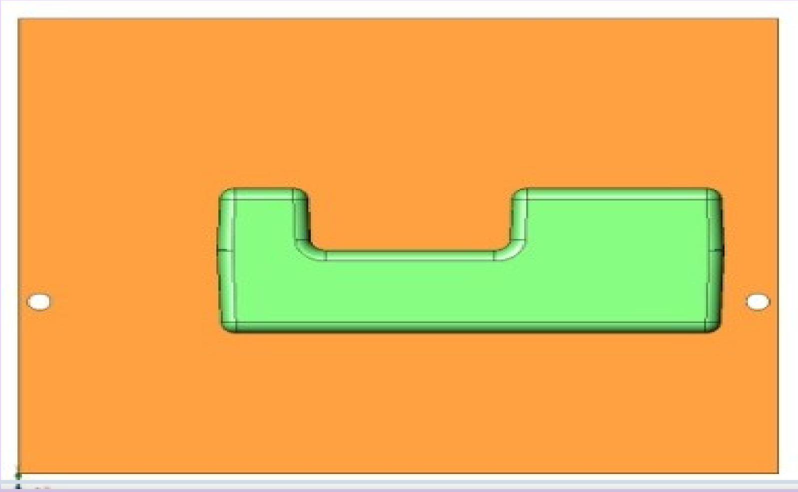
SAND INCLUSIONS

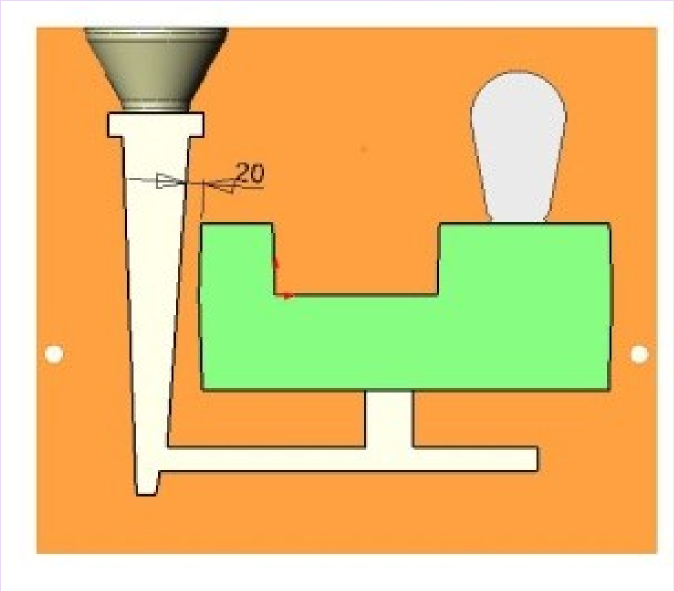
Insufficient fillet or corner radius at partingline.



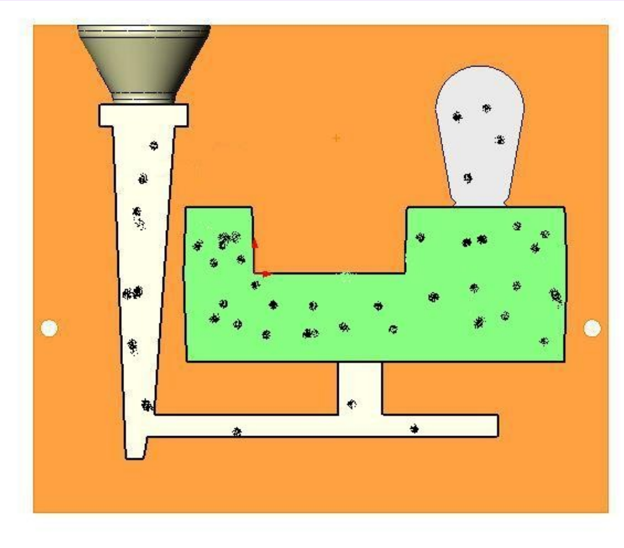
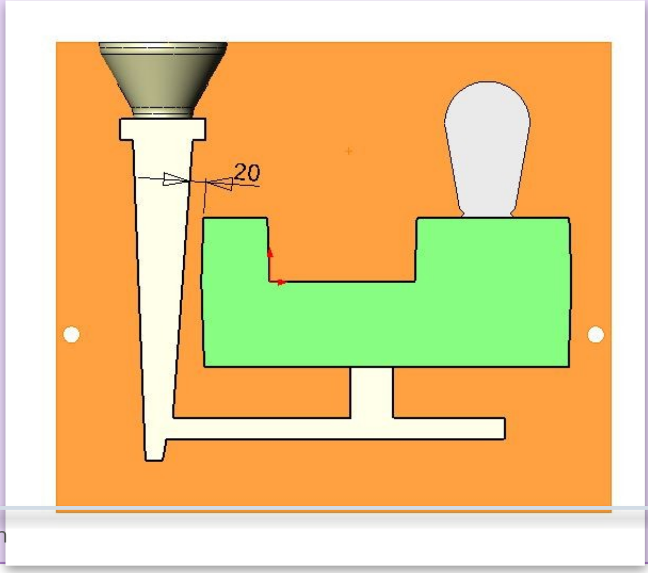


Sufficient fillet or corner radius provbided

SAND INCLUSIONS

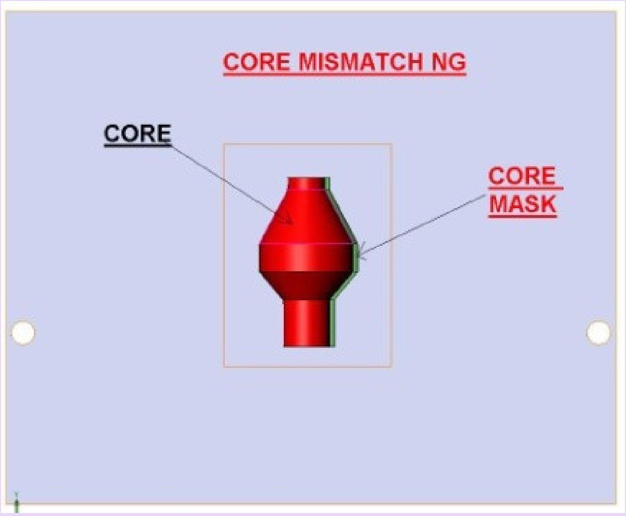
Narrow gap between part and runner	
	The gap widened and draft increased.

