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Issue : 7

Date : 01. 06. 2014

TATA METALIKS LIMITED

Dear Customer,

It gives me great pleasure to connect you through our technical news letter PRAYAS published from our Customer Service Centre (CSC) at Howrah, which is one of our customer relationship management initiatives to reinforce and sustain long term relationship with valued customers like you.

TML intends to share and disseminate knowledge on the best foundry practices to make the foundries competitive and enable you to establish as quality casting producer in your market segment. PRAYAS will also enable you to make a difference in the market with effective resolution of quality issues pertaining to your products and processes.

In the foundry business, pattern making is the key driver to a perfect casting and is a highly skilled and precise process that is critical to the quality of the final product. In this 7th issue of PRAYAS, our team is providing the salient features in technology of Pattern Making to improve skill of your pattern maker, which is a key to determine the quality of the final casting.

We hope, PRAYAS along with the services provided by our CSC, are adding value to your business practices and addressing your technical needs.

We always welcome your valuable feedback and suggestions to improve our effort in future.

Yours sincerely,

SANJIV PAUL
Managing Director

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TATA METALIKS LIMITED

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Editorial

Dear Readers,

All sand casting processes start out with the creation of what is termed tooling.

This tooling consists of a pattern which is a positive replica of the part and forms the outside surface of the casting.

The quality of the patterns that we use is as important as the patterns themselves because Quality of castings not only depends on the quality of raw materials like pig iron, Ferro alloys but also on the quality of pattern. The cost for pattern development is usually the major cost in the development of the casting.

To insist and create awareness on quality of patterns, in this issue of PRAYAS , the insights of pattern making are provided to get an idea of the type of pattern to be made with specific material as per production process, castings quality requirement and quantity. The details of various allowances to be considered during pattern development and expected life of patterns are provided in detail for your understanding.

We are sure that this article will enhance your patterns knowhow and offer salient points in development of patterns for your foundry.

Regards

M Sambasiva Rao and Sukhendu Mukherjee

Editorial Team

M Sambasiva Rao, Sukhendu Mukherjee
Munmun Pal and Monideep Majumder

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Pattern and Technology Of Pattern Making :

Pattern is the principal tool in the hands of foundry men. It is model or the replica of the object to be cast and except for the various allowances a pattern exactly resembles the object to be cast. Pattern is required even if one object has to be cast also.

A pattern may be defined as a model or a form around which sand is packed to give rise to a cavity known as MOULD CAVITY in which when molten metal is poured, the result is the CASTING. The main difference between a pattern and the casting is as regards to their dimensions. A pattern is slightly larger in size as compared to the casting. It carries many allowances like shrinkage allowance, machining allowance etc.

Materials used in making Patterns :

The selection of pattern materials depends on factors such as

1. Service requirements like quantity, quality, intricacy of castings, minimum thickness desired, degree of accuracy and surface finish

2. Type of production of castings, type of moulding method and equipment to be used

3. Possibility of design changes

4. Possibility of repeat orders

Patterns may be constructed out of the following materials. The different materials have their own advantages, limitations and field of applications.

1. *Wood and wood products*
2. *Metals and alloys* ***3.*** *Plasters*
4. *Plastics and Rubbers* ***5.*** *Waxes*

Types Of Patterns:

1. Loose patterns – *One piece type, split type, loose piece type, or with follow board.*

2. Gated patterns – *This is an improvement on the ungated pattern. The gating system constitutes a pat of the pattern. This type eliminates hand cutting of gates, runner etc. and enables more rapid moulding.*

3. Match Plate Patterns – *This is convenient when small castings are to be produced in large quantities on moulding machines. Cope and drag parts of the pattern are mounted, along with the gating system, either on the two sides of the wooden or metal plate or on separate pattern plates conforming to the parting line. This type of pattern increases the dimensional accuracy of the casting. A limitation of this type of pattern arises in the weight of the mould and flask which can be handled by the moulder.*

4. Special Patterns – *Devices such as sweep and skeleton are ideal when preparation of a regular solid pattern would be too expensive and the shapes to be cast permit their use.*

Generally, large sized castings of symmetrical nature, such as wheels, rims and bell shapes can be prepared by sweeping.

