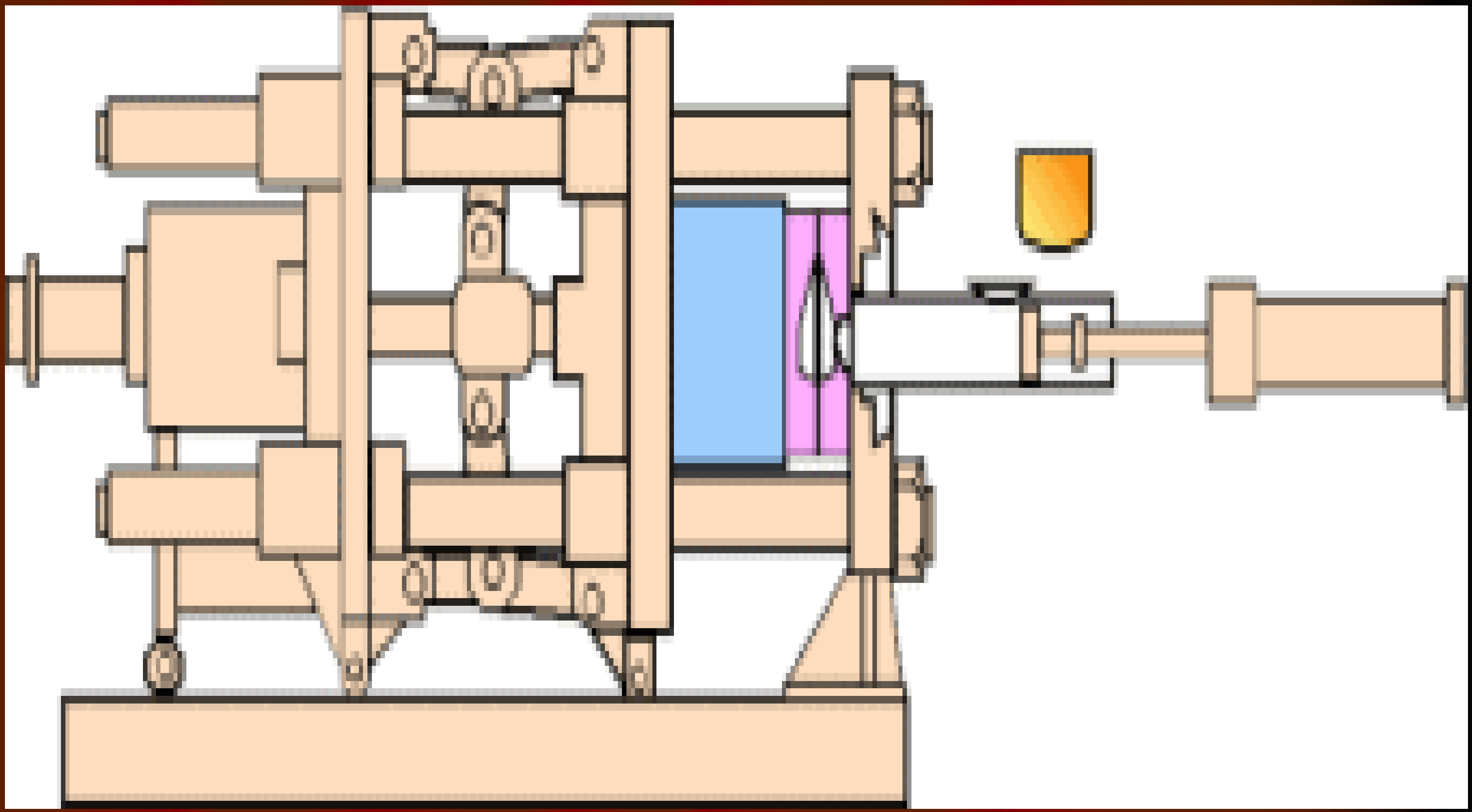