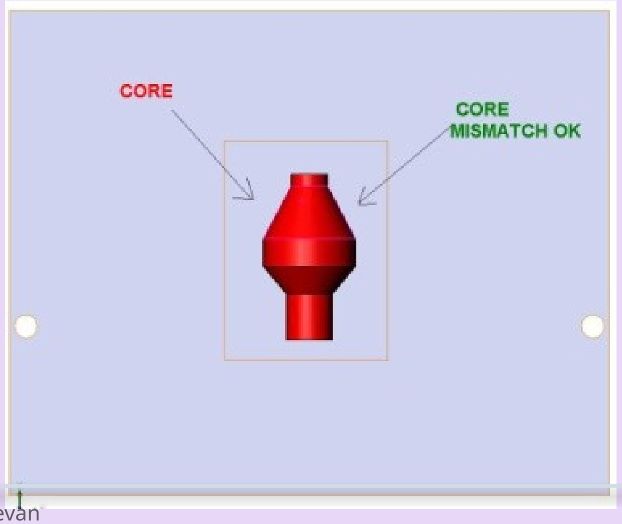
SAND INCLUSIONS

Fines' deposits on the excess oil sprayed on the tooling	
	Oil spray controlled.Sand sticking locations are smoothened

SAND INCLUSIONS

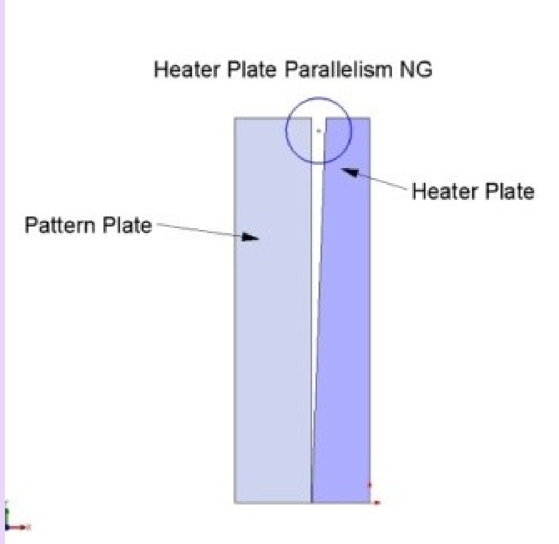
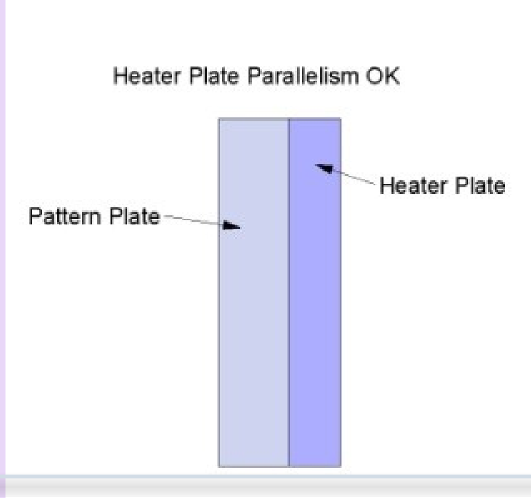
Core setter mismatch causes core loaded on the green sand mould ending sand falling.



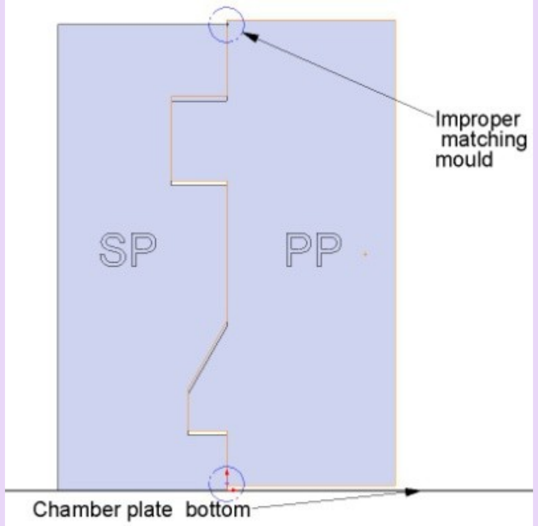
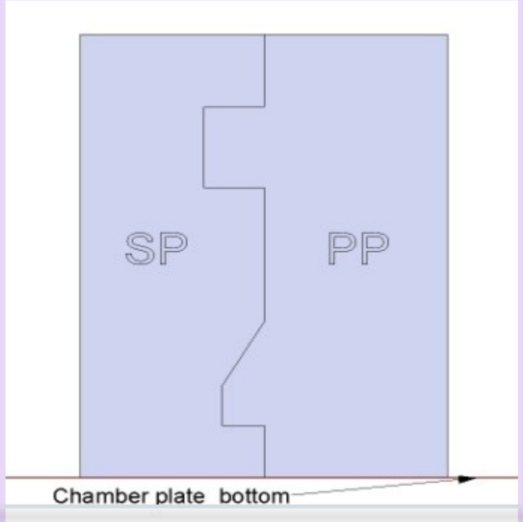


Core setter mismatch corrected

SAND INCLUSIONS

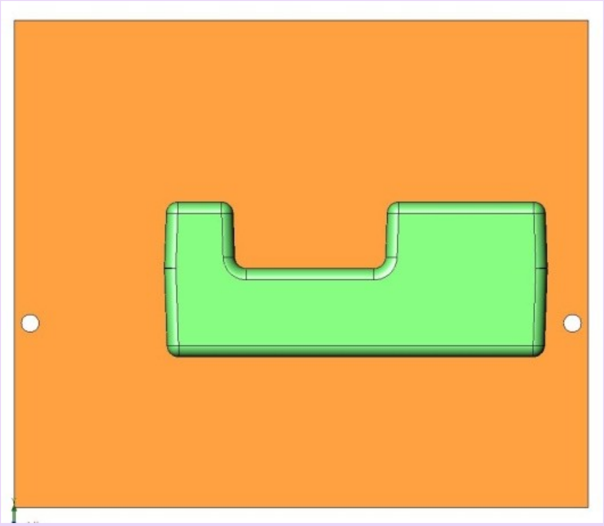
Heater plate parallelism more than 0.5 mm leads to self core broken .	
	Periodical replacement of heater plate.

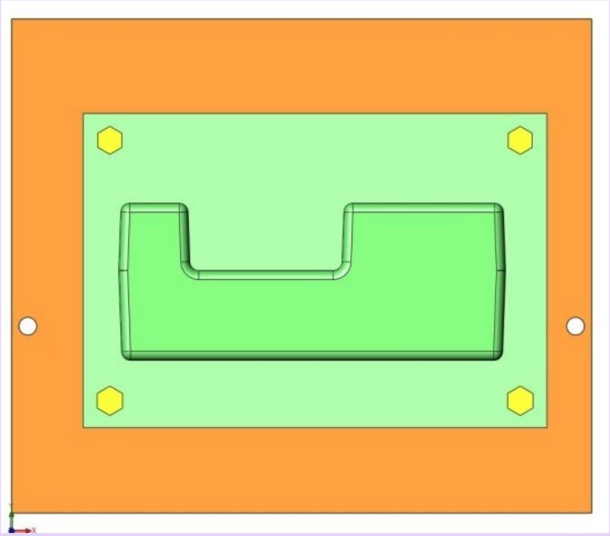
SAND INCLUSIONS

Improper matching of the contour of the print on sp and pp plate.	
	Identify the mould crush after closing and then opening and crushing pad to be provided to avoid sand falling.

SAND INCLUSIONS

Improper tightening of bolt and nuts on the tooling.





