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# BLOW HOLE CONTROL IN HIGH PRESSURE DIE CASTING

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**Abstract— Though I have such small experience in numbers, out my this small die casting experience I have observed all die casters face blow hole defect in there casting. You can say 35 to 40 % of it 100% rejection. Are blow hole parts. This is the only reason I choose one of practical shop floor problem to analyze and give best solution.**

**What I observe most of the die casters don't have a proper methodology to solve problem here I will give you proper methodology to solve problem particularly for blow hole. Though this work I try to give some logical solutions to solve blow hole problem in casting. In this work I used to meteorological approach, runner design re-validation, process re validation, sludge factor calculation., Try to make relation between bend Vs blow hole, machining margin Vs blow hole and rise time Vs metal travel time. We also do slow shot validation to prevent air entrapment also we will share fair result.**

***Keywords*—die casting, blow hole, casting pressure, intensification, runner, rise time, sludge factor, slow speed, bend status and machining margin.**

## I. INTRODUCTION

We are at steady die casting solutions work to make best die casting process. In addition to this work, we try to give best blow hole defect control methodology.

Blow hole is a defect in a casting caused by the escape of gas.

**Image -1:**

## II. PROBLEM

**As** general as we all know blow due to some air entrapment some where in casting. Even after that there were lot of concussion about what is it, is it gas porosity? or its shrinkage porosity.

Problem is that without adopting any methodology we start to solve problem in general which will not give sunstable result or huge variation result. Which convert in anger or frustration due to that there some more unwanted action taken place and situation will go out of control.

In this work area there is a die casting part which have a rejection 28% of blow hole after machining which add machining cost also, transportation cost (Machining at customer end). So problem may defined in categories;

1. Internal team dispute.
2. Some of loose his job.
3. Team confidence legging.
4. Process cost increase.
5. Customer dissatisfaction.

**Image -2:**

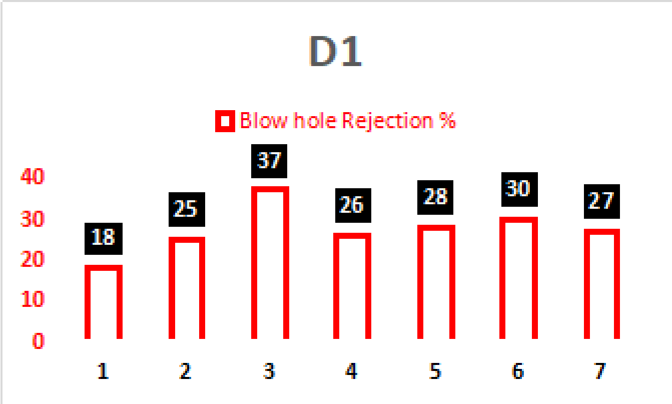


**Image -3:**

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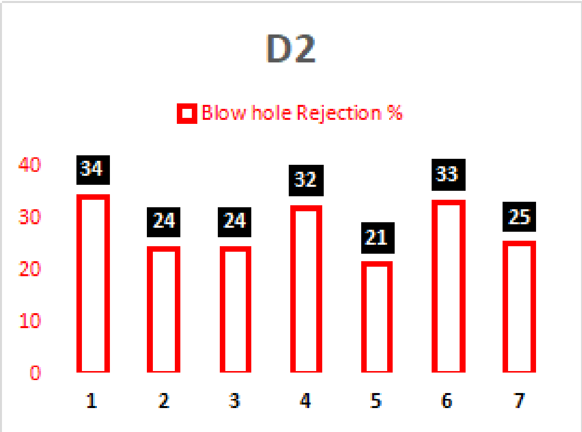
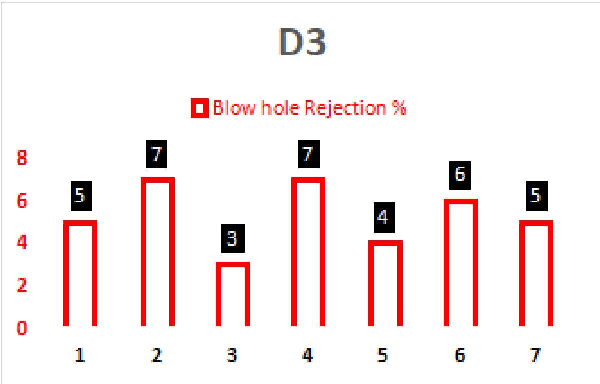



