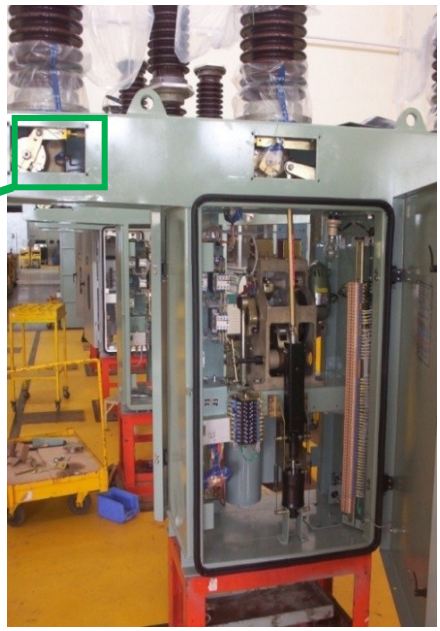
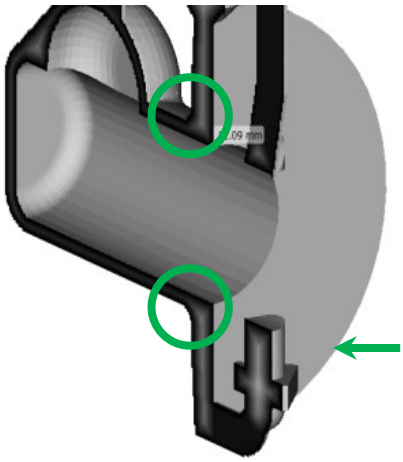
Breaker Oil Tank

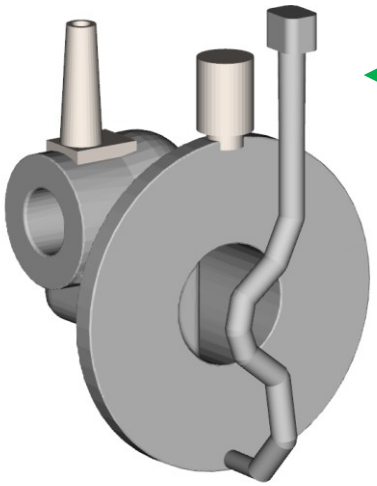
Aluminum Alloy, Gravity Die Casting

***Case*: A circuit breaker oil tank of aluminum alloy is produced by gravity die casting process. The overall size is 320 mm x 270 mm x 300 mm and its weight is 6.1 kg.**

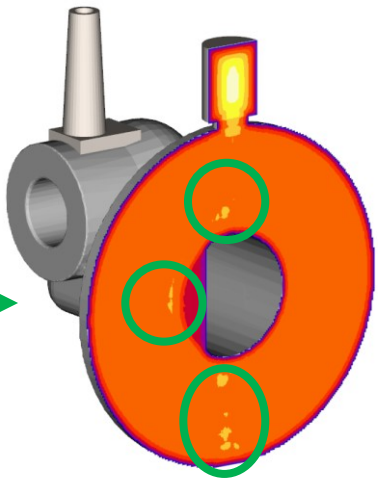




Wall thickness analysis shows two junctions between flange and 'D' shaped enclosure, with 23 mm thickness (inscribed sphere diameter).



The initial methoding of the casting included two top feeders connected to the rim and boss section. Metal flow is controlled by a bottom gating system.



Simulation of existing method shows that feed metal is unable to reach hot spots (yellow) in the flange, just above and below the 'D' shaped hole. These match the shrinkage porosity observed in machined casting.

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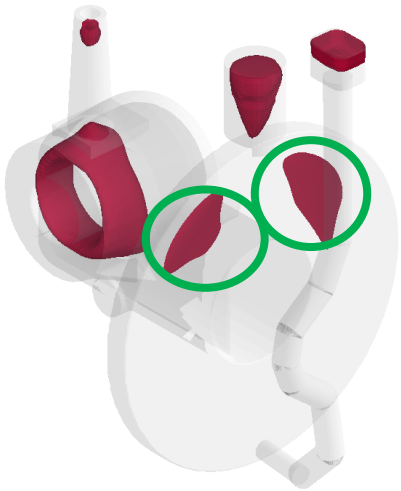
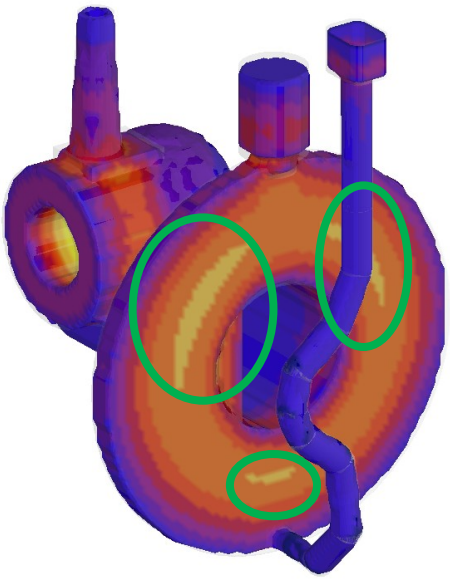
Liquid fraction analysis displays liquid metal remains inside the casting till the end of solidification. Presence of liquid metal in the flange suggest the possibility of shrinkage porosity present in that region.