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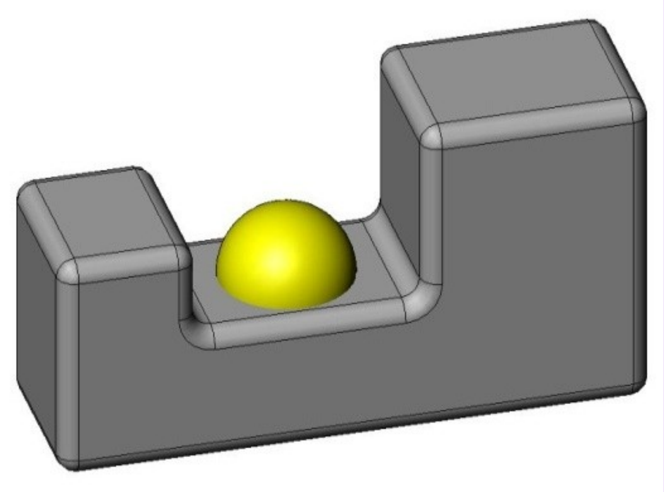
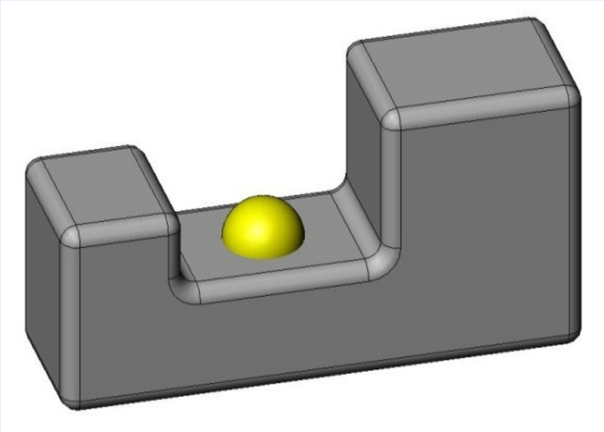
SAND INCLUSIONS

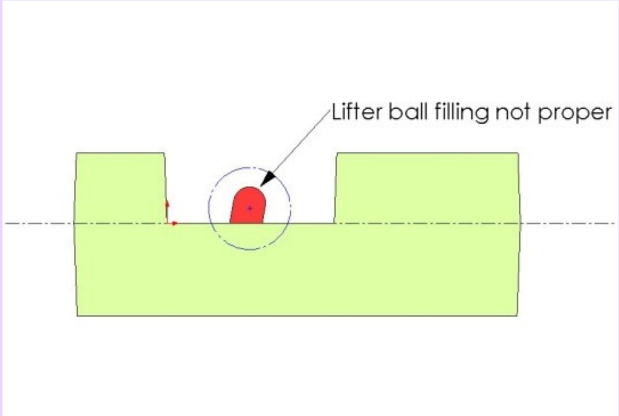
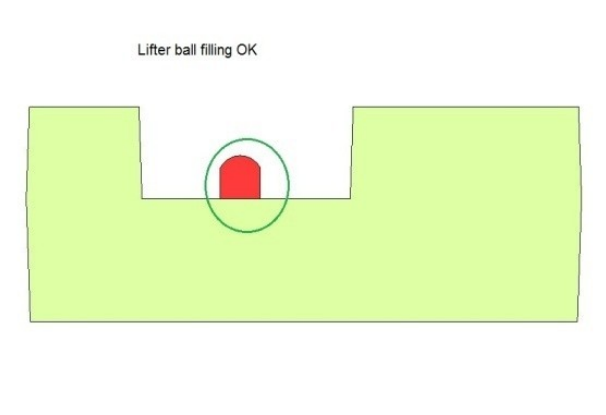
Ejection ball in the hub I.D.,not properly fitted
The gap between the ejection ball and the tooling very narrow



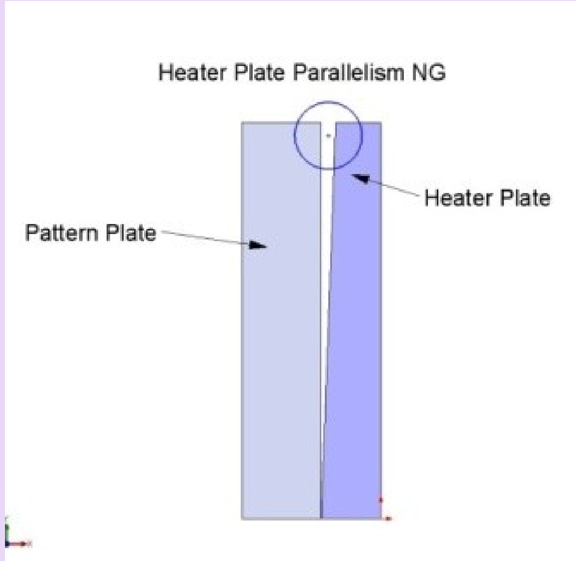
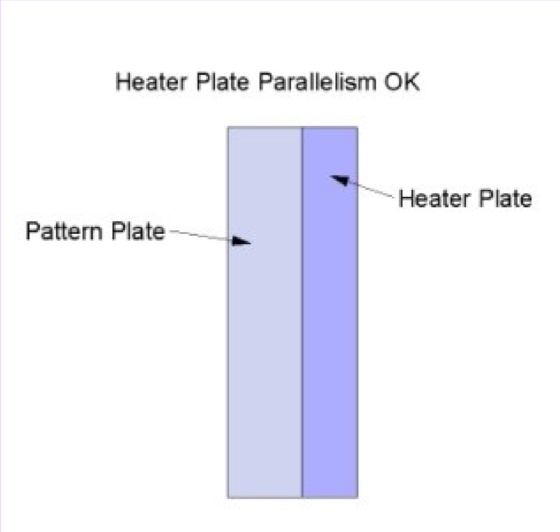


Ejection ball fitted properly without any undercut or sand sticking.
Corrrect size of ejection ball to be fitted to ensure sufficient gap.

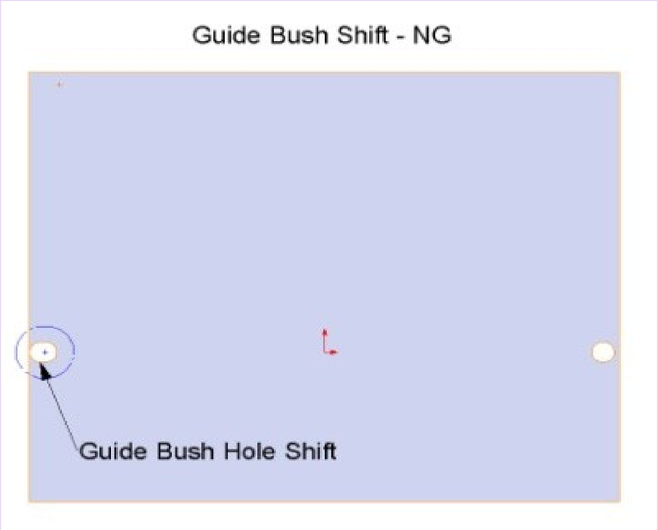
SAND INCLUSIONS

Ejection ball in the hub I.D.,not properly fitted The gap between the ejection ball and the tooling very narrow	
	Ejection ball fitted properly without any undercut or sand sticking. Correct size of ejection ball to be fitted to ensure sufficient gap.