**Image -4:**




## III. ANALYSIS

### 3.1 Reason for blow hole

| Category | Measure | Reason | Countermeasures |
|---|---|---|---|
| Shrinkage porosity | Visually(Un even shape) | § Wall thickness variation | § Balanced by adding overflow near that area. |
| | | ▪ Thermal balancing of die unbalanced | Balanced by adding or removing cooling line |
| | | § Less metal pressure | § Check for correct pressure |
| | | § less si% | Check for correct % |
| | | § less biscuit thickness. | Check for correct thickness. |

| Category | Measure | Reason | Countermeasures |
|---|---|---|---|
| Gas porosity | Visually(Sphere shape) | Excess plunger lubrication | Check & avoid putting lubricant ir front of the tip, use less amount |
| | | Wet die insert | Check dry insert before closing |
| | | Undesired slow shot velocity | Calculate desired slow shot velocity |
| | | Metal treatment ( Degassing, clean ing) | Check & verified |
| | | Sharp metal entry through runner | Check there is any sharp edge and blind end. |
| | | Small size vent or jam | Check for correct size or clean |

### 3.2 Process parameter

| | PARAMETER | UNIT | D1 | D2 | D3 |
|---|---|---|---|---|---|
| 1 | NO. OF CAVITY | NO. | One | One | One |
| 2 | OVER FLOW WT. | W1(Gm) | 215 | 215 | 215 |
| 3 | PRODUCTION WT. | W2(Gm) | 1250 | 1175 | 1220 |
| 4 | RUNNER WT. | W3(Gm) | 875 | 915 | 675 |
| 5 | CASTING WT.(W1+W2+W3) | Wt(Gm) | 2340 | 2305 | 2110 |
| 6 | GATE PASSING WT.(W1+W2) | Wg(Gm) | 1465 | 1390 | 1435 |
| 7 | CASTING VOLUME | Vt=Wt/2.5 | 900 | 886.538462 | 811.5385 |
| 8 | BISCUIT THICKNESS | mm | 24.4 | 27.43 | 17 |
| 9 | TIP DIAMETER | d (mm) | 80 | 80 | 80 |
| 10 | SLEEVE CROSS AREA | As(cm2) | 50.24 | 50.24 | 50.24 |
| 11 | TIP FULL STROKE | L1 (mm) | 530 | 530 | 530 |
| 13 | SLEEVE CAPACITY | Vs=As*L1(cm3) | 2662.72 | 2662.72 | 2662.72 |
| 14 | SLEEVE FILL UP RATIO | Sc=Vt/Vs*100 | 33.80 | 33.29 | 30.48 |
| 15 | PRODUCTION WT. RATIO | Pc=W2/Wt*100 | 53.42 | 50.98 | 57.82 |
| 16 | GATE AREA | Ag | 2.9 | 2.5 | 3.0 |
| 17 | GATE RATIO | K=As / Ag | 17.32 | 20.10 | 16.75 |
| 18 | TIP LUBRICATION | MANUAL | AUTO | AUTO | AUTO |
| 19 | DIE LUBRICATION | MANUAL | AUTO | AUTO | AUTO |
| 20 | GATE VELOCITY | M/S | 72.76 | 84.5 | 70.34 |
| 21 | GATE AREA REQUIRED | CM^2 | 3.1 | 2.97 | 3.01 |
| 22 | DISCHARGE@GATE VELOCITY | M^3/S | 27 | 26.5 | 27.5 |
| 23 | DISCHARGE@45M/S | M^3/S | 13 | 13.25 | 13.75 |
| 24 | SLOW SHOT VELOCITY | M/S | 0.18 | 0.18 | 0.2 |

