

## Minimization of Casting Defects of Double Beat Valve (Bonnet)

Rohit Patil<sup>1</sup>, Anugade Shubham<sup>2</sup>, Vinay Aute<sup>3</sup>, Mayur Raotale<sup>4</sup>, Ajit Pawar<sup>5</sup>, Abhijet Bhosale<sup>6</sup>

<sup>1</sup>Asst.Prof.of Department of Mechanical Engg.AITRC,Vita,India.

<sup>2,3,4,5,6</sup>Student of Department of Mechanical Engg.AITRC,Vita,INDIA.

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**Abstract** - In manufacturing industries, the basic requirement of quality of product, productivity and cost of product, as per current scenario of Thorat Enterprises Palus, they are manufacture various type valves in that Gate Valve, Butterfly Valve, Globe Valve, Non Return Valve, Double Beat Valve by casting process. In Double Beat Valve (Bonnet), the rejection rate is 30% or more percent of rejection. Casting industries run on the trial and error basis. So we can produce quality casting by trial and error method. Currently they are moulding the double beat valve (bonnet) in cope and drag moulding box vertical/insert core is used in this type, the core gases are trapped in moulding box and casting defects are arised. Like blowholes, pinholes, cracks and cold shut.

To eliminate or reduce these casting defects, industry wants to develop and modify the pattern and core box. And by changing the vertical/insert core to hanging core and moulding is done only in drag box and core is resting in top of moulding box, so core is open to atmosphere and core gases directly escape to atmosphere. This reduces the pinholes and cracks in casting.

**Keywords:** Casting Defects, Cause and Effect Diagram, Remedies for Casting Defects.

### 1. INTRODUCTION

Sand casting, also known as sand moulded casting a metal casting process is using sand as the mould material. The term "sand casting" can also refer to an object produced via the sand casting process. Sand castings are produced in specialized factories called foundries. Over 70% of all metal castings are produced via a sand casting process. During the process of casting, there is always a chance where defect will occur. Minor defect can be adjusted easily but high rejected rates could lead to significant change at high cost.

CASTING DEFECTS ARE ARISED IN D.B.V (BONNET) CAN BE CLASSIFIED AS FOLLOWS:

1. Filling related defect
2. Thermal defect
3. Defect by appearance

These defects are explained as follows-

### 1. FILLING RELATED DEFECT:

#### A. Blowhole:

Blowhole is a kind of cavities defect, which is also divided into pinhole and subsurface blowhole. Pin hole is very tiny hole. Subsurface blowhole only can be seen after machining. Gases entrapped by solidifying metal on surface of the casting, which results in a rounded or oval blowhole as a cavity.



Fig No: 1 blow holes

#### Possible Causes:

1. Resin-bonded sand
  - Inadequate core venting
  - Excessive release of gas from core.
2. Clay-bonded sand
  - Moisture content of sand too high, or water released too quickly
  - Gas permeability of the sand too low

#### Remedies:

1. Resin-bonded sand
    - Improve core venting, provide venting channels, ensure core prints are free of dressing
    - Reduce amounts of gas. Use slow-reacting binder. Reduce quantity of binder.
  2. Clay-bonded sand
    - Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust content.
    - Improve gas permeability. Endeavour to use coarser sand. Reduce bentonite and carbon carrier content.
- B. Cold Lap or Cold Shut:

It is a crack with round edges. Cold lap is because of low melting temperature or poor gating system. A cold shunt is called when two metal streams do not fuse together properly.



Fig No: 2 Cold Shut

Possible Causes:

- Lack of fluidity in molten metal.
- Faulty design.
- Faulty gating.

Remedies:

- Adjust proper pouring temperature.
- Modify design.
- Modify gating system.

C. Gas Porosity:

The gas can be from trapped air, hydrogen dissolved in aluminium alloys, moisture from water based die lubricants or steam from cracked cooling lines Air is present in the cavity before the shot. It can easily be trapped as the metal starts to fill the cavity.



Fig No: 3 Gas Porosity

Possible Causes:

- Metal pouring temperature too low.
- Pouring too slow.
- Slag on the metal surface.
- Metal section too thin.
- Inadequately pre-heated metallic moulds.

Remedies:

- Increase metal pouring temperature.
- Modify metal composition to improve fluidity.
- Remove slag from metal surface.
- Adequate venting of moulds and cores.

2. THERMAL DEFECTS:

A. Cracks or Tears:

Some cracks are very obvious and can easily be seen with the naked eye. Other cracks are very difficult to see without magnification.



Fig No: 4 Crack Defect

Possible causes:

- Shrinkage of the casting.
- Excessive porosity in critical regions of the part

Remedies:

- Reduce pouring temperature
- Use chills
- Avoid early knockout. Give sufficient cooling time.

3. DEFECTS BY APPEARANCE:

A. Cavities:

Blowholes, Pinholes, smooth-walled cavities, essentially spherical, often not contacting the external casting surface.



Fig No: 5 Cavities

Possible causes:

- Blowholes and pinholes are produced because of gas entrapped in the metal during the course of solidification.

Remedies:

- Make adequate provision for evacuation of air and gas from the mold cavity; Increase permeability of mold and cores.

## 2. BASIC METHODOLOGY

- Problem identification
- Study of casting defects.
- Study of literature review
- Study of different parameters of pattern.
- Study of gating system and venting.
- Design and Modification of pattern and core.
- Producing modified part by casting.
- Testing of component (hydraulic test).