SAND INCLUSIONS

Heater plate parallelism more than 0.5 mm leads to self core broken.	
	Periodical replacement of heater plate

SAND INCLUSIONS

<table>
<tr>
<td>Guide Bush shift or worn-out</td>
<td>


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<tr>
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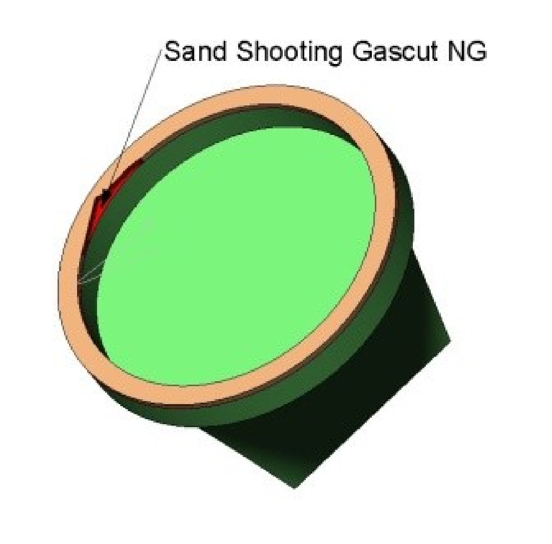
</td>
<td>Replacement by new one</td>
</tr>
</table>

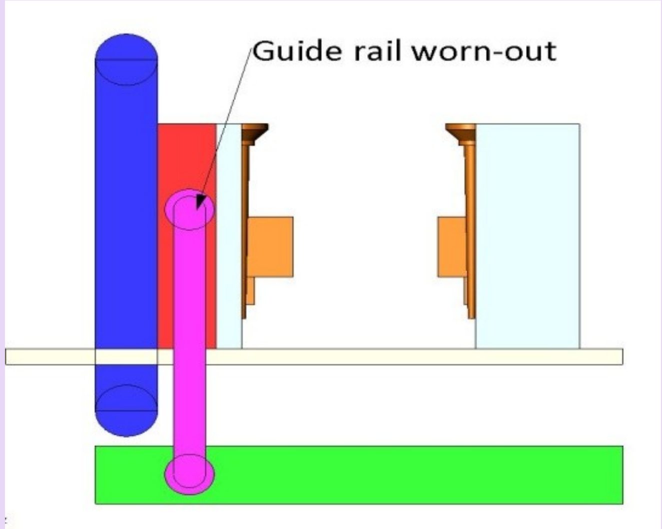
SAND INCLUSIONS

Heater plate lift-up due to sand collectipon at the bottom because of stripper pad wear out. SP side the gap between heater plate and pattern plate leads to loose sand fillup and hence parallelism problem causes sand drop	
	Stripper pad at the bottom of pattern plate to be replaced

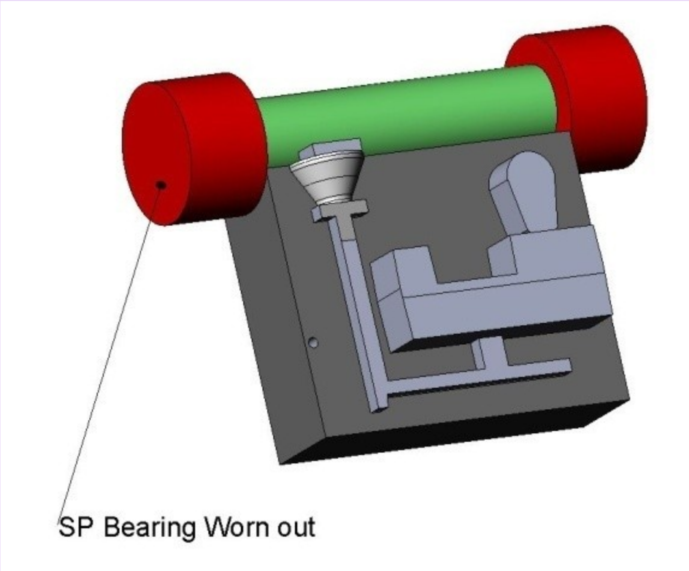
SAND INCLUSIONS

Sand shooting valve problem.Gascut worn out. Shooting valve diaphram reversely fitted and sand conveying to the doom one side	
 	Periodic check-up shooting valve

SAND INCLUSIONS

SP arm guide rail worn-out	
	Replacement by new one.

SAND INCLUSIONS

SP arm Bearing worn out	
•Bearing replaced	

SAND INCLUSIONS

Tie rod arm worn-out	
• .	As a temporary action change the other tail end to the front.As a permanant action replace the tie rod arm *by* new one.

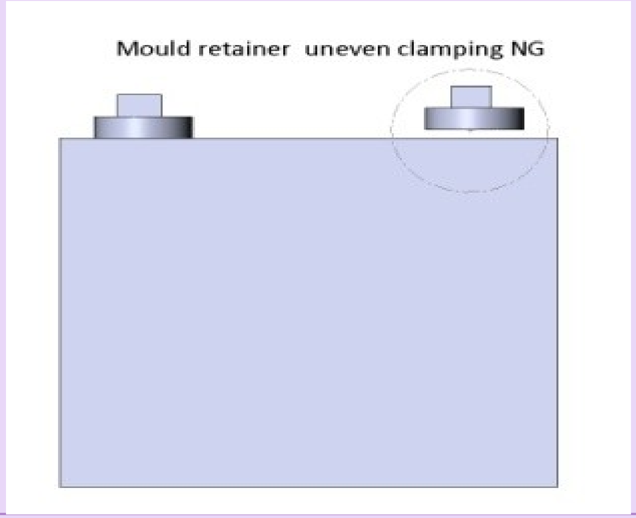
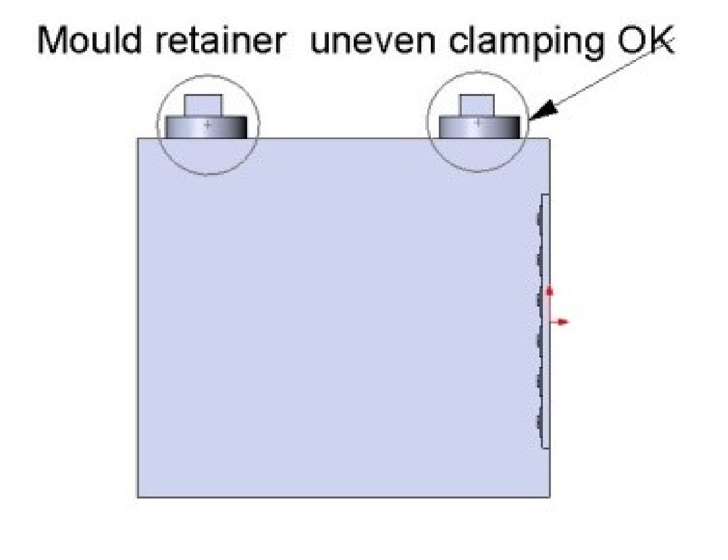
SAND INCLUSIONS

_Double stroke.AMC and SBC not synchronising	
	_AMC and SBC movements synchronised.

