

MANUFACTURING AND METAL WORKING PROCESS CLASSIFICATION

Manufacturing Processes can be classified as

- i) Casting
- ii) Welding
- iii) Machining
- iv) Mechanical working
- v) Powder Metallurgy
- vi) Plastic Technology etc.,

In Mechanical working Process the raw material is converted to a given shape by the application of external force. The metal is subjected to stress. It is a process of changing the shape and size of the material under the influence of external force or stress. Plastic Deformation occurs.

Classification of Metal Working Processes

1. General classification

- i. Rolling
- ii. Forging
- iii. Extrusion
- iv. Wire Drawing
- v. Sheet Metal Forming

2. Based on Temperature of Working

- i. Hot Working
- ii. Cold Working
- iii. Warm Working

3. Based on the applied stress

- i. Direct Compressive Stress
- ii. Indirect Compressive Stress
- iii. Tensile Stress
- iv. Bending Stress
- v. Shear Stress

Classification of Metal Working based on temperature.

Hot working: It is defined as the mechanical working of metal at an elevated (higher) temperature above a particular temperature. This temperature is referred to RCT (Recrystallization Temperature).

Cold Working: It is defined as the mechanical working of metal below RCT.

Warm Working: It is defined as the mechanical working of metal at a temperature between that of Hot working and Cold Working. Ingot is the starting raw metal for all metal working process.

Molten metal from the furnace is taken and poured into metallic moulds and allowed to cool or solidify. The cooled solid metal mass is then taken out of the mould. This solid metal is referred to as Ingot. This Ingot is later on converted to other forms by mechanical working.

What is a Cast Product?

It is a product obtained by just pouring molten metal into the mould and allowing it to solidify to room temperature.

It will have the final size and shape.

Engine block ,Piston etc.,

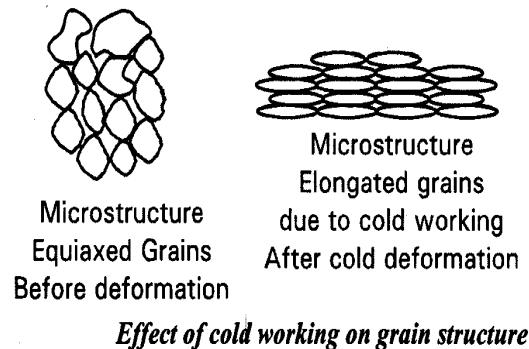
What is a wrought Product?

It is a product obtained by subjecting the hot ingot to mechanical working process to get a variety of products. Ex., spanner, screw driver, connecting rod, crank shaft etc.,

Characteristics of a Wrought Product

*Grains are oriented in a particular direction.

*The metal will show flow lines which are due to the presence of inclusions present between the metal layers.. The Metal will shows higher properties in the direction of metal flow. The defects get welded due to mechanical working



Difference between Cast and Wrought product.

Cast Product	Wrought Product
1. It is obtained by conversion of liquid metal to solid state, to get the required shape of the component in one step. The cast product may undergo machining operation.	1. It is obtained by subjecting the metal to external load or mechanical working to get the shape. It may be subjected to further operation.
2. The cast product will have uniform properties. The product is Isotropic in nature. Properties are same in all directions.	2. The wrought product will have directional properties. Properties are enhanced. The Product is anisotropic in nature. ie., properties are different in different directions.
3. The product will have uniform grain structure.	3. The product will have directional properties and the grain structure will be oriented. Grains get altered.
4. The product will have small amount of porosity which cannot be eliminated completely.	4. Due to mechanical working the porosity level is almost zero.
5. Cast product will have any shape size and complexity. Small to very huge components can be produced easily.	5. Wrought products are smaller in size but large size and moderately complex shapes can also be produced with some difficulty.
6. Even brittle metals can be cast easily.	6. Brittle metals cannot be mechanically worked.
7. The process does not need additional equipments. Only Regular maintenance of the equipment is required.	7. Needs additional equipments for mechanical working.

Difference between Hot Working and Cold Working

Hot Working	Cold Working
1. The metal is subjected to mechanical working above RCT	1. The metal is subjected to mechanical working below RCT.
2. Uniform fine equiaxed grains are produced. Properties are uniform in any direction.	2. Elongated columnar grains are produced. Properties are higher in a particular direction.
3. Properties are uniform in any direction	3. The properties are higher in a particular direction than the other
4. The components will have Isotropic properties.	4. The component will be anisotropic in nature.
5. Energy required for deformation is less.	5. Energy required for deformation is more.
6. No strain hardening takes place in the metal.	6. Strain hardening takes place in the metal.
7. Large components can be hot worked easily.	7. Only small components can be cold worked.
8. Surface oxidation occurs, scaling will be present and surface finish is poor.	8. Surface oxidation is less, scale formation is also less and surface finish is good.
9. Pores are minimized and inclusion gets redistributed.	9. Pores and inclusions cannot be taken care of to a great extent.
10. Capacity of the equipment is less.	10. The capacity of the equipment required for cold working is less.
11. Needs extra equipment for heating of the metal.	11. Does not need extra equipment as in hot working.
12. Handling of hot metal is difficult.	12. Handling of metal is not very difficult.

Based on the type of applied stress

- Direct compression stress : Rolling and Forging
- Indirect Compression: Extrusion and Wire drawing.
- Tensile stress: Stretch forming
- Bending stress: Sheet bending/ roll bending
- Shear stress: Cutting of sheet

Source : <http://elearningatria.files.wordpress.com/2013/10/vtu-e-notes-mpiii-17.pdf>