

UNIT 4

PRODUCTION COST ESTIMATION

COST ESTIMATION IN FOUNDRY SHOP

Foundry is a metal casting process in which the metal is melted and poured into the moulds to get the components in desired shape and size. Castings are obtained from a foundry shop.

Generally a foundry shop has the following sections:

1. Pattern Making Section

In this section the patterns for making the moulds are manufactured. The machines involved in making the patterns are very costly and small foundries may not be able to afford these machines. In such cases the pattern are not made for outside parties who are specialists in pattern making. Patterns are made either from wood or from a metal.

2. Sand-mixing Section

In this section raw sand is washed to remove clay etc., and various ingredients are added in the sand for making the cores and moulds.

3. Core-making Section

Cores are made in this section and used in moulds to provide holes or cavities in the castings.

4. Mould Making Section

This is the section where moulds are made with the help of patterns. The moulds may be made manually or with moulding machines.

5. Melting Section

Metal is melted in the furnace and desired composition of metal is attained by adding various constituents. Metal may be melted in a cupola or in an induction or in an arc furnace. In some cases pit furnace is also used for melting the metals.

6. Fettling Section

The molten metal after pouring in the moulds is allowed to cool and the casting is then taken out of mould. The casting is then cleaned to remove sand and extra material and is shot blasted in fettling section. In fettling operation risers, runners and gates are cut off and removed.

7. Inspection Section

The castings are inspected in the inspection section before being sent out of the factory.

ESTIMATION OF COST OF CASTINGS

The total cost of manufacturing a component consists of following elements:

1. Material cost.
2. Labour cost.
3. Direct other expenses.
4. Overhead expenses.

Material Cost

(a) Cost of material required for casting is calculated as follows:

(i) From the component drawing, calculate the volume of material required for casting.

This volume multiplied by density of material gives the net weight of the casting.

(ii) Add the weight of process scrap *i.e.* weight of runners, gates and risers and other material consumed as a part of process in getting the casting.

(iii) Add the allowance for metal loss in oxidation in furnace, in cutting the gates and runners and over runs etc.

Note: The casting drawing is made by adding various allowances like shrinkage, draft and machining allowance, etc., to the dimensions of finished component.

(a) In addition to the direct material, various other materials are used in the process of manufacture of a casting. Some of the materials are:

(i) Materials required in melting the metal, *i.e.*, coal, limestone and other fluxes etc. The cost of these materials is calculated by tabulating the value of material used on per tonne basis and then apportioned on each item.

(ii) Material used in core shop for making the cores, *i.e.*, oils, binders and refractories etc.

The cost of core materials is calculated depending upon the core size and method of making the core. Similarly the cost of moulding sand ingredients is also calculated.

The expenditure made on these materials is generally expressed as per kg of casting weight and is covered under overhead costs.

Labour Cost

Labour is involved at various stages in a foundry shop. Broadly it is divided into two categories:

(i) The cost of labour involved in making the cores, baking of cores and moulds is based on the time taken for making various moulds and cores.

(ii) The cost of labour involved in firing the furnace, melting and pouring of the metal.

Cleaning of castings, fettling, painting of castings etc., is generally calculated on the

basis of per kg of cast weight.

Direct Other Expenses

Direct expenses include the expenditure incurred on patterns, core boxes, cost of using machines and other items which can be directly identified with a particular product. The cost of patterns, core boxes etc., is distributed on per item basis.

Overhead Expenses

The overheads consist of the salary and wages of supervisory staff, pattern shop staff and inspection staff, administrative expenses, water and electricity charges etc. The overheads are generally expressed as percentage of labour charges.

The cost of a cast component is calculated by adding the above constituents.