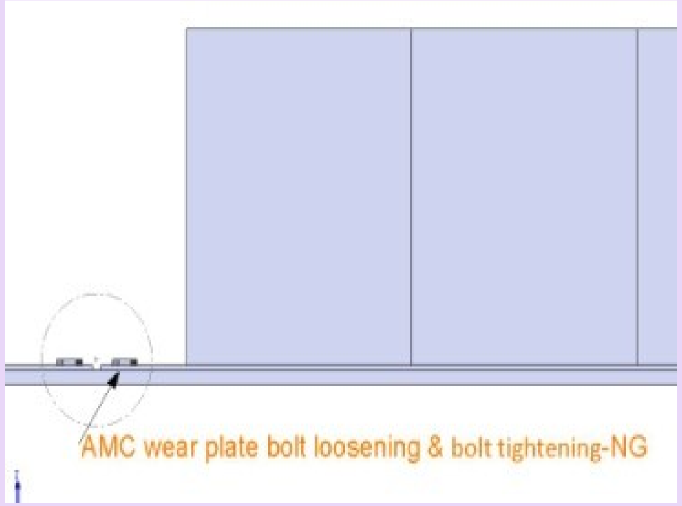
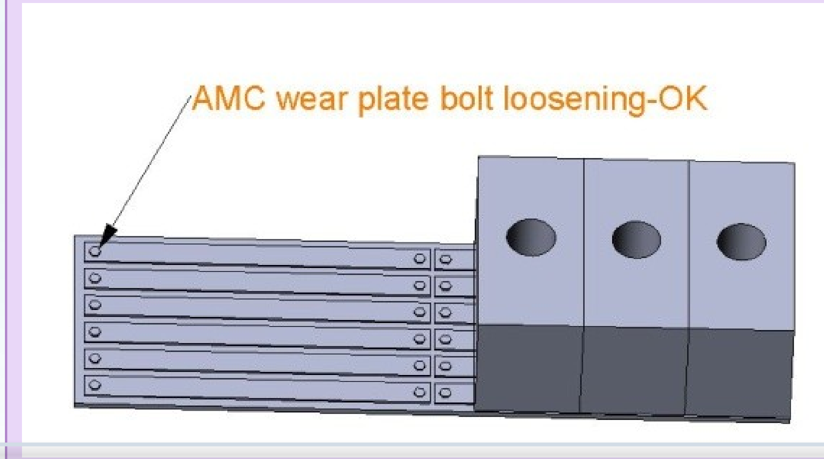
SAND INCLUSIONS

Mould gap due to thrust bar movement not aligned with Disa mould delivery	
	Correct the air valve to thrust bar so as to align with mould delevery

SAND INCLUSIONS

Mould retainer uneven clamping	
	Correct the mould retainer for even clamping

SAND INCLUSIONS

AMC wear plate bolt loosening,leading to mould shaking and hence crush.	
	AMC wear plate bolt tightenin

SAND INCLUSIONS

CAUSE : Disc items in the double Decker method while pasting the centre cores along with the side cores manually and stacked vertically resulting pasted core open that causes sand crushes during core setting.	
•Automatic core pasting equipment introduced	

SAND INCLUSIONS

•**Sand Erosion :**

•**The binder is not able to hold the sand grains they ae flushed out and dispersed to the remote ares of the castings.**

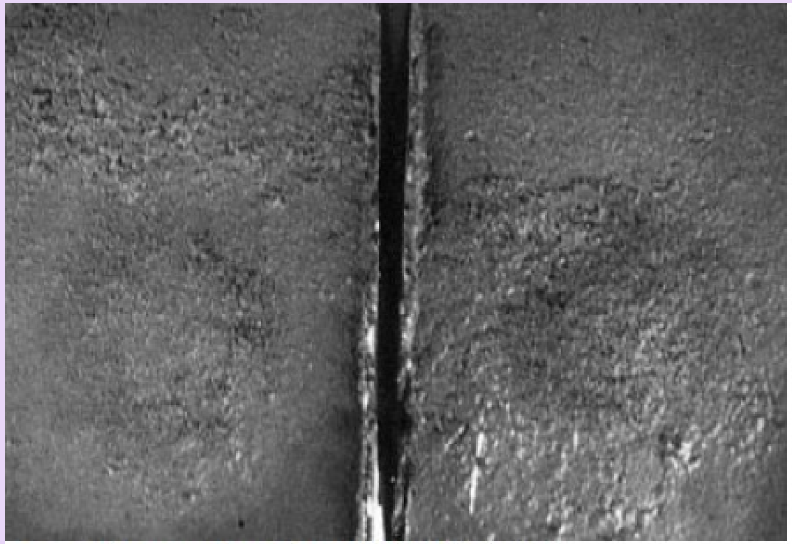
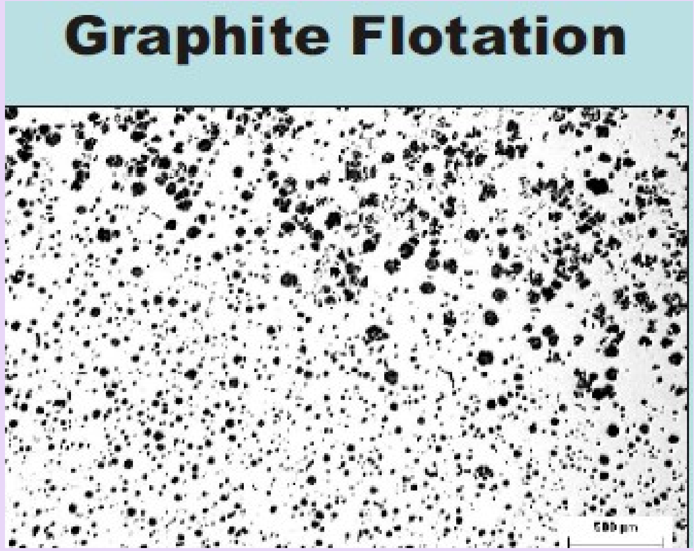
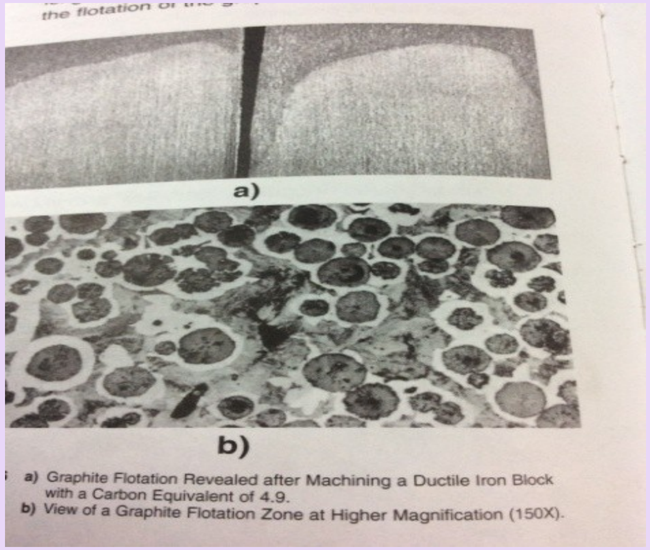


Fig. 6: Sample grey iron casting for testing of erosion with a clay-bonded moulding sand.
Scale: 10 mm ≙ 10 mm