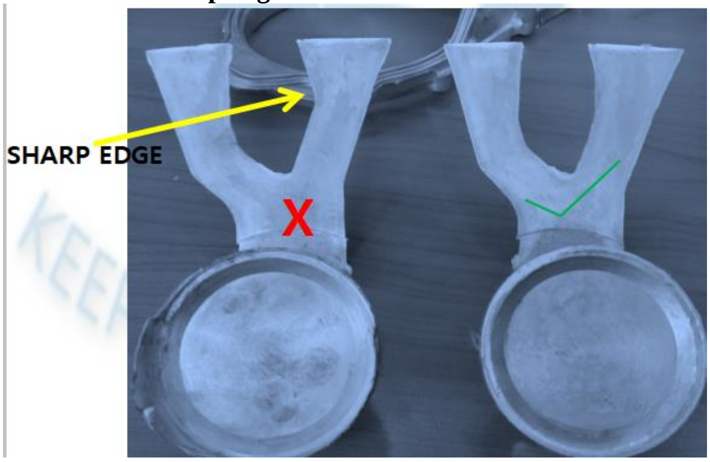
### 3.3 Sludge factor calculation

**Sludge factor (SF)**
**(SF) = (1 x wt% Fe) + (2 x wt%Mn) + (3 x wt%Cr)**

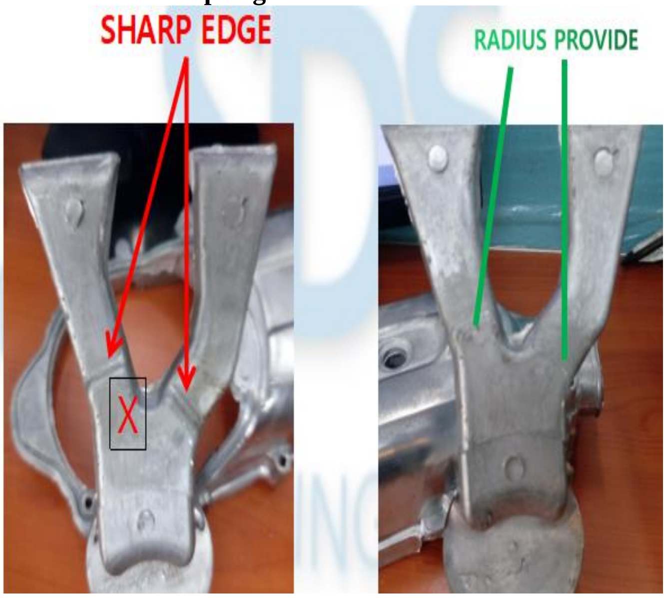
**=(1X.8)+(2X.2)+(3X.04)**
**=1.32**

**NOTE: IT SHOULD BE >=1.85**

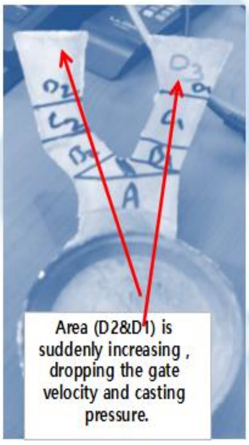
**3.4.1 Runner sharp edge**




**3.4.2 Runner sharp edge**




**3.4.3 Runner design analysis for die no D3**




| | D3 | | |
|---|---|---|---|
| ZONE | AREA (CM^2) | ZONE | AREA (CM^2) |
| A | 7.35 | | |
| B1 | 3.6 | B2 | 2.4 |
| C1 | 2.4 | C2 | 2.4 |
| D1 | 4.2 | D2 | 3.48 |

**3.4.3 Runner design analysis for die no D1 & D2**

| ZONE | AREA (CM^2) | ZONE | AREA (CM^2) |
|---|---|---|---|
| A | 10.21 | | |
| C1 | 4.38 | C2 | 5.94 |
| D1 | 4.28 | D2 | 5.70 |