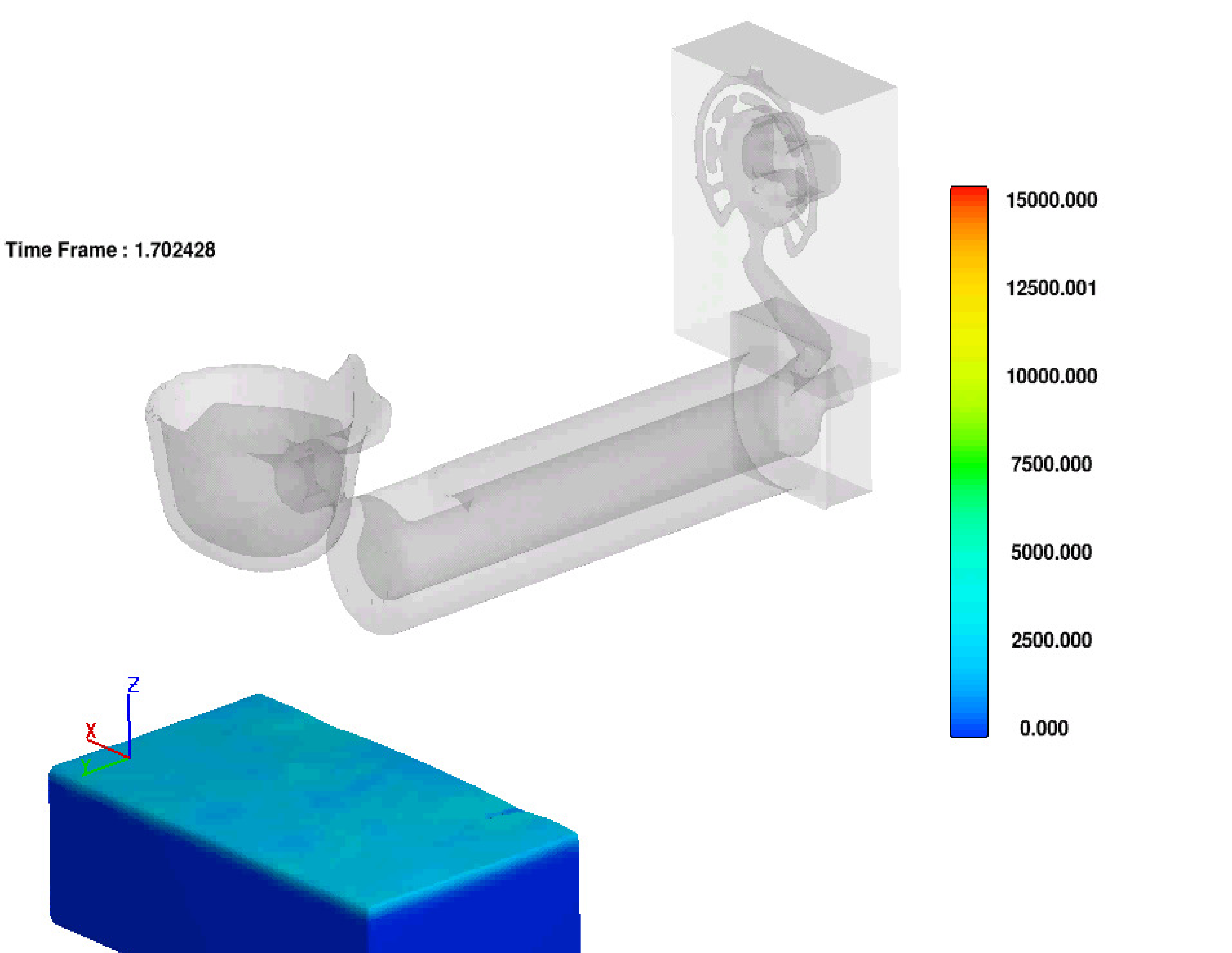
ASK Automotive (P) Limited

