**CHAPTER 5 SPOILAGE, REWORK, AND SCRAP**

**Defining Spoilage, Rework and Scrap**

While the terms used in this chapter may seem familiar, be sure you understand them in the context of management accounting.

**Spoilage** is units of production – whether fully or partially completed – that do not meet the specifications required by customers for good units and that are discarded or sold at reduced prices. Some examples of spoilage are defective shirts, jeans, shoes, and carpeting sold as “seconds,” or defective aluminum cans sold to aluminum manufacturers for remelting to produce other aluminum products.

**Rework** is units of production that do not meet the specifications required by customers but that are subsequently repaired and sold as good finished units. For example, defective units of products (such as pagers, computers, and telephones) detected during or after the production process but before units are shipped to customers can sometimes be reworked and sold as good products.

**Scrap** is residual material that results from manufacturing a product. Examples are short lengths from woodworking operations, edges from plastic molding operations, and frayed cloth and end cuts from suit-making operations. Scrap can sometimes be sold for relatively small amounts. In that sense, scrap is similar to byproducts. The difference is that scrap arises as a residual from the manufacturing process, and is not a product targeted for manufacture or sale by the firm.

Some amounts of spoilage, rework, or scrap are inherent in many production processes. For example, semiconductor manufacturing is so complex and delicate that some spoiled units are commonly produced; usually, the spoiled units cannot be reworked. In the manufacture of high-precision machine tools, spoiled units can be reworked to meet standards, but only at a considerable cost. And in the mining industry, companies process ore that contains varying amounts of valuable metals and rock. Some amount of rock, which is scrap, is inevitable.

**Two Types of Spoilage**

Accounting for spoilage aims to determine the magnitude of spoilage costs and to distinguish between costs of normal and abnormal spoilage. To manage, control, and reduce spoilage costs, companies need to highlight them, not bury them as an unidentified part of the costs of good units manufactured.

To illustrate normal and abnormal spoilage, consider Mendoza Plastics, which makes casings for the iMac computer using plastic injection molding. In January 2012, Mendoza incurs costs of $615,000 to produce 20,500 units. Of these 20,500 units, 20,000 are good units and 500 are spoiled units. Mendoza has no beginning inventory and no ending inventory that month. Of the 500 spoiled units, 400 units are spoiled because the injection molding machines are unable to manufacture good casings 100% of the time. That is, these units are spoiled even though the machines were run carefully and efficiently. The remaining 100 units are spoiled because of machine breakdowns and operator errors.

**Normal Spoilage**

**Normal spoilage** is spoilage inherent in a particular production process. In particular, it arises even when the process is operated in an efficient manner. The costs of normal spoilage are typically included as a component of the costs of good units manufactured, because good units cannot be made without also making some units that are spoiled. There is a tradeoff between the speed of production and the normal spoilage rate.

Management makes a conscious decision about how many units to produce per hour with the understanding that, at the rate decided on, a certain level of spoilage is almost unavoidable. For this reason, the cost of normal spoilage is included in the cost of the good units completed. At Mendoza Plastics, the 400 units spoiled because of the limitations of injection molding machines and despite efficient operating conditions are considered normal spoilage. The calculations are as follows:

|  |
| --- |
| Manufacturing cost per unit, $615,000 /20,500 units = $30 |
| Manufacturing costs of good units alone, $30 per unit x 20,000 units | $600,000 |
| Normal spoilage costs, $30 per unit x 400 units | 12,000 |
| Manufacturing costs of good units completed (includes normal spoilage) | $612,000 |
| Manufacturing cost per good unit =$612,000 /20,000 units = $30.60 |

Because normal spoilage is the spoilage related to the good units produced, normal spoilage rates are computed by dividing units of normal spoilage by total *good units completed*, not total *actual units started* in production. At Mendoza Plastics, the normal spoilage rate is therefore computed as 400 /20,000 = 2%.

**Abnormal Spoilage**

**Abnormal spoilage** is spoilage that is not inherent in a particular production process and would not arise under efficient operating conditions. If a firm has 100% good units as its goal, then any spoilage would be considered abnormal. At Mendoza, the 100 units spoiled due to machine breakdowns and operator errors are abnormal spoilage. Abnormal spoilage is usually regarded as avoidable and controllable. Line operators and other plant personnel generally can decrease or eliminate abnormal spoilage by identifying the reasons for machine breakdowns, operator errors, etc., and by taking steps to prevent their recurrence. To highlight the effect of abnormal spoilage costs, companies calculate the units of abnormal spoilage and record the cost in the Loss from Abnormal Spoilage account, which appears as a separate line item in the income statement. At Mendoza, the loss from abnormal spoilage is $3,000 ($30 per unit x 100 units).

Issues about accounting for spoilage arise in both process-costing and job-costing systems. We discuss both instances next, beginning with spoilage in process – costing.

**Spoilage in Process Costing Using Weighted – Average and FIFO**

How do process-costing systems account for spoiled units? We have already said that units of abnormal spoilage should be counted and recorded separately in a Loss from Abnormal Spoilage account. But what about units of normal spoilage? The correct method is to count these units when computing output units – physical or equivalent – in a process – costing system. The following example and discussion illustrate this approach.