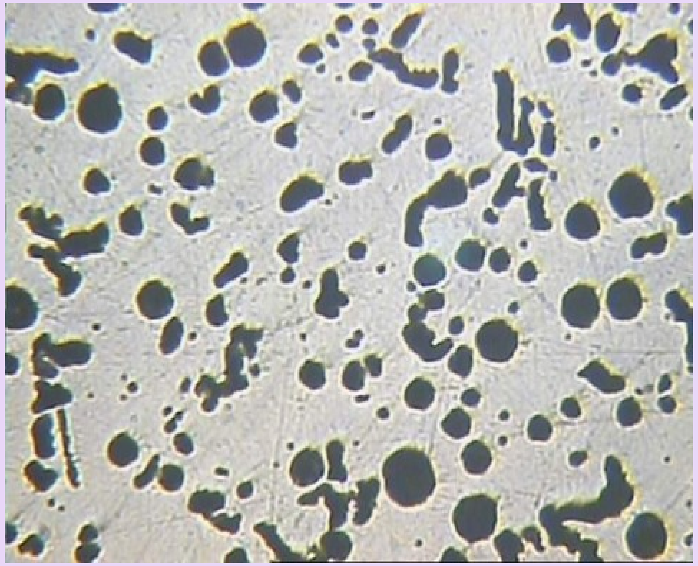
METALLURGICAL DEFECTS



METALLURGICAL DEFECTS

Graphite Floation Carbon Equivalent is moe than 4.5% floation starts in thick castings more than 1"	
	Control the carbon equivalent Pouring Temperature to be reduced. Gating system to be modified so as to ensure uniform heat distribution.

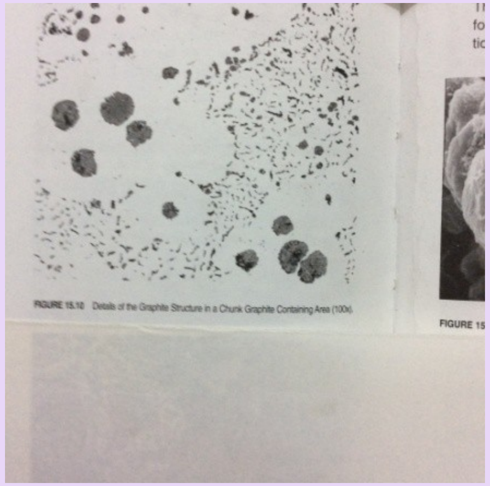
METALLURGICAL DEFECTS

_FLAKE Graphite in Nodular Iron. Low residual Magnesium , High Sulphur content of base iron/mould High Treatment Temperature Associated with slag inclusion	
	_Increase the residual magnesium Treated metal pouring within 7 minutes. Base metal sulphur should be low.Incoming charge materials to be checked. Sulphur in coal dust max.0.2%

METALLURGICAL DEFECTS

Chunk graphite is usually found at the thermal centre of heavy section casting

Carbon supersaturation and high local undercooling and elements like silicon,Cerium/mishmetal in Mg treatment also favours chunk graphite formaation. More purity of iron also prone to occur this type.

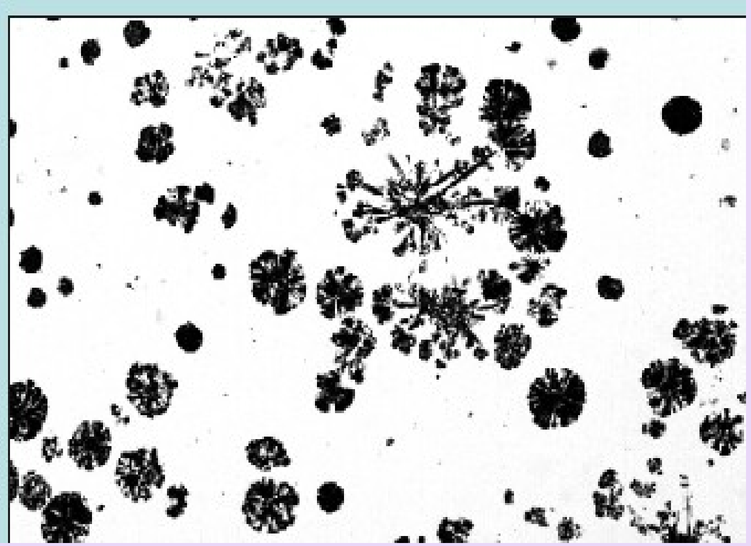


The addition of elements that accumulaate aaround the graphite nuclei, such as Antimony,Tin,copper was found to inhibit the growth of chunk graphite cluster

METALLURGICAL DEFECTS

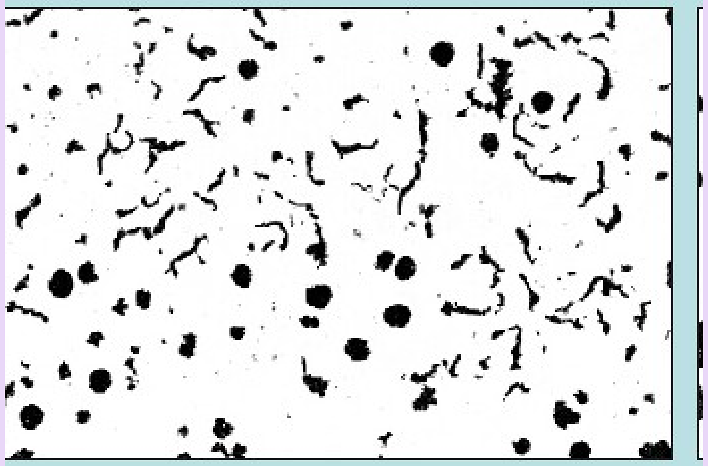
Exploded Graphite

Exploded graphite / or spiky graphite obseerved due to purity of metal
High carbon Equivalent with high pouring Temperature
Presence of more Cerium or mishmetal



The addition of Copper,or Tin or Antimony was found to inhibit the rowth of exploded graphite.
In melting M.S.scrap from same source other source also charged to avoid exploded graphite

METALLURGICAL DEFECTS

Degenerated graphite Nodular (Vermicular graphite) The ideal graphite structure are properly round nodules and many specification require minimum 85% nodularity.Nodule irregularity above the limit due to low residual Mg. less than 0.03% in our process causes this type of structure.	
	Increase the residual Magnesium

METALLURGICAL DEFECTS

Intercellular Flake Graphite

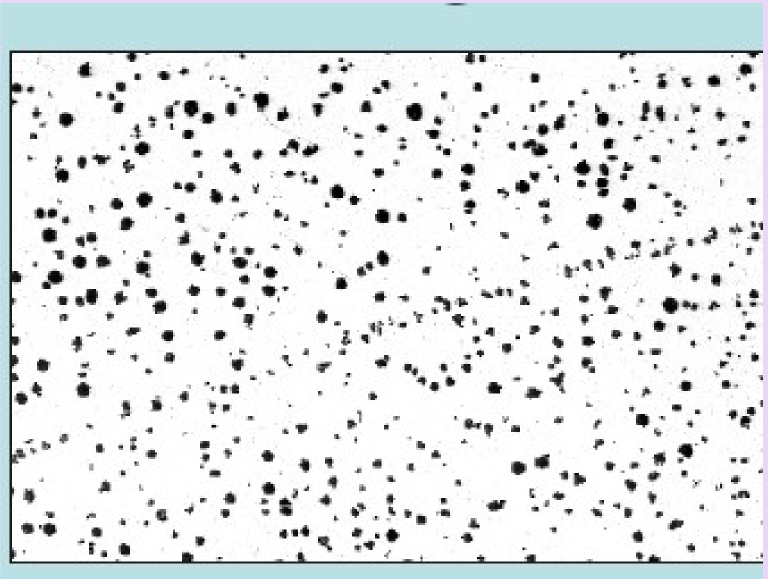
The intercellular and grain boundary regions are those where tramp and trace elements segregate and concentrate. Amongst these are the elements such as lead,Titanium,Bismouth,Antimony,Arsenic and Alluminiumy,Arsenic and Aluminum.