**3.5 Check for excess machining margin**

| As cast | 23.2MM | |
|---|---|---|
| After m/c | | MACHINING CUT |
| D1 | 22.34MM | 0.86MM |
| D2 | 22.14MM | 1.06MM |
| D3 | 22.26MM | 0.94MM |

**3.6 Bend analysis**

| D3 | | D2 | | D1 | |
|---|---|---|---|---|---|
| Min waarpage observe | Max waarpage o bserve | Min waarpag e observe | Max waarpag e observe | Min waarpag e observe | Max waarpage observe |
| 12.49 | 12.64 | 12.25 | 12.31 | 12.44 | 12.53 |
| 11.95 | 12.74 | 12.17 | 12.5 | 12.34 | 12.58 |
| 11.61 | | 11.98 | 13.32 | 12.23 | |
| 11.53 | | 11.7 | | 12.2 | |
| | | 11.61 | | 12.14 | |
| | | | | 12.13 | |
| | | | | 12.06 | |
| Total Bend | 1.21 | | 1.71 | | 0.52 |

**3.7 Blow hole status after machining**

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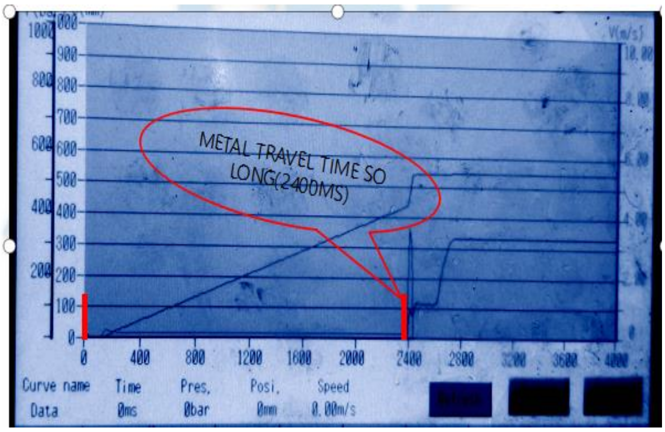
| D3 | | D2 | |
|---|---|---|---|
| BEND | STATUS | BEND | STATUS |
| 0.8 | ok | 0.8 | ok |
| 0.9 | ok | 0.52 | ok |
| 0.8 | ok | 0.3 | blow hloe |
| 0.8 | ok | 0.9 | ok |
| 0.7 | ok | 1.1 | ok |

## IV. ACTION

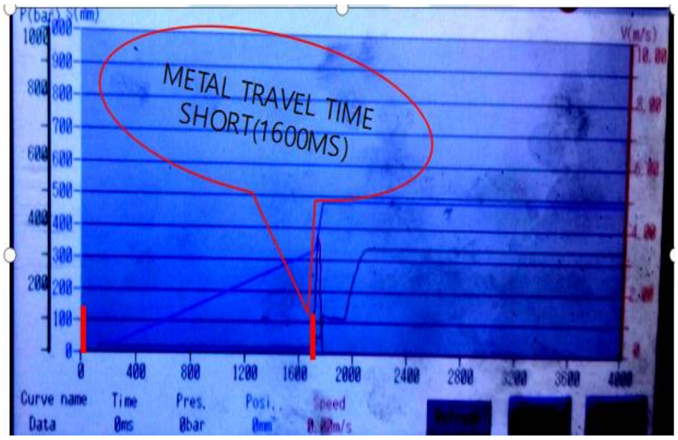
### *A.* Runner design guideline

1. Runner area must be ever-decreasing from sleeve or sprue to gate.
2. Runner design must be smooth and rounded.
3. Smooth and ever-decreasing runners can be made much smaller and more efficient, saving money and energy.
4. Start at the casting, increase area 3% to 5% at every bend, and 3% to 10% at a Y junction.
5. If possible, make the distance to each cavity the same.