Welcomes
to
all the participants

ASK : Die Casting




Time Frame : 1.702428
15000.000
12500.001
10000.000
7500.000
5000.000
2500.000
0.000
Z
X
Y

Die Casting Defects

Causes and Solutions

Introduction

Important

It is impossible to be effective in solving defect problems if there is no historical record about defect problems

Important

It is also impossible to keep track of costs without good defect records; thus these records will be important enough to impact the growth and perhaps the survival of the company.

In most PDC plants keeping track of the scrap is not always the first priority, maintaining production is always more important.

………without knowing the cost of production.

Only when a customer calls or perhaps when scrap costs go sky-high does something happen to trigger some extra effort on a particular defect problem

BUT ALL TOO OFTEN THERE AREN'T ANY REALLY GOOD RECORDS - and the net result is a wild trial and error effort to find the solution.

This is an extremely expensive way to operate, and it cannot compete with the those who use technical approaches and document them properly.

Some Basic Record Keeping

(Description of Defects)

PDC plant should make their own list of casting defect codes to match their special needs.

Some Codes Suggested for PDC Defects

1. Visual appearance
    - a. Non-fills
    - b. Cold flow
    - c. Discolored
    - d. Laminations

Some Codes Suggested for PDC Defects contd….

2. Porosity
    a. Shrink
    b. Gas
    c. Flow

Some Codes Suggested for PDC Defects contd....

3. Leakers
4. Blisters
5. Sinks
6. Cracks
7. Drags
8. Solder
9. Bending
10. Distortion
11. Trim damage

Important Note

All scrap must be reported, including start up or warm up shots. These can be included in a special category if desired, but it must be reported. After all, these shots are not free.

contd…….

Important Note contd….

Every shot on a Rupees Ten Lacs die that will live for 100,000 shots is worth Rs.10/-, regardless of whether it is a start up shot or not.

contd……

Important Note contd….

There is probably another Re.1/- spent for expendables (mostly sleeves and tips) for every shot. This amounts to a good deal of money, and PDC engineers should insist on having the data.

Management must take the responsibility to see that the reporting gets done; and that whoever does it has the training and the time and freedom to do it properly.

The lack of management emphasis is usually the biggest cause for failure of these systems, and it can be very costly.

If the scrap is not defined and reported properly, then correcting the problem will usually be based on the observations available at that particular moment.

This will always result in a correction that isn't adequate and must be done over and over until finally done right.

This should not become a way of life.

There are many instances where an operator or quality control person defines something as a defect where as it really is not true.

Once the communication about so called defect is started, it may result in a series of actions that are always expensive and frequently unnecessary.

This can be avoided by making sure everyone understands the proper nomenclature and description of casting defects.

Let us discuss the various die casting defects

(Causes and Solutions)

1. Surface Defects

(Commonly known as Cold Flow or Non Fill)

Some of the typical names for Surface Defects are as follows:

1. cold flow or non-fill or not filled out
2. cold laps or swirls
3. cold fill or chill
4. Cold or laps
5. poor fill or lines

This defect is usually referred to as a metal flow defect because it is characterized by irregularities on the casting surface where the various metal flows apparently did not knit together properly.

Cold Flow Surface Defects

Cold Flow Surface Defects

Cold Flow Surface Defects

Surface defect occurs because it is always a race between the time of the molten metal arrives at a location in the die and the rapid solidification taking place.

If the metal is partially solidified when two flows come together, they form wrinkles or laps and laminations that are characteristic of surface defects.

This defect is often apparent at the end of the flow pattern and/or where the die is colder, such as the ends of ribs and bosses.

Many times the technician will try to solve this defect with one standard correction for all castings; for example, the most typical reaction is to always make some change to the gate design, even though the gating may not have anything to do with the problem.

Certainly the gating needs to be correct to avoid these defects, but other process adjustments (fill time, for example) can be the major cause and are often much easier to modify.

Main factors involved in Surface Defects are shown below:

1. Wall Thickness
2. Casting Shape
3. Fill Time
4. Flow Pattern
5. Die Temperature
6. Metal Temperature
7. Gate Velocity
8. Metallurgy
9. Venting

1. Wall Thickness

The average wall thickness is used for most castings (some use the thinnest wall section that is critical for quality issues). However the wall thickness is qualified, it is a critical factor in surface defects.

2. Casting Shape

The geometry of the part; mostly the flow distance, the number of reflections before the end of flow, and whether the flow can directly reach critical areas.