A skeleton pattern is made by using a wooden skeleton frame and filling spaces between the wooden pieces with moulding sand. The exact overall shape is obtained by firmly pressing the sand. This method is suitable when just one or a few castings of large size are required.

Pattern Allowances:

Although the pattern is used to produce a casting of the desired dimensions, it is not dimensionally identical with the casting. For metallurgical and mechanical reasons, a number of allowances must be made on the pattern if the casting is to be dimensionally correct.

Pattern allowances is a vital feature in pattern design as it affects the dimensional characteristics of the casting. The selection of correct allowances greatly helps to reduce machining costs and avoid rejections.

(1) Shrinkage Or Contraction Allowance:

Shrinkage allowance on patterns is a correction for solidification shrinkage of the metal and its contraction during cooling to room temperature. The total contraction is volumetric, but the correction for it is usually expressed linearly. Pattern shrinkage allowance is the amount the pattern must be made larger than the casting to provide for total contraction.

Generally the pattern maker is equipped with the contraction (shrink) rule, which is used to compensate for the shrinkage value. Contraction allowance for grey cast iron is from 0.7% to 1% and for spheroidal graphite iron is 1.2 to 1.5% depending on various factors like composition of metal, impurities and constituents present, method of moulding, pouring temperature and design & intricacy of the casting.

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(2) Machining Allowance :

Machining allowance is the amount the dimensions on a casting are made oversize to provide stock for machining. This allowance is influenced by the metal, the casting design and the method of casting and cleaning. In general, machining allowances may be minimum if the surfaces to be machined are entirely in the drag half of the mould since dimensional variation and other defects are usually least prevalent there.

Providing too large a machining allowance would mean producing a heavier casting than required, involving an increase in the melting cost and removal of greater quantity of metal during machining. This will lead to a rise in the cost of production. On the other hand, too small a machining allowance would lead to a difficulty in machining to achieve the desired dimensional accuracy, causing the casting to be rejected. Thus, good foundry practice demands selection of optimum values of machining allowance on different surfaces of the pattern. The recommended machining allowance for cast irons is 3.0 mm to 3.5 mm in case of hand moulding and 2.0 mm to 2.5 mm in case of machine moulding.

(3) Draft or Taper Allowance:

Draft is the taper allowed on vertical faces of a pattern to permit its removal from the sand or other moulding medium without tearing the mould cavity surfaces.

The amount of taper depends on shape and size of the pattern in depth direction in contact with the mould cavity, moulding method and pattern material.

A taper of 10 to 15 mm per 1000mm is common for vertical walls on patterns drawn by hand and machine drawn patterns require about one degree taper.

In case of metal or resin patterns, mould taper can be reduced by 50% and in case of pockets or deep drawn cavities in the pattern, considerably more draft is necessary to avoid tearing of the mould during withdrawal of the pattern.

(4) Size Tolerance:

The variation which may be permitted on a given casting dimension is called its tolerance and is equal to the difference between the minimum and maximum limits for any specified dimension.

A common rule states that size tolerance should be at least half the shrinkage allowance.

(5) Rapping and Shake Allowance:

Pattern is shaken or rapped by striking the same with a wooden piece from side to side for easy withdrawal, the mould cavity gets slightly larger in size to loosen the pattern to remove easily. This also causes the casting size to increase.

To compensate for this growth, the pattern should initially be made slightly smaller (negative allowance) than the required size. In small and medium size castings, this allowance may be ignored but for large castings or where high precision is desired, this allowance should be considered.

Its value is decided by experience or by trial as it varies with the moulder and the magnitude of shake allowance can be reduced by increasing the taper.

(6) Distortion Allowance:

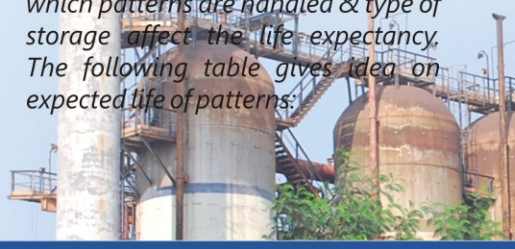
Certain castings such as large flat plates and dome or U shaped castings, distort when reproduced from a straight or perfect pattern. In such cases, the pattern may be intentionally distorted. The distorted pattern then produces a casting of the proper shape and size.