To nutralise the effect of tramp and trace elements Cerium or rare earth 0.005% to be added

METALLURGICAL DEFECTS

Ferritic Skin The presence of ferrite concentration in matrix regions of a casting where pearlite is required can present problem.. Ferritic Skin The presence of ferrite concentration in matrix regions of a casting where pearlite is required can present problem..	
	.. Lower the silicon content. Innoculant sufficient quantity to avoid carbides. Increase the thickness of the mould in the area of concern.

METALLURGICAL DEFECTS

Plate Fracture (Graphite Nodule Alignment) The surface of the plate fracture is studded with graphite spheroids which are smallar than those in the rest of the area,irregular in shape and are arranged an atmost crystal-latice-like accuracy On a microscopic ewxamination a definite alinment the nodules embedded on a ferritic band . This is found at location such as riser neck connections or within casting often at the junction between two sections. High incidence of inclusions in and near the ferrite shells surrounding the plate fracture	
•**Low carbon equivalent** •**Under inoculation** •**High pouring Temperature** •**Causes this type of structure**	_Changing the riser neck location and change the mould filling & running system

METALLURGICAL DEFECTS

Higher pearlite content : .One location in a casting found more pearlite and the rest of the area within spec Not uniform cooling during freezing.That particular area subject to fast cooling.	
	Hot zone created around the particular area to make uniform cooling.

METALLURGICAL DEFECTS

Caliper alarm drill hole found over size. Hardness was also found lower range. he riser located in between caliper arm and make slow cooling.In addition to this low Mn less than 0.2% and low residual Mg aggravate this issue.	
	Mn is maintained 0.2 to 0.3% and residual Mg. min.0.04%

METALLURGICAL DEFECTS

Lower Tensile Stremgth observed. Riser neck provided on gthe arm make the arm to cool slowly	
	Chemical composition adjusted,copper percentage increased to get the results.

METALLURGICAL DEFECTS

One particular location Elongation found lower but Tensile strength found more.Hardness difference was found more than 50 HB

That particular location gets fast cooling than other areas irrespective to chemical composition. Gating system has role in determining the matrix.

Gating system modified to uniform cooling

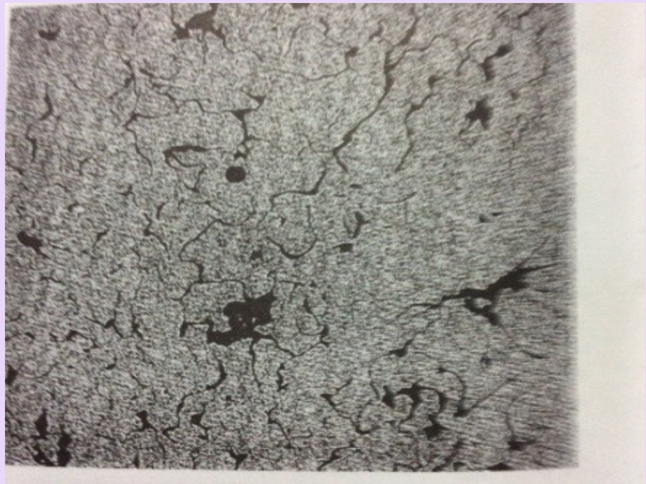
METALLURGICAL DEFECTS

Low Yield Strength Tensile strength itself in the lower range of spec. Silicon content in the lower range.	
	_Increase the copper content to improve the Tensile strength and increase the silicon content to improve the yield strength

METALLURGICAL DEFECTS

Base Sulphur is more than 0.02%.
Base metal contains more oxygen
Impurity in pure Mg is more than 0.1% And small size less than 100 mm
Exposed to air after treatment.
Pressurising inert gas Nitrogen contaminated with AIR.
Frequent venting of press pour.
Leakage of Nitrogen in press pour.
More slag build up in press pour.
Converter reaction chamber volume less.
Too long holding time after treatment.
Too long more than 3 minutes to transfer the treated metal into the pouring furnace.
Excess carburiser like petroleum coke, sulphur bearing materials, into the converter ladles.
Excess additives like ferro-silicon etc are added after treatment.
Too high treatment Temperature.
Too low treatment quantity.
Slag built-up in the Magnesium treatment chamber.
Grey metal tapped converter is used for S.G iron treatment.
Converter chamber Hole size is too large.

METALLURGICAL DEFECTS

Flake Graphite in Ductile Iron . Metal contaminated with Lead and Antimoney	 IGURE 4.14 Flake Graphite Typical of Magnesium-Treated Iron Contaminated with Lead (0.0086%) and Antimony (0.0057%) (100x, Unetched).
	_Dilute the metal with mild steel scrap free from Lead,Antimoney Incoming materials to be ensured free from contamination

METALLURGICAL DEFECTS

_Distortion(Mould wall movement)Based on the oriention and gating system some portions of the part distorted due to Sand: Low shear strength,Green compression strength,sand to metal ratio low,Hot sand and high moisturised sand.
Disa machine: Soft mould,Ramming not uniform throughout the mould,sand shooting valve problem,too low closing pressure.
High residual Magtnesium and high pouring Temperature.
Incoming material Bentonite qualilty.
Metal to sand ratio is low ,1:4. Requiement min.1:6.
Excess poured weight than the machine manufacturer specified.
Selection of oriention and layout require review.

_Ensure the Bentonite Quality,sand parameters,Residual Magnesiium,Pouring Temperature and Machine settings mould thickness, closing pressure, clamping pressure,improvements and compactablity at the mixer below 40

METALLURGICAL DEFECTS

Deformation of Mould uneven bottom wearplate. Worn bottom wearplate Guide rail incorrectly adjusted. Mould retaine pressure too high. Close up pressure too high. Sand under the shoe (PP) Soft moldablity	
	Correct the above factor

DISC UNBALANCING

_Unbalancing max.due to cores.: Core warpage,Core dressing improper- dressing of fins or veins, balls are formed on the casting part,Excess coatings deposited on the radius near prints (waviness),coating not uniform, patch up on the cores, damages on the cores and sand deposited in between the ribs on the core box.
Mismatch on the casting, cores gets tilted during core setting

_REMEDY

If core are made shell after taking the cores from the core box core should be stacked horizontally in plain surface so as not to allow any warpage.
Core are dressed perfectly and free from fins & veins,excess materials or undercuts, gas holes.
Cores free from excess deposit of coatings.
Cores rib thickness should be more or less uniform.
Mismatch on the casting should be less than 0.5 mm