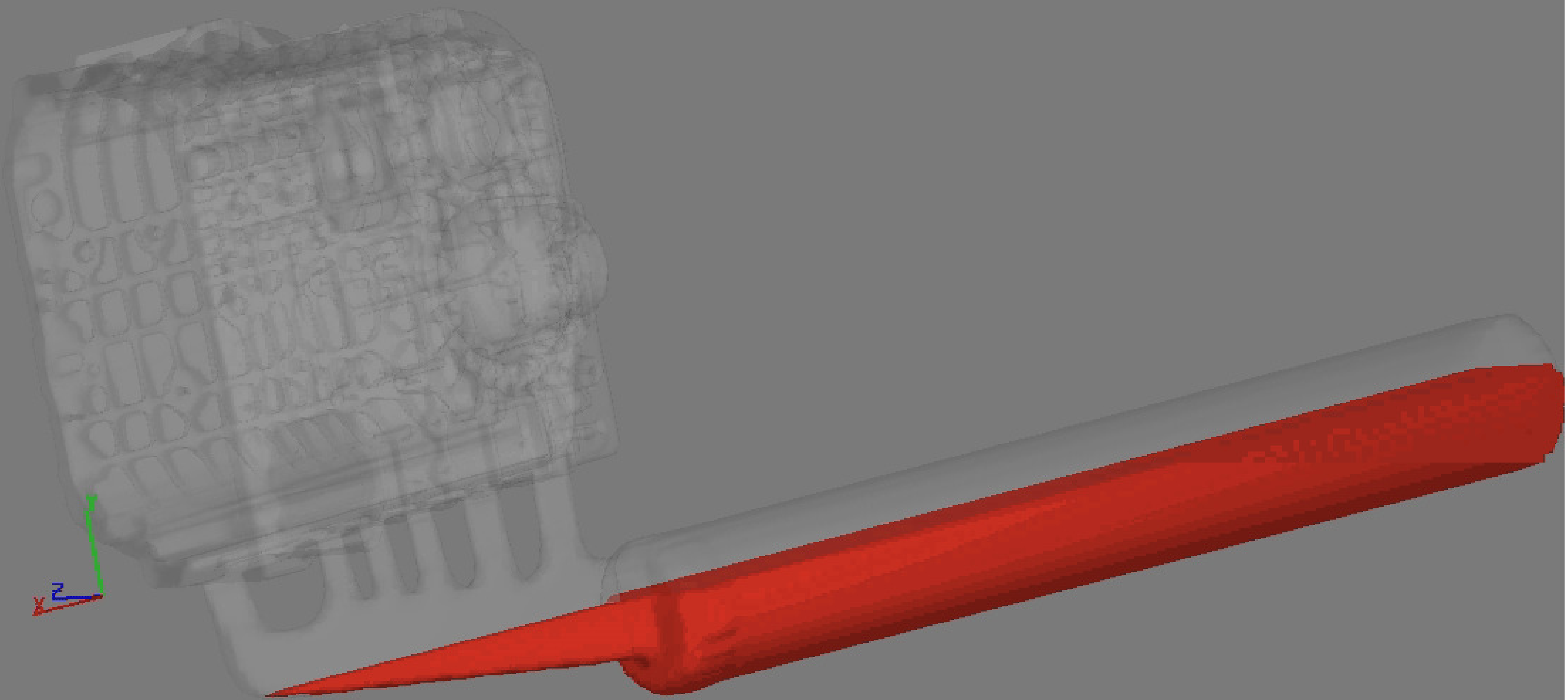
3. Fill Time

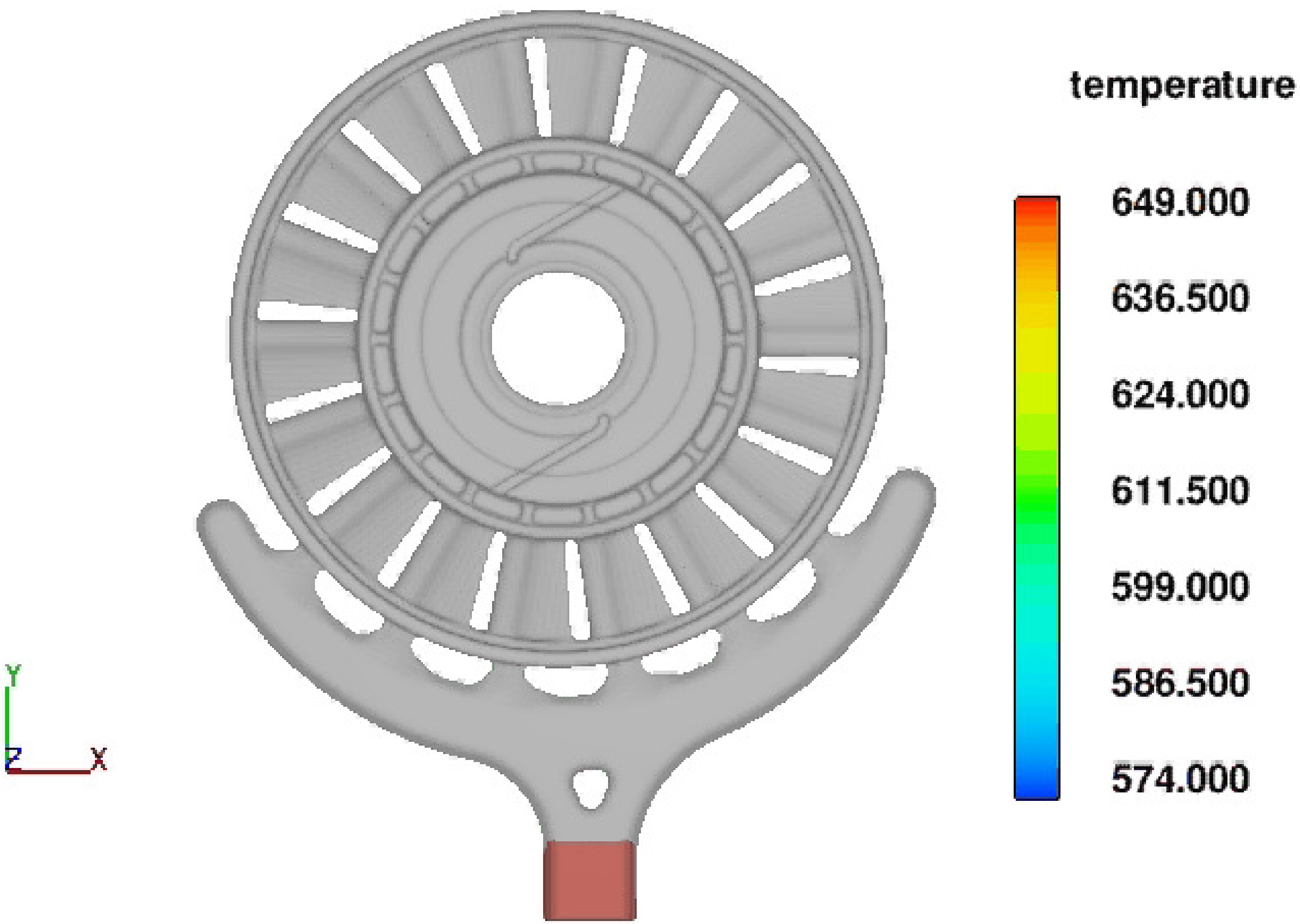
The length of time it takes to completely fill the casting with molten metal.