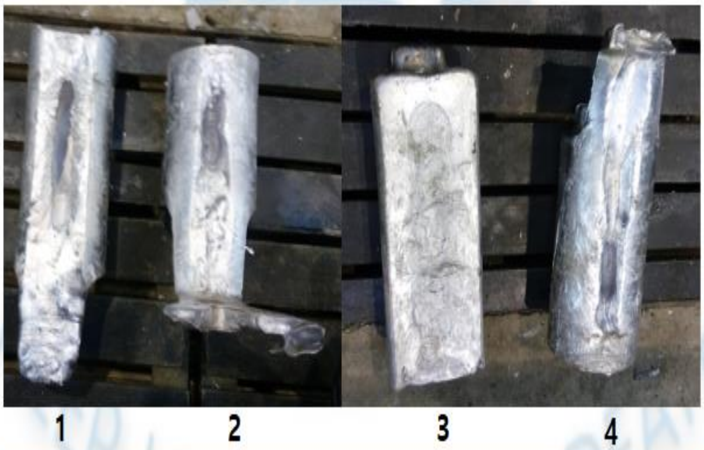
### *B.* Metal travel time before




### *C.* Metal travel time after




### *D.* Slow shot speed validation




| TRIAL | DISTANCE TRAVELBYPLUNGER(MM) | SLOW SHOT VELOCITY(M/S) |
|---|---|---|
| 1 | 360 | .15 |
| 2 | 380 | .15 |
| 3 | 300 | .2 |
| 4 | 340 | .16 |

## V. CONCLUSIONS

Thanks to all my team member. Thanks to management for their patients. In this work first we identified the type of porosity for that we use Zoom camera , X-ray and cut section. So here we find both type of porosity, accordingly we move further and take action accordingly. But before that we have to measure and analyze few things.

1. We measure blow hole % with respect to die's. e.g. D1, D2 and D3. We found D1 and D2 has higher blow hole % than D3.

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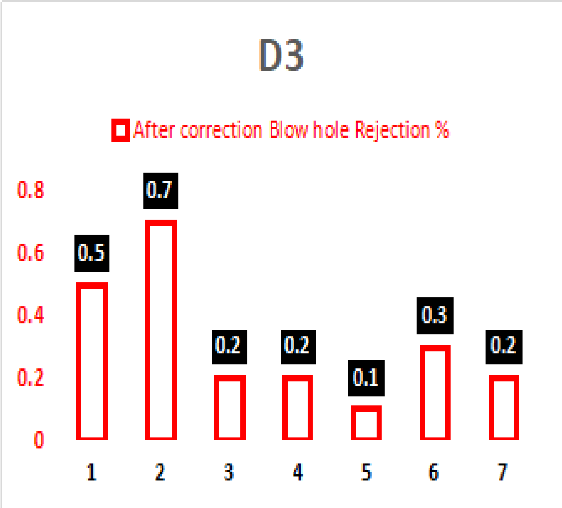
2. So first of all we categorize the blow hole as one is shrinkage porosity and second is gas porosity.
3. Write down the all possible cause of that type of porosity and it' countermeasure.
4. Here we analyzed one by one each reason and action taken care accordingly.
5. We have checked for 24 no's process parameter, sludge factor, runner design, part bend analysis, excess machining margin, metal travel time and slow shot speed.
6. As a conclusion we stop D1 and D2 die's for further mass production till action decided for these two die. We keep on running D3 die for mass production with following correction's

a) We remove sharp edges from runner.
b) We decrease metal travel time by reducing first phase length.
c) We have re validate slow shot speed for minimum air entrapment.

### 5.1 There are other few things also taken care:

1 Air vent should be clean.
2 Melting temperature variation should not be more than +-5 degree centigrade.
3 Biscuit thickness variation should be +-2mm.
4 N2 pressure should maintain as per machine standard in both accumulator (a) fast shot accumulator (b) intensification accumulator.
5 We have to ensure there should not be any water leakage in die.
6 Ensure there should not be any spray droppage on die after die coating spray function, in case of automatic spray unit.
7 Ensure die should be fully dry after spray.
8 Remove spray vapour from near die, by using fan or duct.
9 Ensure plunger lubrication should not mix with alloy during plunger lubrication.
10 Molten metal should be clean

## VI. RESULT




Again thanks to all my team member,
**"keep learning till death"**.

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