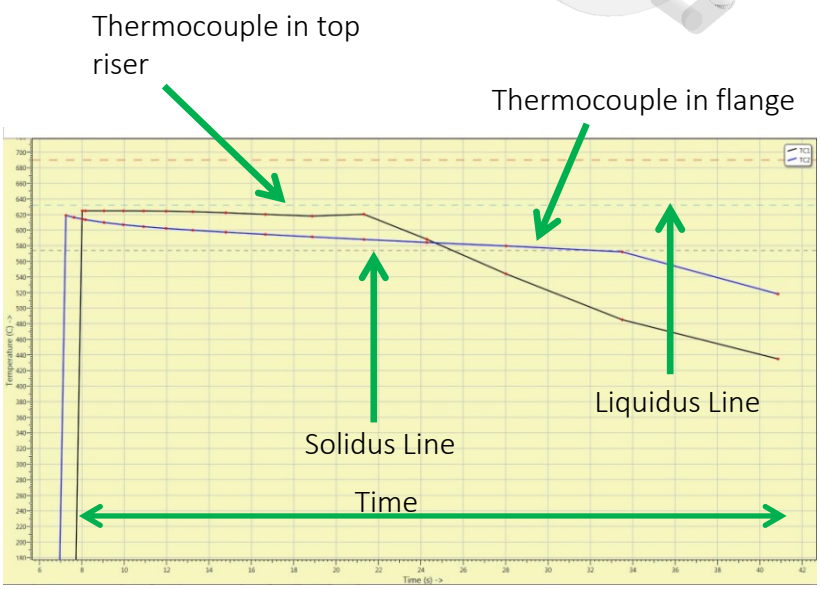




Solidification time analysis indicates presence of last to solidify region in the flange. These locations are matching with the location of defect observed on the shop floor.

Shrinkage porosity is seen inside the flange. The lighter colour shows micro shrinkages and darker colour shows macro shrinkages.

Thermocouple analysis suggests that location in flange takes much more time than the connected top feeder to cross solidus line which validates the result from shrinkage porosity analysis.



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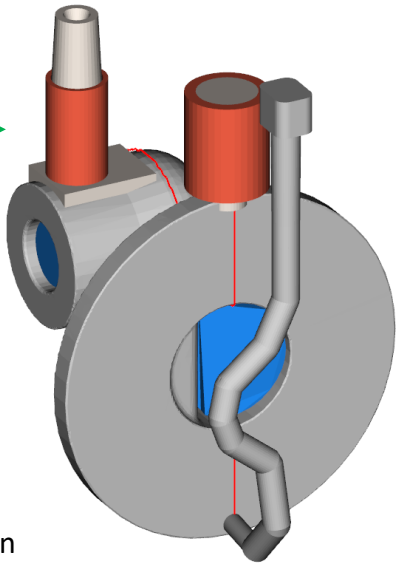
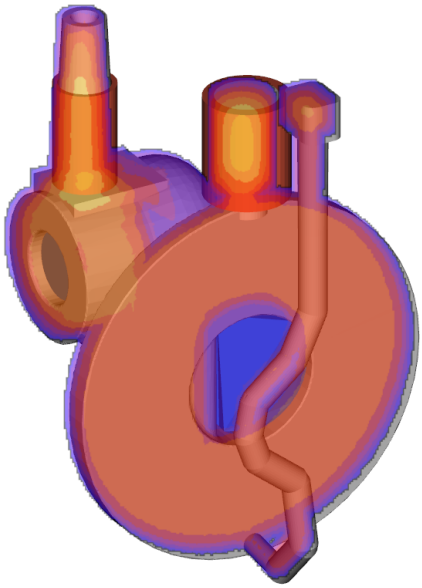
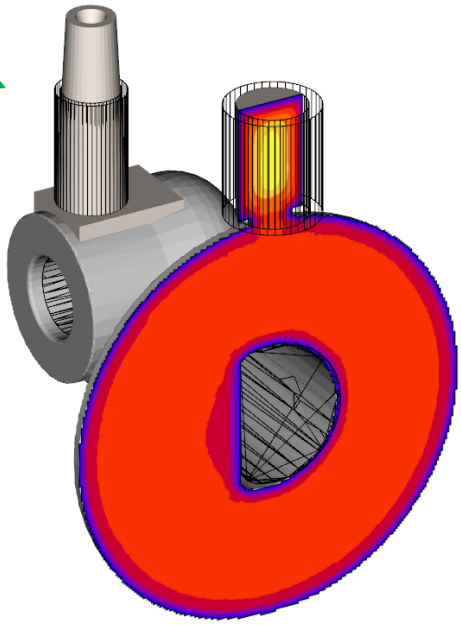
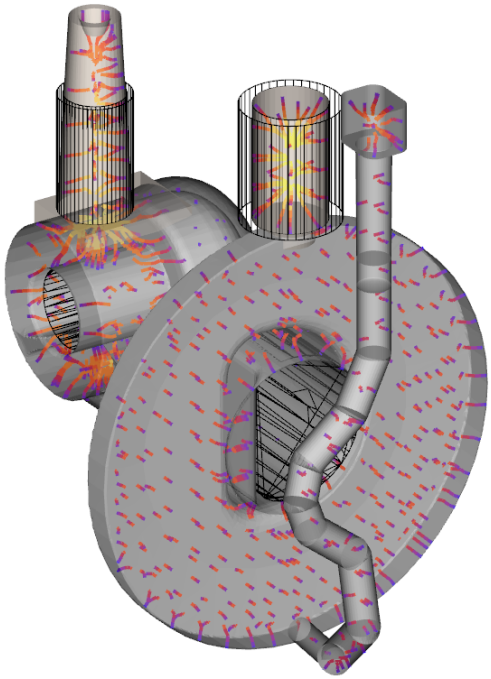
The quality had to be improved without any major changes in the die design. Hence exothermic sleeves were provided over feeders to increase the feeding effect. A copper core was placed inside the steel core to increase the heat transfer in the ‘D’ hole.