## 3. LITERATURE REVIEW

1. **Achamyelah A. Kassie, Samuel B. Assfaw**- Author concluded that, through nine experiments that much more experiments were needed to determine the clear causes of gas defects as such causes are so many in number. Increasing the number of parameters and variables would give more accurate results and enables to know the effect of any individual variable on the defect scenario but, it costs is high.
2. **Rajesh Rajkolhe, J. G. Khan**- Author concluded that, different types of casting defect produced which were classified under Filling related defect, Shape related defect, Thermal defect, Defect by appearance and provided remedies to be applied to minimize the defects.
3. **Farooq Ahmed, Saood Ali, ZakaullahZaka**- Author concluded that, six different surface defects, five internal defects and six visible defects with approximately ten causes for each defect and ten remedies for each defects. Suggested remedies in the above analysis of defects should be implemented in order to enhance the quality and hence reduce the rejection cost. Sand quality, moisture content, pouring temperature, binding material quantity etc. should be in a controlled amount in order to control the process.
4. **Avinash Juriani**- Author concluded that, in this paper Foundries play a key role for manufacturing industries as they are the major source of castings. The challenges of castings defects are to be identified and minimized for effective casting. In this paper efforts are made to achieve technically feasible remedies for minimizing several castings defects and improving the quality of castings.
5. **Bhushan Shankar Kamble**- Author concluded that, the foundry had not standardized its production processes in different areas. In this review several casting defects and their occurrence cause were identified. Casting Rejection on the basis of the casting defects should be as minimum as possible for improved quality. Therefore it is essential for a metal caster to have knowledge on the identification of type of defect and be able to identify the exact root cause, and their remedies. Hence this systematic work will be fruitful for quality casting.
6. **Jatoth Ramachander**- Author concluded that, if castings are inspected with technologically advanced way, it keeps foundry men to alert condition for control of rejections and it will be within limit specified by the Indian standard. It was observed on sand process parameters and proved that they have successfully reduced the casting defects due to sand process up to 6% and it will vary in each case.
7. **Sudhir Kishore and Prakash Kumar**- Author concluded that, this paper focuses on varying sand properties and temperature. Analysis of various sand properties and temperature was carried with help of metal as pure aluminum.
8. **Mr. Siddalingswami, S. Hiremath, dr. S.R. dulange**- Author concluded that, various casting defects and their causes. While production involve various parameter like pattern making, molding, core making, and melting. A various defects like blowhole shrinkage, gas porosity, cold shot, sand inclusion etc. are generated while casting process. For improved their casting quality, they use product process search analysis, inspection method, design of experiment method to found out their remedies in casting process.
9. **M. Choudhari, B. E. Narkhede, S. K. Mahajan** Author concluded that, it was observed that solidification simulation enables visualization of the progress of freezing inside a casting and identification of the last freezing regions or hot spots. This facilitated the optimized placement and design of feeders with improvement in yield by 15 % while ensuring casting soundness without expensive and time-consuming trial runs. In this case, the thick portion of the component was subjected to shrinkage porosity. It was the root cause for the poor strength which was leading to premature failure of the component.

**4. RESULT**

Hydraulic testing report of double beat valve:

<b>THORAT VALVES PVT. LTD. SATARA</b>		<b>VALVE HYDRAULIC TEST REPORT</b>						Format no.: QA/F-02
								Ref. no.: VHTR/
								Page No.:
								Date:
SR. NO.	VALVE DETAILS			HEAT NUMBER		TEST PRESSURE (Kg/cm <sup>2</sup> )		REMARK
	VALVENO.	TYPE	SIZE	BODY	BONNET	BODY	SEAT	
1	01-C-19	C.I-DBV	300mm	-	TK-1822	15	10	A
2	02-C-19	C.I-DBV	300mm	-	TK-1823	15	10	A
3	03-C-19	C.I-DBV	300mm	-	TK-1824	15	10	R(CRACK)
4	04-C-19	C.I-DBV	300mm	-	TK-1825	15	10	A
5	05-C-19	C.I-DBV	300mm	-	TK-1826	15	10	A
6	06-C-19	C.I-DBV	300mm	-	TK-1827	15	10	A BONNET(SEAL)
7	07-C-19	C.I-DBV	300mm	-	TK-1828	15	10	A
8	08-C-19	C.I-DBV	300mm	-	TK-1829	15	10	A
9	09-C-19	C.I-DBV	300mm	-	TK-1830	15	10	A
10	10-C-19	C.I-DBV	300mm	-	TK-1831	15	10	A
STANDARD TESTING PARAMETERS								
PARTICULERS				BODY/MAX		SEAT/MAX		
DURATION OF TEST				5.00 MINUTES		2.00 MINUTES		
CI VALVES (SV, RSV, NRIV) TEST PRESSURE				15.00 KG/CM <sup>2</sup>		10.00 KG/CM <sup>2</sup>		
CS VALVE (SV, RSV, NRIV, DBV) TEST PRESSURE				30.00 KG/CM <sup>2</sup>		22.00 KG/CM <sup>2</sup>		
CI/CS VALVE (SV, RSV, NRIV, DBV) TSAT PRESSURE				As per customer requirement				
Valve numbering example, valve no.-15/C/14/A								
Abbreviations: 15=valve serial no. /C=month(march) / 14= year of manufacturing 2014								
Abbreviations: A=Valve Accepted By QA								

**5. CONCLUSION**

The main outcome from the project is to reduce casting defects in double beat valve (bonnet). By developing the core and pattern and changing the insert/vertical core to hanging/resting core. So it reduce rejection rate up to 15 - 20%.

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