A PROGRAM
for
MANUFACTURING COST ESTIMATING
of
SHEET METAL STAMPING and FORMING
(Sample C)

The program presented here is limited to estimating the manufacturing cost of sheet metal stamping and forming. With the entry of certain data (to be defined) the application of this program will yield the cost of material, labor, burden and scrap. The sum of these factors is considered to be manufacturing cost.

We should state here that the system being presented is based on Asset Center Costing (ACC). This costing technique is akin to Activity Based Costing but may best be explained by comparing it with the traditional Labor Base Distribution (LBD) technique. Using the LBD method, hourly burden costs are determined by collecting all shop burden costs for some period of time, then dividing this total by the number of direct labor hours accumulated in that period of time. The quotient is the burden rate per direct labor hour. This burden rate does not discriminate between the cost of a simple bench operation and the cost of a complex CNC machine, in spite of the obvious discrepant burden costs. The LBD method will charge the burden rate for a given piece of equipment for as many times as there are operators on that operation. If there are two operators, the burden is charged twice, if there are three operators the burden is tripled. This simple presentation easily illustrates the potential inequality of LBD costing. The ACC method accounts for the specific burden costs associated with a given piece of equipment. The cost charged to the part being costed is only for the time that a given operation takes in that equipment. Labor costs are calculated independently. Machine burden is only charged once. The ACC method assumes 100% utilization. Where the utilization is something less than 100%, additional calculations must be made to account for the lower utilization.

The method used in this program for cost determination is Asset Center Costing. Simply stated this method uses burden derived for each piece of production equipment (asset center) as compared to the labor hour distribution method that has been in common usage.

The database of this program contains the burdened hourly cost of labor, the installed cost of the required equipment, the burden associated with the operation of that equipment and the nominal scrap rate used in the pricing formula.

The application of this program requires that the user possess some degree of competence in the following disciplines:
1. Geometry
2. Trigonometry
3. The behavior of metals in the stamping/forming process
4. The rudiments of die design
5. Die cost
6. The economic impact of die design alternatives (single function, progressive, transfer, etc)
Knowledge of these characteristics can be acquired in intensive training sources. A typical engineering curriculum includes training in these subjects. Some field exposure will hone these skills.

Items 1 and 2 relate to being able to determine the weight and blank size of the part to be produced,

Item 3 affects the manner in which the blank must/may be worked to produce the finished part; forming relative to the grain, springback, material elasticity, formability

Item 4 is important in being able to process the part through the fewest stages and least complexity in order to form it to the print shape and tolerance. The number of stages and their complexity will affect the cost of the die(s).

An essential element in manufacturing cost is the cost of the die(s) necessary to produce a given part. In the part cost estimating stage of product planning, die cost must be estimated. There is no die drawing from which an exact cost may be obtained (Item 5). These estimates may be derived by comparing die stages to some previously produces stamping. Exposure to several such programs will improve estimating process.

The skills necessary for proficiency in the application of Item 6 may be classroom taught to some extent. They are, however, best acquired by experience. Production volume easily dictates whether or not a progressive die must be used, but when do we go to a transfer press? What kind and which transfer system do we buy? Initial exposure to these decisions requires more time and care than if one has been making them for several programs. Discussions with equipment vendors will initiate the estimator to the variables in the cost and mechanics of various costs and options. The final selection, and cost, must be made based on the durability, ease of maintenance and, simplicity of operation.

It is important to remember that a significant element in die cost is blank development. Any effort to obtain a die cost by comparing previously produced parts must be account for part, blank complexity.

As an illustrative example of the use of the subject program, we are going to use a cross member reinforcement bracket. A sample part is provided.

**MATERIAL COST**

The material required for a given part is specified by the designer on the part print. The estimator’s responsibility is to determine the weight of the blank necessary to produce the required part.

The weight of any sheet metal part, from the simple to the complex, is simplified by dividing the part into simple geometric components.

The scale weight of the sample part is 1.824 lbs. The blank weight of the sample part was calculated to be 2.695 lbs.
The material cost per part is simply the product of the weight times the cost per pound. The type of material used is 11 gage (.125) SAE 1008 DQSK (Draw Quality, Special Killed) steel. The engineer doing the manufacturing estimating ordinarily is not concerned with material selection since that has already been accomplished in the product design phase. The cost per pound of this, or any other, material is best obtained from the Purchasing Department. Purchasing is able to combine steel purchases to order a volume which will yield the best price. The estimator must provide purchasing with the projected annual volume of the part in question. These data include:
1. Blank weight
2. Annual usage
3. Material type (obtained from design drawing)
4. Material form and size, i.e. if coil stock, its size (O.D./I.D.) and slit width.

The material cost is then

\[ \text{Cost} = \text{Weight of the Blank} \times \text{Cost/Ib (as obtained form Purchasing)} \]

In the sample being presented the blank size is 7 1/4 x 8 3/4. Giving consideration to the character of the draw and the grain of the coil, the 7 1/4 dimension represents the width of the coil. With a blanking allowance of 5/32 per side, the coil width would be 79/16.

In the program being illustrated here, cost/lb for a given material at a given annual usage is part of the computer data base. The extent of that data base is based on the user's decision reflecting the economics of its size and variety of the data as compared to its utility. That is, how frequently will a given entry be used?

**MANUFACTURING PROCESSING**

The part must now be processed for manufacturing. That is, the estimator must define each step (operation) necessary to produce the part to print. This definition consists of:

1. The tooling required
2. The machinery required
3. The gages required
4. The manpower required, per operation
5. The cycle time of each operation
6. Scrap Rate

Here we will simulate the computer program to illustrate how the discretionary data is fed into the system:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Eqpt Code</th>
<th>Manpower</th>
<th>Cycle Time</th>
<th>Tool &amp; Gage Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (Blank)</td>
<td>I</td>
<td>0</td>
<td>12 min</td>
<td>$17,500</td>
</tr>
<tr>
<td>20 (Form &amp; Pierce)</td>
<td>1A</td>
<td>1</td>
<td>.167 min</td>
<td>$180,000</td>
</tr>
</tbody>
</table>
These data are entered into the computer. A separate screen appears for every operation, after all the necessary data are entered for a given operation. With the entered data, the computer selects the associated labor and burden rates for the time, manpower and equipment specified for each operation. Since the material cost has already been entered, the computer calculates the scrap cost for the operation, based on the labor and burden costs. The computer prints out the cost summary for the part.

Tool and gage costs are presented as estimated. These costs may be amortized with different schedules, depending on product pricing policy.