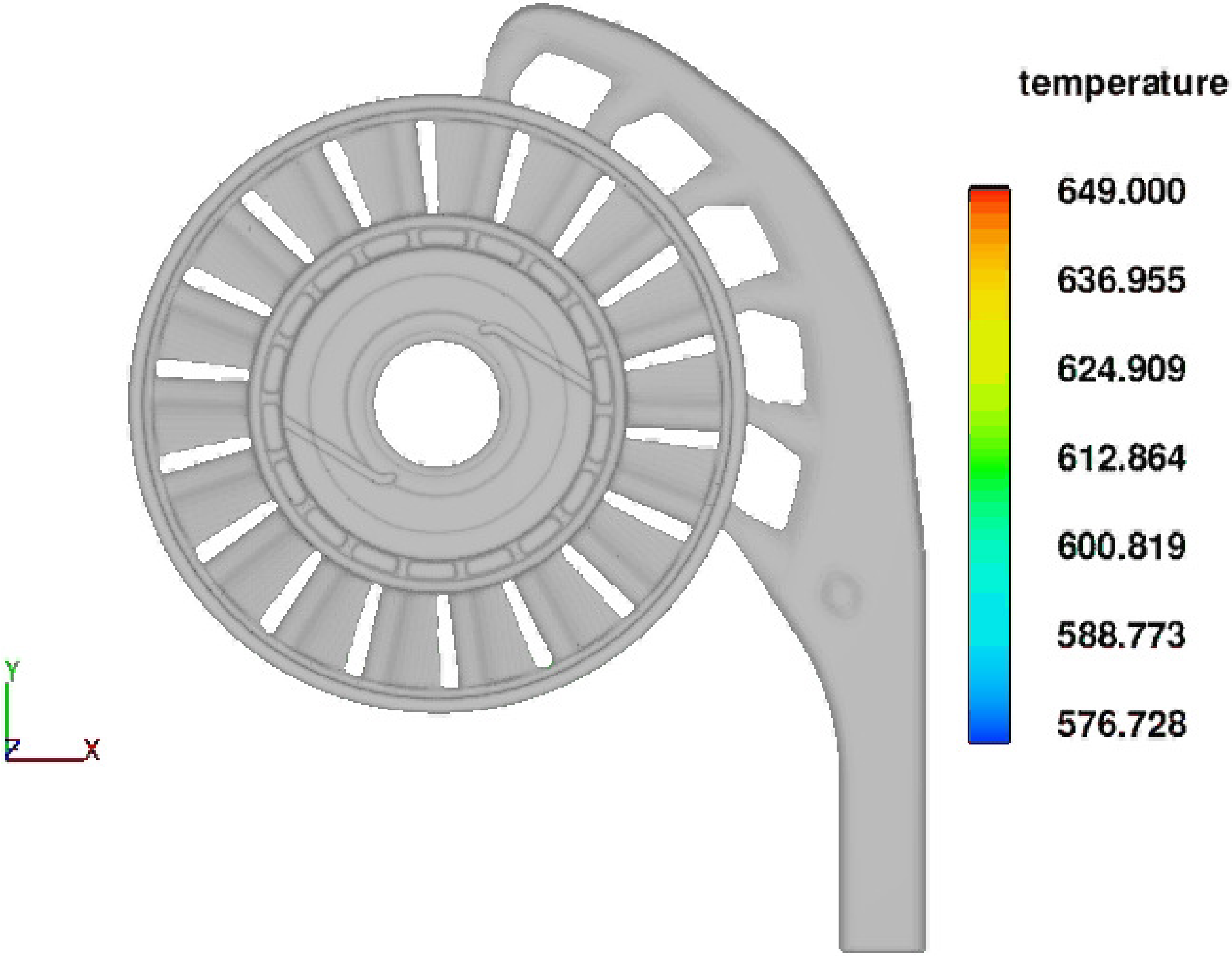
4. Flow Pattern

This is the flow pattern of the metal as determined by the gate design, and also by how many obstructions are in the flow path.

Flow-3D®




temperature
649.000
636.500
624.000
611.500
599.000
586.500
574.000
Y
Z
X


temperature
649.000
636.955
624.909
612.864
600.819
588.773
576.728
Y
Z
X

5. Die Temperature

The temperature of the die surface when the metal flows over it.

6. Metal Temperature

The temperature of the metal as it enters the die.

7. Gate Velocity

The **velocity** of the metal as it goes **through the gate**.

8. Metallurgy

The effect of the alloy constituents / elements on the casting characteristics.

9. Venting

The venting is efficiency of the die in releasing trapped gasses. This concerns porosity too, but it also has an effect on metal flow from the back pressure of the trapped gas.

Discussion on

1. Wall Thickness
2. Casting Shape
3. Fill Time
4. Flow Pattern
5. Die Temperature
6. Metal Temperature
7. Gate Velocity
8. Metallurgy
9. Venting

1. Wall Thickness

Wall Thickness is controlled by the part design as set by customer, and not controlled on the PDC, it is often eliminated from the list of potential solutions.

Contd……

1. Wall Thickness

This should not be the case because it is so important. If an effort is made to correct wall thickness problems it will often prove to be the most robust and lowest cost solution.