The distortion in casting may occur due to internal stresses in casting, which in turn may be caused on account of unequal cooling rates of different sections of the casting, hindered contraction from cores and unequal heat transfer rates.

Measures taken to prevent distortion include modification of the casting design to avoid abrupt changes in sections, areas of heat and stress concentration, intersecting ribs, improving foundry practice and reducing casting strain by controlled pouring temperature, use of chills for uniform cooling rates and by providing suitable distortion allowance on the pattern.

Life of Patterns:

The life of patterns can be expressed in terms of the number of moulds that can be produced. The pattern material, type of construction, moulding method and care with which patterns are handled & type of storage affect the life expectancy. The following table gives idea on expected life of patterns:



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S.N.	Method Of Using Pattern	Pattern Material	Construction Type	Expected Life In Number Of Moulds Produced
1.	Loose	Soft wood	Skeleton	20 to 50
2.	Loose	Hard wood	Skeleton	200
3.	Mounted	Hard wood	Solid & Wearing surfaces faced with metal	1000
4.	Mounted	Epoxy Resin	Cast in plaster or plastic moulds	2000
5.	Mounted	Epoxy Resin with filler	Gel coat, lamination with fibre glass	5000
6.	Mounted	Aluminium pressure cast	As cast and cleaned	5000 - 7000
7.	Mounted	Aluminium Sand cast	Machined all over and polished	30,000
8.	Mounted	Brass, S.G.Iron, Grey Iron and steel	Machined all over and polished	1,00,000

Machines, equipment and techniques for pattern making

Constructing or making of patterns is a science and an art. It is a skill which plays a major role in producing the desired dimensions of a casting. Most of the tools employed for pattern making are same as used by a carpenter.

A pattern maker is of course more concerned with the accuracy of dimensions and surface finish of the object than a carpenter.

***Machines for wood pattern making** – Wood working lathe, Circular saw, Band saw, Jig saw, Jointer, Planer, Shaper, Milling machine, Disc& bobbin sander and tool grinding machine and hand tools for measuring, marking, boring, clamping tool etc.*

***Machines for metal pattern making** – Universal and vertical Milling machines, Lathe machine, Shaping machine, vertical boring machine, Radial drilling machine, Hydraulic hacksaw machine, surface grinding machine, coordinate marking and measuring machine and hand tools for measuring, marking, boring, clamping tool etc.*

***Rapid tool manufacturing techniques** – Rapid prototyping, Modelling & Slicing, Prototype fabrication etc.*

CUSTOMER VOICE

Mr. Pawan Kumar Kejriwal, CMD
M/s Sunline Steel Industries (P) Ltd.,
Telangana.

We have recently started taking SG Grade pig iron from TATA METALIKS. We are very much pleased and satisfied by the product and the technical service given by them. Not only is the product quality excellent, but the technical service given by Mr Rao has helped us to reduce our costing and improve drastically on our end product.

They are available 24X7 to assist us. This technical know how which was provided by them is very beneficial for small foundries like ours.

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TATA METALIKS LIMITED

Bouquet Of Tata Metaliks Technical Services

- CHARGE MIX AND MELTING
- S G IRON PRODUCTION AND DEVELOPMENT
- POLLUTION RELATED SERVICES
- MOULDING & CORE MAKING
- PROJECT BASED TECHNICAL CONSULTANCY
- CUSTOMISED TRAINING PROGRAMMES

Customer Service Centre is equipped with Laboratory to provide following Testing Facilities. For samples of :

(1) Coke, Coal, CPC and Graphite : % content of Moisture, Ash, Volatile Matter, Carbon, Sulphur and Phosphorus
(2) Casting, Scrap & Pig Iron : % content of Carbon, Silicon, Manganese, Sulphur, Phosphorous and Chromium
(3) Limestone : % content of CaO & SiO_2 **(4) Refractory bricks :** % content of Al_2O_3 & SiO_2 **(5) Bentonite :** Gel Index, PH Value

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Route Map of Customer Service Centre, Howrah