3D solidification simulation of the complete methods design shows more uniform temperature around the ‘D’ hole, confirmed by a virtual cut section.





The feed path simulation shows low temperature and gradients around the ‘D’ hole, ruling out any feeding issues.

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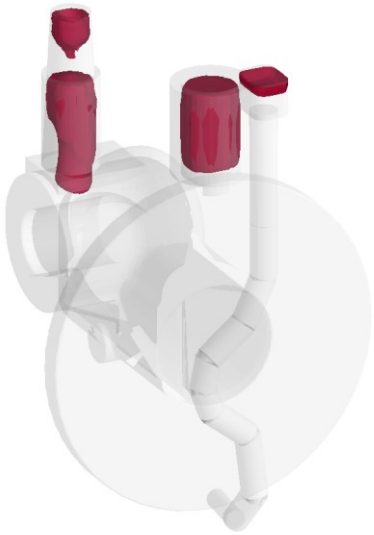
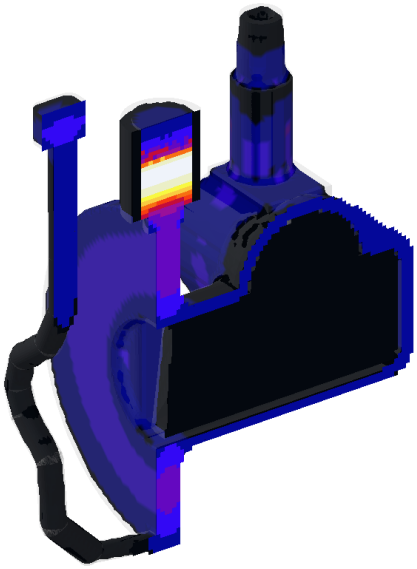
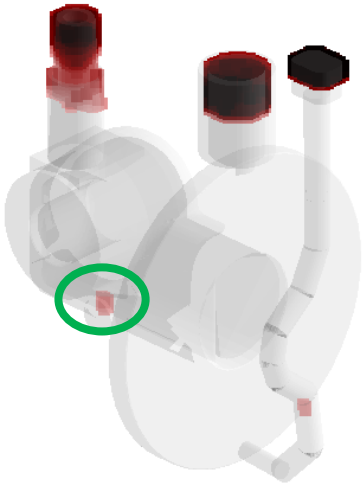


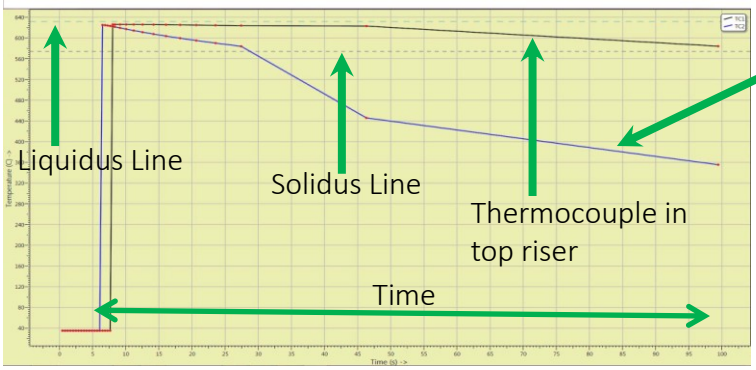
Liquid fraction analysis displays all liquid metal inside the feeder and sprue at the end of casting.

Sectional solidification time analysis shows no last to solidify regions in the casting.





Shrinkage porosity is observed in the feeders. Some micro shrinkage porosity is also visible in the casting.



Thermocouple in flange

Thermocouple analysis supports the shrinkage porosity results. Flange takes less time to solidify then the top riser.

Summary: ***The combined effect of insulating sleeves and core chill reduced the rejections to less than half. Complete elimination requires changing the cavity orientation in the die.***