Solution for Wall Thickness

- Be an associate to die designer and share your experience of process with designers at early stage of tool making.

- Work to get consistent wall thickness.

Contd……..

Solution for Wall Thickness

contd…..

- Check the actual wall thickness if there are problems.
- Use the wall thickness dimensional tolerance for the process, not for tool making.
- Feed critical thin walls directly from the gate.

Contd……..

Solution for Wall Thickness

contd.....

- For thin walls,

Use very short fill times

Use high die temperatures

Use high gate velocities
(but not high enough to cause erosion)

2. Casting Shape

Part shape is a very important factor when trouble shooting surface defects and often can be the most important; but unfortunately, it is the most difficult to change

Important factors in the shape are:

- **Flow distance (distance as the metal has to travel from the gate to the furthest point to fill)**
- **Complexity of the metal flow path (how many reflections are required for the metal to reach it's final destination)**

contd.......

Important factors in the shape are:

contd…..

- Blind fill areas (cores, fins, etc.)
- Shaded areas (areas that are directly behind an object that divides the metal flow)
-

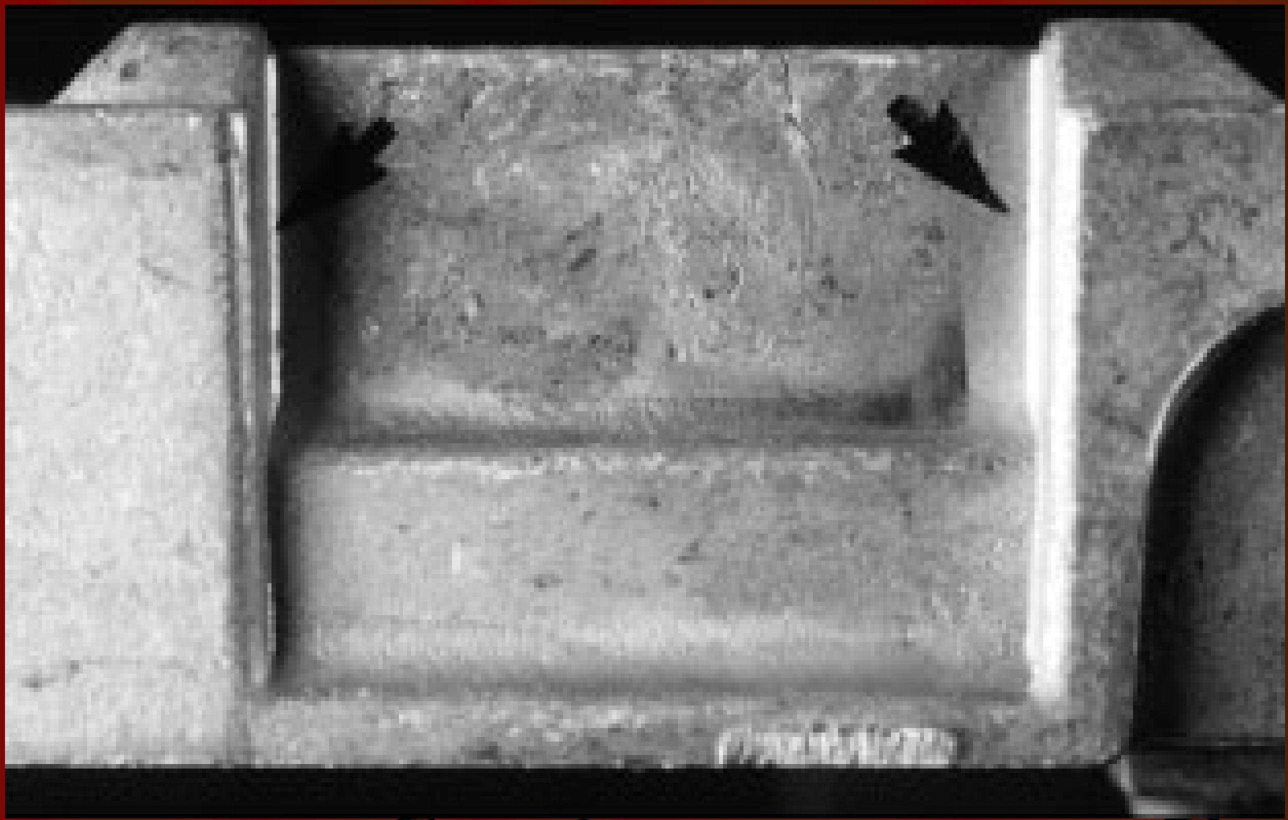
contd…

Important factors in the shape are:

contd…..