**Count All Spoilage**

Example 1: Chipmakers, Inc., manufactures computer chips for television sets. All direct materials are added at the beginning of the production process. To highlight issues that arise with normal spoilage, we assume no beginning inventory and focus only on direct material costs. The following data are available for May 2012.

|  |  |  |
| --- | --- | --- |
|  | **Physical****Units** | **Direct****Materials** |
| Work in process, beginning inventory (May 1) | 0 |  |
| Started during May | 10,000 |  |
| Good units completed and transferred out during May | 5,000 |  |
| Units spoiled (all normal spoilage) | 1,000 |  |
| Work in process, ending inventory (May 31) | 4,000 |  |
| Direct material costs added in May |  | $270,000 |

Spoilage is detected upon completion of the process and has zero net disposal value.

An **inspection point** is the stage of the production process at which products are examined to determine whether they are acceptable or unacceptable units. Spoilage is typically assumed to occur at the stage of completion where inspection takes place. As a result, the spoiled units in our example are assumed to be 100% complete with respect to direct materials.

Exhibit 5 – 1 calculates and assigns cost per unit of direct materials. Overall, Chipmakers generated 10,000 equivalent units of output: 5,000 equivalent units in good units completed (5,000 physical units x 100%), 4,000 units in ending work in process (4,000 physical units x 100%), and 1,000 equivalent units in normal spoilage (1,000 physical units x 100%). Given total direct material costs of $270,000 in May, this yields an equivalent-unit cost of $27. The total cost of good units completed and transferred out, which includes the cost of normal spoilage, is then $162,000 (6,000 equivalent units x $27), while the ending work in process is assigned a cost of $108,000 (4,000 equivalent units x $27).

There are two noteworthy features of this approach. First, the 4,000 units in ending work in process are not assigned any of the costs of normal spoilage. This is appropriate because the units have not yet been inspected. While the units in ending work in process undoubtedly include some that will be detected as spoiled when inspected, these units will only be identified when the units are completed in the subsequent accounting period. At that time, costs of normal spoilage will be assigned to the good units completed in that period. Second, the approach used in Exhibit 5 – 1 delineates the cost of normal spoilage as $27,000. By highlighting the magnitude of this cost, the approach helps to focus management’s attention on the potential economic benefits of reducing spoilage.

**Exhibit 5 – 1** Effect of Recognizing Equivalent Units in Spoilage for Direct Material Costs for Chipmakers, Inc., for May 2012

|  |  |
| --- | --- |
|  | Approach Counting Spoiled Units When Computing Output in Equivalent Units |
| Costs to account for | $ 270,000 |
| Divide by equivalent units of output | ÷ 10,000 |
| Cost per equivalent unit of output  | $ 27 |
| Assignment of costs: |  |
| Good units completed (5,000 units × $27 per unit) | $ 135,000 |
| Add normal spoilage (1,000 units × $27 per unit) | 27,000 |
| Total costs of good units completed and transferred out | 162,000 |
| Work in process, ending (4,000 units × $27 per unit) | 108,000 |
| Costs accounted for | $270,000 |

**Five – Step Procedure for Process Costing with Spoilage**

Example 2: Anzio Company manufactures a recycling container in its forming department. Direct materials are added at the beginning of the production process. Conversion costs are added evenly during the production process. Some units of this product are spoiled as a result of defects, which are detectable only upon inspection of finished units. Normally, spoiled units are 10% of the finished output of good units. That is, for every 10 good units produced, there is 1 unit of normal spoilage. Summary data for July 2012 are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Physical Units** **(1)** | **Direct****Materials****(2)** | **Conversion****Costs****(3)** | **Total****Costs****(4) = (2) + (3)** |
| Work in process, beginning inventory (July 1) | 1,500 | $12,000 | $9,000 | $21,000 |
|  Degree of completion of beginning work in process |  | 100% | 60% |  |
| Started during July | 8,500 |  |  |  |
| Good units completed and transferred out during July | 7,000 |  |  |  |
| Work in process, ending inventory (July 31) | 2,000 |  |  |  |
| Degree of completion of ending work in process |  | 100% | 50% |  |
| Total costs added during July |  | $76,500 | $89,100 | $165,600 |
| Normal spoilage as a percentage of good units  | 10% |  |  |  |
|  Degree of completion of normal spoilage |  | 100% | 100% |  |
|  Degree of completion of abnormal spoilage |  | 100% | 100% |  |

The five-step procedure for process costing used in Chapter 4 needs only slight modification to accommodate spoilage.

**Step 1: Summarize the Flow of Physical Units of Output.** Identify the number of units of both normal and abnormal spoilage.

***Total Spoilage***

***=***

***(Units in beginning work – in – process inventory + Units started)***

***–***

***(Good units completed and transferred out + Units in ending work – in – process inventory)***

Total Spoilage= (1,500 + 8,500) – (7,000 + 2,000)

 = 10,000 – 9,000

 = 1,000 units

Recall that normal spoilage is 10% of good output at Anzio Company. Therefore, normal spoilage = 10% of the 7,000 units of good output = 700 units.

Abnormal spoilage = Total spoilage – Normal spoilage

 = 1,000 – 700

 = 300 units

**Step 2: Compute Output in Terms of Equivalent Units.** Compute equivalent units for spoilage in the same way we compute equivalent units for good units. As illustrated previously, all spoiled units are included in the computation of output units. Because Anzio’s inspection point is at the completion of production, the same amount of work will have been done on each spoiled and each completed good unit.

**Step 3: Summarize Total Costs to Account For.** The total costs to account for are all the costs debited to Work in Process. The details for this step are similar to Step 3 in Chapter 4.