GAS OR BLOW HOLES AND PIN HOLES

Gas Hole
Looks small,clean and Bright

low pouring Temperatue
High Sulphur and Phosperoous in metal.
Poor Refractory Materials
Bad gating system
Mismatch on the castings

Increased the pouring Temperature.
Controlled the Sulphur and Phosperous.
High refractory materials used
Improved gating system

GAS/BLOW HOLES AND PIN HOLES

Gaas Hole. Looks small and very shining Too high aluminium content in the melt or inoculant. High moistured sand. Wet lining of ladles or pouring spout	
	Control of Aluminum in metal and inoculants. Control of moisture in the sand preheat the ladle or pouring spout

GAS OR BLOW HOLES AND PIN HOLES

Gas Hole Looks elongatedand irregular High Nitrogen in the moulding or core sand	
	Control Nitrogen in the moulding or core sand

GAS OR BLOW HOLES AND PIN HOLES

Gas Holes Looks larger and rounded Gases from mould or core Vents are blocked	
	REMEDY: Avoid excessive gas production from mold by reducing coal-dust,binder,water etc. Use less binder in cores and cure adequately. Improve venting of cores and mold cavities.

GAS

GAS OR BLOW HOLES AND PIN HOLES

_Gas Hole looks elongatedand irregular High Nitrogen in the molding or core sand	
	_Control Nitrogen in the moulding or core sand

GAS OR BLOW HOLES AND PIN HOLES

_Gas Hole Looks larger and rounded Gases from mould or core Vents are blocked	
	_Control VCM,LOI, Moisture and Total Clay in the sand and any other contaminants

GAS OR BLOW HOLES AND PIN HOLES

_Gas Hole looks elongated and irregular High Nitrogen in the molding or core sand	
	Control Nitrogen in the moulding or core sand

GAS OR BLOW HOLES AND PIN HOLES

_Gas Hole Looks larger and rounded Gases from mould or core Vents are blocked	
	_Control VCM,LOI, Moisture and Total Clay in the sand and any other contaminants

Blow Hole More slag in the metal Due to Materials; More fines and oolitics in the silica sand. Uneven sand grain distribution. Inferior quality of Bentonite. Inferior quality of Coal dust. Salt water. Due to sand properties: Low GCI, WTS and Shear Strength High Moisture in the sand. High Compactabllity. Hot Sand Low Permeability More or low total clay Due to Disa molding Machine: Ducting pipe damage reduces suction. Damper closing conditions in the cooling drum .Based on the negative pressure development problems gets aggravated. Ducting line pipe Blockage. Filter bag blockage. Cleaning carriage failure and drop in suction pressure due to I.D fan problem .	Correct the above factors

GAS OR BLOW HOLES AND PIN HOLES

Gas Hole. Looks small and very shining Too high aluminum content in the melt or inoculants. High moisture sand. Wet lining of ladles or pouring spout	
	Control of Aluminum in metal and inoculants. Control of moisture in the sand preheat the ladle or pouring spout

GAS OR BLOW HOLES AND PIN HOLES

Blow Hole problem Due to pouring: Interrupted and double or triple stream of pouring. Within 2 Secs.from pouring started not filled and pouring continued with partial fill-up of pouring cup. Pouring continued without maintaing Min.metal height in the pouring spout. Due to mould pitch variations pouring not centred After pouing stopped and restart continuously without left next mould unpoured.. Pouring disturbed due to hunting of stopper rod	
	Correct the above points.

GAS OR BLOW HOLES AND PIN HOLES

_Blow Hole Insufficient or inhomogeneous filling of chamber;- Shot pressure too low or high. Shot time too short. S and shot valve defect. Exhaust valve defect. Chamber plate vents blocked. Injection slot partly blocked. Uneven sand level in the hopper Sand level too low in the hopper Sand build up in the hopper Sand build up in the blow head. Holes worn in the sand hopper insert. Sand gate leaking during shot.	Correct the above factors
	–

MAGNESIUM FADING

Magnesium fading Since Magnesium is more volatile and affinity towards Sulphur and Oxygen the fading of Magnesium was also very fast. Maintain base sulphur and oxygen to the minimum possible. Avoid impure Mg. and small size. Avoid exposure to air after treatment. Avoid frequent venting of presspour. Nitrogen Leakage in presspour. Avoid slag build up in presspour. Maintain the convertor reaction chamber clean. Avoid long holding time in convertor after treatment. Too long transfer time from convertor to presspour. Excess alloy like ferrsilicon, carburiser into the convertor after treatment. Too high trreatment Temperature. Too low treatment quantity. Slag build up in the convertor/presspour. Grey metal tapped ladle is used for SG. Convertor chamber hole size is too large./convertor chamber volume is less due to slag built up	Correct the above factors.

FACTORS INFLUENCING THE FEEDING SYSTEM EFFECTIVE

Casting modulus ,Riser Modulus And Riser Neck Modulus will be in
the ratio 1:1.2:1.4.
Neck shape preferred in the order of
Round ,trapozoid,Square,Rectangle,
Top riser is preferable than Side riser.
The centre line of riser and riser neck to be inline.
Riser volume should be more than 20% than calculated.
Hot riser is preferable than cold riser.
For isolated sections multiple riser cab be used.
For isolated sections if possible connectivity improvement will be done.
Mould rigidity to be ensured.
Riser shape may be cylindrical,spheriocal,suare or rectangular.
And Bottleneck riser..
Ingate to the riser should solidify immediately after completion of pouring.
Choke may be provided on the riser ingate runner to improve the the piping.
V Notch to be provided to initiate piping.

GAS OR BLOW HOLES AND PIN HOLES

_Blow Hole Insufficient or inhomogeneous filling of chamber;- Shot pressure too low or high. Shot time too short. S and shot valve defect. Exhaust valve defect. Chamber plate vents blocked. Injection slot partly blocked. Uneven sand level in the hopper Sand level too low in the hopper Sand build up in the hopper Sand build up in the blow head. Holes worn in the sand hopper insert. Sand gate leaking during shot.	Correct the above factors

GAS OR BLOW HOLES AND PIN HOLES

_Gas Hole
looks elongated and irregular
High Nitrogen in the molding or core sand

Control Nitrogen in the molding or core sand

METALLURGICAL DEFECTS

Carbon Flotation	
High carbon content High pouring Temperature Heavy section thickness	•

METALLURGICAL DEFECTS

Micro porosity due eutectic phosphide	
	Reduce phosperous content below 0.04%

METALLURGICAL DEFECTS

METALLURGICAL DEFECTS

METALLURGICAL DEFECTS

GAS OR BLOW HOLES AND PIN HOLES

Ventilated disc-Blow Holes observed at the top of the disc below the cold riser.	-
•The ingate at the bottom cover the print height perpendicularly. The 2.5 mm thin ingate at this location may vary due to core setting leading to extended pouring time .	-

Casting defects

Core mismatch

•Core setter setter piston and eye portion are separately assembled and **f**requently got broken.	Piston and eyeportion was made into integral so as no variation and no broken.

COMPACTABLITY OF MOULDING SAND

C

Mg.

METALLURGICAL DEFECTS

METALLURGICAL DEFECTS