Problems on COST ESTIMATION IN FOUNDRY SHOP

Example 1 : Calculate the total cost of CI (Cast Iron) cap shown in Fig. from the following data :

Cost of molten iron at cupola spout	= Rs. 30 per kg
Process scrap	= 17 percent of net wt. of casting
Process scrap return value	= Rs. 5 per kg
Administrative overhead charges	= Rs. 2 per kg of metal poured.
Density of material used	= 7.2 gms/cc
The other expenditure details are:	

<i>Process</i>	<i>Time per piece</i>	<i>Labour charges per hr</i>	<i>Shop overheads per hr</i>
Moulding and pouring	10 min	Rs. 30	Rs. 30
Casting removal, gate cutting etc.	4 min	Rs. 10	Rs. 30
Fettling and inspection	6 min	Rs. 10	Rs. 30

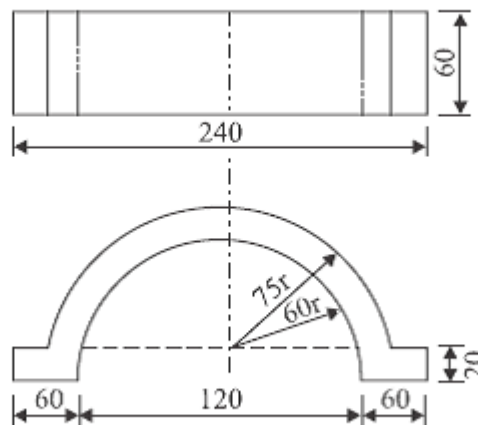


Fig. 5.1. All dimensions are in mm.

Solution: To calculate material cost :

$$\text{Volume of the component} = (2 \times 6 \times 2 \times 6) + \frac{1}{2} \times \pi [(7.5^2 - 6^2) 6]$$

$$= 335 \text{ cc}$$

$$\text{Net weight of the casting} = 335 \times 7.2$$

$$= 2,412 \text{ gms}$$

$$= 2.4 \text{ kgs}$$

$$\text{Process scrap} = 2.4 \times 0.17 = 0.4 \text{ kg}$$

$$\text{Metal required per piece} = 2.4 + 0.4 = 2.8 \text{ kgs}$$

$$\text{Material cost/piece} = 2.8 \times 30 = \text{Rs. } 84$$

$$\text{Process return} = 0.4 \times 5 = \text{Rs. } 2$$

$$\text{Net material cost per piece} = 84 - 2 = \text{Rs. } 82$$

(ii) Calculate Labour Cost and Overheads

<i>Process</i>	<i>Time per piece</i>	<i>Labour charges per piece (Rs.)</i>	<i>Shop overheads per piece (Rs.)</i>
Moulding and pouring	10 min	$\frac{10}{60} \times 30 = 5$	$\frac{30 \times 10}{60} = 5$
Casting removal, gate cutting etc.	4 min	$\frac{4}{60} \times 10 = 0.67$	$\frac{30 \times 4}{60} = 2$
Fettling and inspection	6 min	$\frac{6}{60} \times 10 = 1$	$\frac{30 \times 6}{60} = 3$
Total		Rs. 6.67	Rs. 10

$$\text{Labour charges} = \text{Rs. } 6.67 \text{ per piece}$$

$$\text{Shop overheads} = \text{Rs. } 10 \text{ per piece}$$

$$\text{Administrative overheads} = 2 \times 2.8 = \text{Rs. } 5.6$$

$$\text{Total cost per piece} = 82 + 6.67 + 10 + 5.6$$

$$= \text{Rs. } 104.27$$

Example 2: A cast iron component is to be manufactured as per Fig. 5.2. Estimate the selling price per piece from the following data:

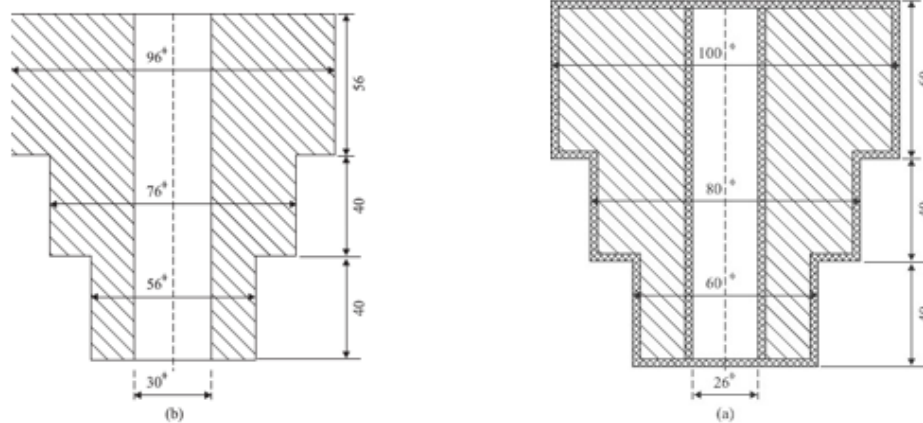
Density of material	= 7.2 gms/cc
Cost of molten metal at cupola spout	= Rs. 20 per kg
Process scrap	= 20 percent of net weight
Scrap return value	= Rs. 6 per kg
Administrative overheads	= Rs. 30 per hour
Sales overheads	= 20 percent of factory cost
Profit	= 20 percent of factory cost
Other expenditures are:	

Operation	Time (min)	Labour cost/hr (Rs.)	Shop overheads/hr (Rs.)
Moulding and pouring	15	20	60
Shot blasting	5	10	40
Fettling	6	10	40

The component shown is obtained after machining the casting. The pattern which costs

Rs. 5,000 can produce 1,000 pieces before being scrapped. The machining allowance is to be taken as 2 mm on each side.

Solution: Fig. 5.2 (b) shows the component in finished condition. Fig. 5.2 (a) has been drawn by adding the machining allowance of 2 mm on each side.



(i) *Material cost:*

$$\begin{aligned}\text{Net volume of cast component} &= \frac{\pi}{4} (10^2 \times 6 + 8^2 \times 4 + 6^2 \times 4 - 2.62^2 \times 14) \\ &= 711 \text{ cc}\end{aligned}$$

$$\begin{aligned}\text{Net weight of cast component} &= 711 \times 7.2 = 5117 \text{ gm} \\ &= 5.117 \text{ kg}\end{aligned}$$

$$\begin{aligned}\text{Process scrap} &= 20 \text{ percent of } 5.117 \text{ kg} \\ &= 0.2 \times 5.117 = 1.02 \text{ kg}\end{aligned}$$

$$\text{Total metal required per component} = 5.12 + 1.02 = 6.14 \text{ kg}$$

$$\text{Cost of metal poured} = 6.14 \times 20 = \text{Rs. } 122.8$$

$$\text{Process return value} = 1.02 \times 6 = \text{Rs. } 6.12$$

$$\text{Material cost per component} = 122.8 - 6.1 = \text{Rs. } 116.7$$

(ii) *Labour cost and factory overheads:*

$$\text{Labour cost} = \text{Rs. } 6.83$$

$$\text{Shop overheads} = \text{Rs. } 22.33$$

<i>Process</i>	<i>Time per piece (Minutes)</i>	<i>Labour cost per piece (Rs.)</i>	<i>Shop overheads per piece (Rs.)</i>
Melting and pouring	15	5.00	15.00
Shot blast	5	0.83	3.33
Fettling	6	1.00	4.00
Total	26 min	6.83	22.33

$$(iii) \text{ Factory cost per component} = 116.70 + 6.83 + 22.33 = \text{Rs. } 145.86$$

$$(iv) \text{ Administrative overheads} = \frac{30 \times 26}{100} \\ = \text{Rs. } 13$$

$$(v) \text{ Sales overheads} = 0.2 \times 145.86 = \text{Rs. } 29.17$$

$$(vi) \text{ Profit} = 0.2 \times 145.86 = \text{Rs. } 29.17$$

$$\begin{aligned}\text{Selling price per component} &= \text{Factory cost} + \text{Administrative overheads} \\ &\quad + \text{Sales overheads} + \text{profit} \\ &= 145.86 + 13 + 29.17 + 29.17 \\ &= \text{Rs. } 217.2\end{aligned}$$