**Step 4: Compute Cost per Equivalent Unit.** This step is similar to Step 4 in Chapter 4.

**Step 5: Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work in Process.** This step now includes computation of the cost of spoiled units and thecost of good units.

We illustrate these five steps of process costing for the weighted-average and FIFO methods next.

**Weighted-Average Method and Spoilage**

Exhibit 5 – 2, Panel A, presents Steps 1 and 2 to calculate equivalent units of work done to date and includes calculations of equivalent units of normal and abnormal spoilage. Exhibit 5 – 2, Panel B, presents Steps 3, 4, and 5 (together called the production – cost worksheet).

Step 3 summarizes total costs to account for. Step 4 presents cost – per – equivalent – unit calculations using the weighted – average method. Note how, for each cost category, costs of beginning work in process and costs of work done in the current period are totaled and divided by equivalent units of all work done to date to calculate the weighted – average cost per equivalent unit. Step 5 assigns total costs to completed units, normal and abnormal spoiled units, and ending inventory by multiplying the equivalent units calculated in Step 2 by the cost per equivalent unit calculated in Step 4. Also note that the $13,825 costs of normal spoilage are added to the costs of the related good units completed and transferred out.

***Cost per good unit completed and transferred out of the process = Total costs transferred out (including normal spoilage)***

 ***Number of good units produced***

 = $152,075 /7,000 good units = $21.725 per good unit

This amount is not equal to $19.75 per good unit, the sum of the $8.85 cost per equivalent unit of direct materials plus the $10.90 cost per equivalent unit of conversion costs. That’s because the cost per good unit equals the sum of the direct material and conversion costs per equivalent unit, $19.75, plus a share of normal spoilage, $1.975 ($13,825 / 7,000 good units), for a total of $21.725 per good unit. The $5,925 costs of abnormal spoilage are charged to the Loss from Abnormal Spoilage account and do not appear in the costs of good units.

**Exhibit 5 – 2** Weighted – Average Method of Process Costing with Spoilage for Forming Department of the Anzio Company for July 2012

**PANEL A: Steps 1 and 2 – Summarize Output in Physical Units and Compute Equivalent Units**

|  |  |  |
| --- | --- | --- |
| **Flow of Production** | **(Step 1)** | **(Step 2)** |
| **Physical Units** **(1)** | **Equivalent Units** |
| **Direct****Materials****(2)** | **Conversion****Costs****(3)** |
| Work in process, beginning  | 1,500 |  |  |
| Started during current period  | 8,500 |  |  |
| To account for  | 10,000 |  |  |
| Good units completed and transferred out during current period | 7,000 | 7,000 | 7,000 |
| Normal spoilagea | 700 |  |  |
|  (700 × 100%; 700 × 100%) |  | 700 | 700 |
| Abnormal spoilageb  | 300 |  |  |
|  (300 × 100%; 300 × 100%)  |  | 300 | 300 |
| Work in process, endingc | 2,000 |  |  |
|  (2,000 × 100%; 2,000 × 50%) |  | 2,000 | 1,000 |
| Accounted for | 10,000 | \_\_\_\_\_ | \_\_\_\_\_ |
| Equivalent units of work done to date |  | 10,000 | 9,000 |
| aNormal spoilage is 10% of good units transferred out: 10% × 7,000 = 700 units. Degree of completion of normal spoilage in this department: direct materials, 100%; conversion costs, 100%.bAbnormal spoilage = Total spoilage – Normal spoilage = 1,000 – 700 = 300 units. Degree of completion of abnormal spoilage in this department: direct materials, 100%; conversion costs, 100%.cDegree of completion in this department: direct materials, 100%; conversion costs, 50%. |

**PANEL B: Steps 3, 4, and 5 – Summarize Total Costs to Account For, Compute Cost per Equivalent Unit, and Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work Process**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Total****Production****Costs** | **Direct****Materials** | **Conversion****Costs** |
| **(Step 3)** | Work in process, beginning  | $9,000 | $12,000 | $21,000 |
|  | Costs added in current period  | 165,600 | 76,500 | 89,100 |
|  | Total costs to account for  | 186,600 | 88,500 | 98,100 |
| **(Step 4)** | Costs incurred to date  |  | $88,500 | $98,100 |
|  | Divide by equivalent units of work done to date (Panel A)  |  | ÷10,000 | ÷ 9,000 |
|  | Cost per equivalent unit  |  | $ 8.85 | $ 10.90 |
| **(Step 5)** | Assignment of costs: |  |  |  |
|  | Good units completed and transferred out (7,000 units) |  |  |  |
|  |  Costs before adding normal spoilage | $138,250 | (7,000d × $8.85) | (7,000d × $10.90) |
|  |  Normal spoilage (700 units) | 13,825 | (700d × $8.85) | (700d × $10.90) |
| (A) |  Total costs of good units completed and transferred out | 152,075 |  |  |
| (B) | Abnormal spoilage (300 units) | 5,925 | (300d × $8.85)  | (300d × $10.90) |
| (C) | Work in process, ending (2,000 units) | 28,600 | (2,000d × $8.85) | (1,000d × $10.90) |
| (A)+(B)+(C) | Total costs accounted for  | $186,600 | $88,500 | $98,100 |
| dEquivalent units of direct materials and conversion costs calculated in Step 2 in Panel A. |

**FIFO Method and Spoilage**

Exhibit 5 – 3, Panel A, presents Steps 1 and 2 using the FIFO method, which focuses on equivalent units of work done in the current period. Exhibit 5 – 3, Panel B, presents Steps 3, 4, and 5. Note how when assigning costs, the FIFO method keeps the costs of the beginning work in process separate and distinct from the costs of work done in the current period. All spoilage costs are assumed to be related to units completed during this period, using the unit costs of the current period.