- **Draft and radii allowed.**
- **Allowable gate locations.**
- **The shape also causes hot or cold spots in the die, which in turn affects surface defects.**

The arrows point to corners that were made sharp by the customer after the part had been run without problems for several years. The sharp radii caused the surface defects shown here to appear.



3. Fill Time

Fill time is one of the most important factors in surface finish control.

The fill time is defined as the time beginning when the metal arrives at the gate and ending when the cavity is full (if they are small compared to the casting volume, the overflows can be included).

A good rule is that the faster the fill time, the better the surface finish. It should be observed that no surface defect problems arise from a very short fill time.

Unless the gate area is changed, changing fill time will change gate velocity at the same time, and excessive gate velocities can cause problems; but a quick fill time with the appropriate gate velocity and proper gate design will never by itself contribute to surface defects.

Approximate Fill Times for average surface finish

	Thin Wall up to 2.3mm	**Average Wall** above 2.3mm
Aluminum 11kg appx.	**0.09 sec**	**0.10 sec**
Zinc 6.6 kg appx.	**0.03 sec**	**0.05 sec**
Magnesium 4.4 kg appx.	**0.02 sec**	**0.03 sec**

These numbers are approximate, and should be used for an average functional casting.

For high quality surface finish, these numbers should be reduced by as much as 50%.

Controlling Fill Time

- **Changing the plunger speed :**

Faster is lower fill time,
and better finish.

Contd…..

Controlling Fill Time

contd…

Gate size : A smaller gate will generally cause the plunger to slow down because of the extra resistance at the gate.

(if no other changes are made)

contd…

Controlling Fill Time

contd…

This increases the fill time and causes a worse finish. It also affects gate velocity, but the main effect on surface finish is on the fill time.

contd……

Controlling Fill Time

contd…

Dragging tip:

A dragging tip will cause the plunger speed to change and hence the fill time to change, which can make the casting look different every shot, and will cause surface defect problems.

Contd……

Controlling Fill Time

contd…

PDC Engineer must use a monitoring system to measure and control plunger speed.

Contd….

Controlling Fill Time

contd…

Causes of dragging tips also include:

- Plunger lubrication
- Poor sleeve condition
- Poor plunger condition
- Poor cooling water flow to the plunger
- Sleeve deflection

Contd…..

Controlling Fill Time

contd…

Low (or high) nitrogen charge in the shot accumulator:

The nitrogen charge affects the speed of the plunger, especially at the end of the stroke. The nitrogen charge should be checked frequently, and always when unexpected surface defect problems occur.

contd….

Controlling Fill Time

contd…

Changing the shot system hydraulic pressure (if no other changes are made).

Increasing pressure increases plunger speed and reduces fill time (it may also contribute to flashing).

Lowering pressure reduces plunger speed and increases fill time.

Contd……

Controlling Fill Time

contd…

Summary of fill time management

- Set fill time maximum values with calculations supplemented by experience, then use disciplined process control to keep it there.

Controlling Fill Time
contd…

Summary of fill time management

- Use calculations to predict the right values for gate size, plunger size, machine pressure, and machine speed settings - eliminate costly trial and error.

Controlling Fill Time

contd…

Summary of fill time management

- Measure and control process variables with monitor system.

Controlling Fill Time
contd…

Summary of fill time management

- Maintain control of sleeve operating condition to keep the fill time within limits, and maintain nitrogen pressure correctly

4. Flow Pattern

The flow pattern is as important as the fill time in correcting surface defects, however, it is not an adjustment that can be made easily on the floor.

Getting the best flow pattern is an engineering design issue, and it should be done correctly at the time of die design.

One important step in developing the correct flow pattern is obtaining the correct gate velocity.

The actual gate velocity is either measured with a monitoring system or predicted by the PQ2 calculation.