**Exhibit 5 – 3** First-In, First-Out (FIFO) Method of Process Costing with Spoilage for Forming Department of the Anzio Company for July 2012

**PANEL A: Steps 1 and 2 – Summarize Output in Physical Units and Compute Equivalent Units**

|  |  |  |
| --- | --- | --- |
| **Flow of Production** | **(Step 1)** | **(Step 2)** |
| **Physical Units** **(1)** | **Equivalent Units** |
| **Direct****Materials****(2)** | **Conversion****Costs****(3)** |
| Work in process, beginning  | 1,500 |  |  |
| Started during current period  | 8,500 |  |  |
| To account for  | 10,000 |  |  |
| Good units completed and transferred out during current period: |  |  |  |
|  From beginning work in processa  | 1,500 |  |  |
|  [1,500 × (100% – 100%); 1,500 × (100% – 60%)]  |  | 0 | 600 |
|  Started and completed  | 5,500b |  |  |
|  (5,500 × 100%; 5,500 × 100%)  |  | 5,500 | 5,500 |
| Normal spoilagec  | 700 |  |  |
|  (700 × 100%; 700 × 100%)  |  | 700 | 700 |
| Abnormal spoilaged  | 300 |  |  |
|  (300 × 100%; 300 × 100%)  |  | 300 | 300 |
| Work in process, endinge  | 2,000 |  |  |
|  (2,000 × 100%; 2,000 × 50%)  |  | 2,000 | 1,000 |
| Accounted for | 10,000 | \_\_\_\_\_ | \_\_\_\_\_ |
| Equivalent units of work done in current period  |  | 8,500  | 8,100 |
|  |  |  |  |
| aDegree of completion in this department: direct materials, 100%; conversion costs, 60%.b7,000 physical units completed and transferred out minus 1,500 physical units completed and transferred out from beginning work – in – process inventory.cNormal spoilage is 10% of good units transferred out: 10% × 7,000 = 700 units. Degree of completion of normal spoilage in this department: direct materials, 100%; conversion costs, 100%.dAbnormal spoilage = Actual spoilage – Normal spoilage = 1,000 – 700 = 300 units. Degree of completion of abnormal spoilage in this department: direct materials, 100%; conversion costs, 100%.eDegree of completion in this department: direct materials, 100%; conversion costs, 50%. |

**PANEL B: Steps 3, 4, and 5 – Summarize Total Costs to Account for, Compute Cost per Equivalent Unit, and Assign Total Costs to Units Completed, to Spoiled Units, and to Units in Ending Work in Process**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Total****Production****Costs** | **Direct****Materials** | **Conversion****Costs** |
| **(Step 3)** | Work in process, beginning  | $9,000 | $12,000 | $21,000 |
|  | Costs added in current period  | 165,600 | 76,500 | 89,100 |
|  | Total costs to account for  | 186,600 | 88,500 | 98,100 |
| **(Step 4)** | Costs added in current period  |  | $76,500 | $89,100 |
|  | Divide by equivalent units of work done in current period (Panel A) |  | ÷ 8,500 | ÷ 8,100 |
|  | Cost per equivalent unit |  | $ 9.00 | $ 11.00 |
| **(Step 5)** | Assignment of costs: |  |  |  |
|  | Good units completed and transferred out (7,000 units) |  |  |  |
|  |  Work in process, beginning (1,500 units)  | $ 21,000 | $12,000 | $9,000 |
|  |  Costs added to beginning work in process in current period  | 6,600 | (0f × $9)  | (600f × $11) |
|  |  Total from beginning inventory before normal spoilage  | 27,600 |  |  |
|  |  Started and completed before normal spoilage (5,500 units)  | 110,000 | (5,500f × $9) | (5,500f × $11) |
|  |  Normal spoilage (700 units) | 14,000 | (700f × $9) | (700f × $11) |
| (A) |  Total costs of good units completed and transferred out  | 151,600 |  |  |
| (B) | Abnormal spoilage (300 units)  | 6,000 | (300f × $9) | (300f × $11) |
| (C) | Work in process, ending (2,000 units)  | 29,000 | (2,000f × $9) | (1,000f × $11) |
| (A)+(B)+(C) | Total costs accounted for  | $186,600 | $88,500 | $98,100 |
| fEquivalent units of direct materials and conversion costs calculated in Step 2 in Panel A. |

**Journal Entries**

The information from Panel B in Exhibits 5 – 2 and 5 – 3 supports the following journal entries to transfer good units completed to finished goods and to recognize the loss from abnormal spoilage.

|  |  |  |
| --- | --- | --- |
|  | **Weighted Average** | **FIFO** |
| Finished Goods | 152,075 |  | 151,600 |  |
|  Work in Process – Forming  |  | 152,075 |  | 151,600 |
| To record transfer of good units completed in July. |  |  |  |  |
|  |  |  |  |  |
| Loss from Abnormal Spoilage | 5,925 |  | 6,000 |  |
|  Work in Process – Forming  |  | 5,925 |  | 6,000 |
| To record abnormal spoilage detected in July. |  |  |  |  |

**Inspection Points and Allocating Costs of Normal Spoilage**

Our Anzio Company example assumes inspection occurs upon completion of the units. Although spoilage is typically detected only at one or more inspection points, it might actually occur at various stages of a production process. The cost of spoiled units is assumed to equal all costs incurred in producing spoiled units up to the point of inspection. When spoiled goods have a disposal value (for example, carpeting sold as “seconds”), the net cost of spoilage is computed by deducting the disposal value from the costs of the spoiled goods that have been accumulated up to the inspection point.

The unit costs of normal and abnormal spoilage are the same when the two are detected at the same inspection point. However, situations may arise when abnormal spoilage is detected at a different point from normal spoilage. Consider shirt manufacturing. Normal spoilage in the form of defective shirts is identified upon inspection at the end of the production process. Now suppose a faulty machine causes many defective shirts to be produced at the halfway point of the production process. These defective shirts are abnormal spoilage and occur at a different point in the production process from normal spoilage. In such cases, the unit cost of abnormal spoilage, which is based on costs incurred up to the halfway point of the production process, differs from the unit cost of normal spoilage, which is based on costs incurred through the end of the production process.

Costs of abnormal spoilage are separately accounted for as losses of the accounting period in which they are detected. However, recall that normal spoilage costs are added to the costs of good units, which raises an additional issue: Should normal spoilage costs be allocated between completed units and ending work-in-process inventory? *The common approach is to* *presume that normal spoilage occurs at the inspection point in the production cycle and to* *allocate its cost over all units that have passed that point during the accounting period.*

In the Anzio Company example, spoilage is assumed to occur when units are inspected at the end of the production process, so no costs of normal spoilage are allocated to ending work in process. If the units in ending work in process have passed the inspection point, however, the costs of normal spoilage are allocated to units in ending work in process as well as to completed units. For example, if the inspection point is at the halfway point of production, then any ending work in process that is at least 50% complete would be allocated a full measure of normal spoilage costs, and those spoilage costs would be calculated on the basis of all costs incurred up to the inspection point. If ending work in process is less than 50% complete, however, no normal spoilage costs would be allocated to it.

To better understand these issues, let us now assume that inspection at Anzio Company occurs at various stages in the production process. How does this affect the amount of normal and abnormal spoilage? As before, consider the forming department, and recall that direct materials are added at the start of production, while conversion costs are added evenly during the process.

Consider three different cases: Inspection occurs at (1) the 20%, (2) the 55%, or (3) the 100% completion stage. The last option is the one we have analyzed so far (see Exhibit 5 – 2). Assume that normal spoilage is 10% of the good units passing inspection. A total of 1,000 units are spoiled in all three cases. Normal spoilage is computed on the basis of the number of *good units* that pass the inspection point *during the current period*. The following data are for July 2012. Note how the number of units of normal and abnormal spoilage changes, depending on when inspection occurs.

|  |  |
| --- | --- |
| **Flow of Production** | **Physical Units: Stage of Completion at Which Inspection Occurs** |
| **20%** | **55%** | **100%** |
| Work in process, beginninga | 1,500 | 1,500 | 1,500 |
| Started during July | 8,500 | 8,500 | 8,500 |
| To account for | 10,00 | 10,00 | 10,00 |
| Good units completed and transferred out |  |  |  |
| (10,000 – 1,000 spoiled – 2,000 ending) | 7,000 | 7,000 | 7,000 |
| Normal spoilage | 750 | 550 | 700 |
| Abnormal spoilage (1,000 – normal spoilage) | 250c | 450d | 300e |
| Work in process, endingb | 2,000 | 2,000 | 2,000 |
| Accounted for | 10,00 | 10,000 | 10,000 |
| aDegree of completion in this department: direct materials, 100%; conversion costs, 60%.bDegree of completion in this department: direct materials, 100%; conversion costs, 50%.c10% × (8,500 units started – 1,000 units spoiled), because only the units started passed the 20% completion inspection point in the current period. Beginning work in process is excluded from this calculation because, being 60% complete at the start of the period, it passed the inspection point in the previous period.d10% × (8,500 units started – 1,000 units spoiled – 2,000 units in ending work in process). Both beginning and ending work in process are excluded since neither was inspected this period.e10% × 7,000, because 7,000 units are fully completed and inspected in the current period. |

The following diagram shows the flow of physical units for July and illustrates the normal spoilage numbers in the table. Note that 7,000 good units are completed and transferred out – 1,500 from beginning work in process and 5,500 started and completed during the period – while 2,000 units are in ending work in process.

 **0% 20% 50% 55% 60% 100%**

 1,500 units from beginning work in process

 5,500 units started and completed

 Work done on 2,000 units in ending work in process

To see the number of units passing each inspection point, consider in the diagram the vertical lines at the 20%, 55%, and 100% inspection points. Note that the vertical line at 20% crosses two horizontal lines – 5,500 good units started and completed and 2,000 units in ending work in process – for a total of 7,500 good units. (The 20% vertical line does not cross the line representing work done on the 1,500 good units completed from beginning work in process, because these units are already 60% complete at the start of the period and, hence, are not inspected this period.) Normal spoilage equals 10% of 7,500 = 750 units. On the other hand, the vertical line at the 55% point crosses just the second horizontal line, indicating that only 5,500 good units pass this point. Normal spoilage in this case is 10% of 5,500 = 550 units. At the 100% point, normal spoilage = 10% of 7,000 (1,500 + 5,500) good units = 700 units.

Exhibit 5 – 4 shows the computation of equivalent units under the weighted – average method, assuming inspection at the 20% completion stage. The calculations depend on the direct materials and conversion costs incurred to get the units to this inspection point. The spoiled units have a full measure of direct materials and a 20% measure of conversion costs. Calculations of costs per equivalent unit and the assignment of total costs to units completed and to ending work in process are similar to calculations in previous illustrations in this chapter. Because ending work in process has passed the inspection point, these units bear normal spoilage costs, just like the units that have been completed and transferred out. For example, conversion costs for units completed and transferred out include conversion costs for 7,000 good units produced plus 20% x (10% x 5,500) = 110 equivalent units of normal spoilage. *We multiply by 20% to obtain equivalent units of normal spoilage because* *conversion costs are only 20% complete at the inspection point.* Conversion costs of ending work in process include conversion costs of 50% of 2,000 = 1,000 equivalent good units plus 20% (10% x 2,000) = 40 equivalent units of normal spoilage. Thus, the equivalent units of normal spoilage accounted for are 110 equivalent units related to units completed and transferred out plus 40 equivalent units related to units in ending work in process, for a total of 150 equivalent units, as shown in Exhibit 5 – 4.

Early inspections can help prevent any further direct materials and conversion costs being wasted on units that are already spoiled. For example, if inspection can occur when units are 70% (rather than 100%) complete as to conversion costs and spoilage occurs prior to the 70% point, a company can avoid incurring the final 30% of conversion costs on the spoiled units. The downside to conducting inspections at too early a stage is that spoilage that happens at later stages of the process may go undetected. It is for these reasons that firms often conduct multiple inspections and also empower workers to identify and resolve defects on a timely basis.

**Exhibit 5 – 4** Computing Equivalent Units with Spoilage Using Weighted- Average Method of Process Costing with Inspection at 20% of Completion for Forming Department of Anzio Company for July 2012

|  |  |  |
| --- | --- | --- |
| **Flow of Production** | **(Step 1)** | **(Step 2)** |
| **Physical Units** **(1)** | **Equivalent Units** |
| **Direct****Materials****(2)** | **Conversion****Costs****(3)** |
| Work in process, beginninga  | 1,500 |  |  |
| Started during current period  | 8,500 |  |  |
| To account for  | 10,000 |  |  |
| Good units completed and transferred out: | 7,000 | 7,000 | 7,000 |
| Normal spoilage | 750 |  |  |
| (750 × 100%; 750 × 20%) |  | 750 | 150 |
| Abnormal spoilage | 250 |  |  |
| (250 × 100%; 250 × 20%) |  | 250 | 50 |
| Work in process, endingb | 2,000 |  |  |
| (2,000 × 100%; 2,000 × 50%) | \_\_\_\_ | 2,000 | 1,000 |
| Accounted for | 10,000 | \_\_\_\_ | \_\_\_\_ |
| Equivalent units of work done to date |  | 10,000 | 8,200 |
| aDegree of completion: direct materials, 100%; conversion costs, 60%.bDegree of completion: direct materials, 100%; conversion costs, 50%. |

**Job Costing and Spoilage**

The concepts of normal and abnormal spoilage also apply to job-costing systems. Abnormal spoilage is separately identified so companies can work to eliminate it altogether. Costs of abnormal spoilage are not considered to be inventoriable costs and are written off as costs of the accounting period in which the abnormal spoilage is detected. Normal spoilage costs in job-costing systems – as in process-costing systems – are inventoriable costs, although increasingly companies are tolerating only small amounts of spoilage as normal. When assigning costs, job-costing systems generally distinguish *normal spoilage attributable to a specific job from normal spoilage common to all jobs*.

We describe accounting for spoilage in job costing using the following example.

Example 3: In the Hull Machine Shop, 5 aircraft parts out of a job lot of 50 aircraft parts are spoiled. Costs assigned prior to the inspection point are $2,000 per part. When the spoilage is detected, the spoiled goods are inventoried at $600 per part, the net disposal value.

Our presentation here and in subsequent sections focuses on how the $2,000 cost per part is accounted for.

**Normal Spoilage Attributable to a Specific Job**

When normal spoilage occurs because of the specifications of a particular job, that job bears the cost of the spoilage minus the disposal value of the spoilage. The journal entry to recognize disposal value (items in parentheses indicate subsidiary ledger postings) is as follows:

|  |  |  |
| --- | --- | --- |
| Materials Control (spoiled goods at current net disposal value): 5 units x $600 per unit | 3,000 |  |
|  Work – in – Process Control (specific job): 5 units x $600 per unit |  | 3,000 |

Note, the Work – in – Process Control (specific job) has already been debited (charged) $10,000 for the spoiled parts (5 spoiled parts x $2,000 per part). The net cost of normal spoilage $7,000 ($10,000 – $3,000), which is an additional cost of the 45 (50 – 5) good units produced. Therefore, total cost of the 45 good units is $97,000: $90,000 (45 units x $2,000 per unit) incurred to produce the good units plus the $7,000 net cost of normal spoilage. Cost per good unit is $2,155.56 ($97,000 /45 good units).

**Normal Spoilage Common to All Jobs**

In some cases, spoilage may be considered a normal characteristic of the production process. The spoilage inherent in production will, of course, occur when a specific job is being worked on. But the spoilage is not attributable to, and hence is not charged directly to, the specific job. Instead, the spoilage is allocated indirectly to the job as manufacturing overhead because the spoilage is common to all jobs. The journal entry is as follows:

|  |  |  |
| --- | --- | --- |
| Materials Control (spoiled goods at current net disposal value): 5 units x $600 per unit | 3,000 |  |
| Manufacturing Overhead Control (normal spoilage): ($10,000 - $3,000) | 7,000 |  |
|  Work – in – Process Control (specific job): 5 units x $2,000 per unit |  | 10,000 |

When normal spoilage is common to all jobs, the budgeted manufacturing overhead rate includes a provision for normal spoilage cost. Normal spoilage cost is spread, through overhead allocation, over all jobs rather than allocated to a specific job. For example, if Hull produced 140 good units from all jobs in a given month, the $7,000 of normal spoilage overhead costs would be allocated at the rate of $50 per good unit ($7,000 /140 good units). Normal spoilage overhead costs allocated to the 45 good units in the job would be $2,250 ($50 x 45 good units). Total cost of the 45 good units is $92,250: $90,000 (45 units x $2,000 per unit) incurred to produce the good units plus $2,250 of normal spoilage overhead costs. Cost per good unit is $2,050 ($92,250 / 45 good units).

**Abnormal Spoilage**

If the spoilage is abnormal, the net loss is charged to the Loss from Abnormal Spoilage account. Unlike normal spoilage costs, abnormal spoilage costs are not included as a part of the cost of good units produced. Total cost of the 45 good units is $90,000 (45 units x $2,000 per unit). Cost per good unit is $2,000 ($90,000 / 45 good units).

|  |  |  |
| --- | --- | --- |
| Materials Control (spoiled goods at current net disposal value): 5 units x $600 per unit | 3,000 |  |
| Loss from Abnormal Spoilage: ($10,000 - $3,000) | 7,000 |  |
|  Work – in – Process Control (specific job): 5 units x $2,000 per unit |  | 10,000 |

Even though, for external reporting purposes, abnormal spoilage costs are written off in the accounting period and are not linked to specific jobs or units, companies often identify the particular reasons for abnormal spoilage, and, when appropriate, link abnormal spoilage with specific jobs or units for cost management purposes.

**Job Costing and Rework**

Rework is units of production that are inspected, determined to be unacceptable, repaired, and sold as acceptable finished goods. We again distinguish (1) normal rework attributable to a specific job, (2) normal rework common to all jobs, and (3) abnormal rework.

Consider the Hull Machine Shop data in Example 3. Assume the five spoiled parts are reworked. The journal entry for the $10,000 of total costs (the details of these costs are assumed) assigned to the five spoiled units before considering rework costs is as follows:

|  |  |  |
| --- | --- | --- |
| Work – in – Process Control (specific job) | 10,000 |  |
|  Materials Control  |  | 4,000 |
|  Wages Payable Control  |  | 4,000 |
|  Manufacturing Overhead Allocated |  | 2,000 |

Assume the rework costs equal $3,800 (comprising $800 direct materials, $2,000 direct manufacturing labor, and $1,000 manufacturing overhead).

**Normal Rework Attributable to a Specific Job**

If the rework is normal but occurs because of the requirements of a specific job, the rework costs are charged to that job. The journal entry is as follows:

|  |  |  |
| --- | --- | --- |
| Work – in – Process Control (specific job) | 3,800 |  |
|  Materials Control  |  | 800 |
|  Wages Payable Control  |  | 2,000 |
|  Manufacturing Overhead Allocated |  | 1,000 |

**Normal Rework Common to All Jobs**

When rework is normal and not attributable to a specific job, the costs of rework are charged to manufacturing overhead and are spread, through overhead allocation, over all jobs.

|  |  |  |
| --- | --- | --- |
| Manufacturing Overhead Control (rework costs) | 3,800 |  |
|  Materials Control  |  | 800 |
|  Wages Payable Control  |  | 2,000 |
|  Manufacturing Overhead Allocated |  | 1,000 |

**Abnormal Rework**

If the rework is abnormal, it is recorded by charging abnormal rework to a loss account.

|  |  |  |
| --- | --- | --- |
| Loss from Abnormal Rework | 3,800 |  |
|  Materials Control  |  | 800 |
|  Wages Payable Control  |  | 2,000 |
|  Manufacturing Overhead Allocated |  | 1,000 |

Accounting for rework in a process-costing system also requires abnormal rework to be distinguished from normal rework. Process costing accounts for abnormal rework in the same way as job costing. Accounting for normal rework follows the accounting described for normal rework common to all jobs (units) because masses of identical or similar units are being manufactured.

Costing rework focuses managers’ attention on the resources wasted on activities that would not have to be undertaken if the product had been made correctly. The cost of rework prompts managers to seek ways to reduce rework, for example, by designing new products or processes, training workers, or investing in new machines. To eliminate rework and to simplify the accounting, some companies set a standard of zero rework. All rework is then treated as abnormal and is written off as a cost of the current period.

**Accounting for Scrap**

*Scrap* is residual material that results from manufacturing a product; it has low total sales value compared with the total sales value of the product. No distinction is made between normal and abnormal scrap because no cost is assigned to scrap. The only distinction made is between scrap attributable to a specific job and scrap common to all jobs.

There are two aspects of accounting for scrap:

1. Planning and control, including physical tracking
2. Inventory costing, including when and how scrap affects operating income

Initial entries to scrap records are commonly expressed in physical terms. In various industries, companies quantify items such as stamped-out metal sheets or edges of molded plastic parts by weighing, counting, or some other measure. Scrap records not only help measure efficiency, but also help keep track of scrap, and so reduce the chances of theft. Companies use scrap records to prepare periodic summaries of the amounts of actual scrap compared with budgeted or standard amounts. Scrap is either sold or disposed of quickly or it is stored for later sale, disposal, or reuse.

Careful tracking of scrap often extends into the accounting records. Many companies maintain a distinct account for scrap costs somewhere in their accounting system. The issues here are similar to the issues in Chapter 16 regarding the accounting for byproducts:

* When should the value of scrap be recognized in the accounting records – at the time scrap is produced or at the time scrap is sold?
* How should revenues from scrap be accounted for?

To illustrate, we extend our Hull example. Assume the manufacture of aircraft parts generates scrap and that the scrap from a job has a net sales value of $900.

**Recognizing Scrap at the Time of Its Sale**

When the dollar amount of scrap is immaterial, the simplest accounting is to record the physical quantity of scrap returned to the storeroom and to regard scrap sales as a separate line item in the income statement. In this case, the only journal entry is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Sale of scrap: | Cash or Accounts Receivable | 900 |  |
|  |  Scrap Revenues |  | 900 |

When the dollar amount of scrap is material and the scrap is sold quickly after it is produced, the accounting depends on whether the scrap is attributable to a specific job or is common to all jobs.

**Scrap Attributable to a Specific Job**

Job – costing systems sometimes trace scrap revenues to the jobs that yielded the scrap. This method is used only when the tracing can be done in an economically feasible way. For example, the Hull Machine Shop and its customers, such as the U.S. Department of Defense, may reach an agreement that provides for charging specific jobs with all rework or spoilage costs and then crediting these jobs with all scrap revenues that arise from the jobs. The journal entry is as follows:

|  |  |
| --- | --- |
| Scrap returned to storeroom: | No journal entry. [Notation of quantity received and related job entered in the inventory record] |
| Sale of scrap: | Cash or Accounts Receivable | 900 |  |
|  |  Work – in – Process Control |  | 900 |
|  | Posting made to specific job cost record. |

Unlike spoilage and rework, there is no cost assigned to the scrap, so no distinction is made between normal and abnormal scrap. All scrap revenues, whatever the amount, are credited to the specific job. Scrap revenues reduce the costs of the job.

**Scrap common to all jobs**

The journal entry in this case is as follows:

|  |  |
| --- | --- |
| Scrap returned to storeroom: | No journal entry. [Notation of quantity received and related job entered in the inventory record] |
| Sale of scrap: | Cash or Accounts Receivable | 900 |  |
|  |  Manufacturing Overhead Control |  | 900 |
|  | Posting made to subsidiary ledger – “Sales of Scrap” column on department cost record. |

Scrap is not linked with any particular job or product. Instead, all products bear production costs without any credit for scrap revenues except in an indirect manner: Expected scrap revenues are considered when setting the budgeted manufacturing overhead rate. Thus, the budgeted overhead rate is lower than it would be if the overhead budget had not been reduced by expected scrap revenues. This method of accounting for scrap is also used in process costing when the dollar amount of scrap is immaterial, because the scrap in process costing is common to the manufacture of all the identical or similar units produced (and cannot be identified with specific units).

**Recognizing Scrap at the Time of Its Production**

Our preceding illustrations assume that scrap returned to the storeroom is sold quickly, so it is not assigned an inventory cost figure. Sometimes, as in the case with edges of molded plastic parts, the value of scrap is not immaterial, and the time between storing it and selling or reusing it can be long and unpredictable. In these situations, the company assigns an inventory cost to scrap at a conservative estimate of its net realizable value so that production costs and related scrap revenues are recognized in the same accounting period. Some companies tend to delay sales of scrap until its market price is considered attractive. Volatile price fluctuations are typical for scrap metal. In these cases, it’s not easy to determine some “reasonable inventory value.”

**Scrap Attributable to a Specific Job**

The journal entry in the Hull example is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Scrap returned to storeroom: | Materials Control | 900 |  |
|  |  Work – in – Process Control |  | 900 |

**Scrap Common to All Jobs**

The journal entry in this case is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Scrap returned to storeroom: | Materials Control | 900 |  |
|  |  Manufacturing Overhead Control |  | 900 |

Observe that the Materials Control account is debited in place of Cash or Accounts Receivable. When the scrap is sold, the journal entry is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Sale of scrap: | Cash or Accounts Receivable | 900 |  |
|  |  Materials Control |  | 900 |

Scrap is sometimes reused as direct material rather than sold as scrap. In this case, Materials Control is debited at its estimated net realizable value and then credited when the scrap is reused. For example, the entries when the scrap is common to all jobs are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Scrap returned to storeroom: | Materials Control | 900 |  |
|  |  Manufacturing Overhead Control |  | 900 |
| Reuse of scrap:  | Work – in – Process Control | 900 |  |
|  |  Materials Control |  | 900 |

Accounting for scrap under process costing is similar to accounting under job costing when scrap is common to all jobs. That’s because the scrap in process costing is common to the manufacture of masses of identical or similar units.

Managers focus their attention on ways to reduce scrap and to use it more profitably, especially when the cost of scrap is high. For example, General Motors has redesigned its plastic injection molding processes to reduce the scrap plastic that must be broken away from its molded products. General Motors also regrinds and reuses the plastic scrap as direct material, saving substantial input costs.