

# Process Costing

## Costing the “Quicker-Picker-Upper”



If you have ever spilled milk, there is a good chance that you used Bounty paper towels to clean up the mess. Procter & Gamble (P&G) manufactures Bounty in two main processing departments—Paper Making and Paper Converting. In the Paper Making Department, wood pulp is converted into paper and then spooled into 2,000 pound rolls. In the Paper Converting Department, two of the 2,000 pound rolls of paper are simultaneously unwound into a machine that creates a two-ply paper towel that is decorated, perforated, and embossed to create texture. The large sheets of paper towels that emerge from this process are wrapped around a cylindrical cardboard core measuring eight feet in length. Once enough

sheets wrap around the core, the eight foot roll is cut into individual rolls of Bounty that are sent down a conveyor to be wrapped, packed, and shipped.

In this type of manufacturing environment, costs cannot be readily traced to individual rolls of Bounty; however, given the homogeneous nature of the product, the total costs incurred in the Paper Making Department can be spread uniformly across its output of 2,000 pound rolls of paper. Similarly, the total costs incurred in the Paper Converting Department (including the cost of the 2,000 pound rolls that are transferred in from the Paper Making Department) can be spread uniformly across the number of cases of Bounty produced.

P&G uses a similar costing approach for many of its products such as Tide, Crest toothpaste, and Pringles. ■

Source: Conversation with Brad Bays, formerly a Procter & Gamble financial executive.

### BUSINESS FOCUS

## LEARNING OBJECTIVES

*After studying Chapter 4, you should be able to:*

- LO1** Record the flow of materials, labor, and overhead through a process costing system.
- LO2** Compute the equivalent units of production using the weighted-average method.
- LO3** Compute the cost per equivalent unit using the weighted-average method.
- LO4** Assign costs to units using the weighted-average method.
- LO5** Prepare a cost reconciliation report.
- LO6** (Appendix 4A) Compute the equivalent units of production using the FIFO method.
- LO7** (Appendix 4A) Compute the cost per equivalent unit using the FIFO method.
- LO8** (Appendix 4A) Assign costs to units using the FIFO method.
- LO9** (Appendix 4A) Prepare a cost reconciliation report using the FIFO method.
- LO10** (Appendix 4B) Allocate service department costs to operating departments using the direct method.
- LO11** (Appendix 4B) Allocate service department costs to operating departments using the step-down method.

**J**ob-order costing and process costing are two common methods for determining unit product costs. As explained in the previous chapter, job-order costing is used when many different jobs or products are worked on each period. Examples of industries that use job-order costing include furniture manufacturing, special-order printing, shipbuilding, and many types of service organizations.

By contrast, **process costing** is used most commonly in industries that convert raw materials into homogeneous (i.e., uniform) products, such as bricks, soda, or paper, on a continuous basis. Examples of companies that would use process costing include **Reynolds Aluminum** (aluminum ingots), **Scott Paper** (toilet paper), **General Mills** (flour), **Exxon** (gasoline and lubricating oils), **Coppertone** (sunscreens), and **Kellogg's** (breakfast cereals). In addition, process costing is sometimes used in companies with assembly operations. A form of process costing may also be used in utilities that produce gas, water, and electricity.

Our purpose in this chapter is to explain how product costing works in a process costing system.

## Comparison of Job-Order and Process Costing

In some ways process costing is very similar to job-order costing, and in some ways it is very different. In this section, we focus on these similarities and differences to provide a foundation for the detailed discussion of process costing that follows.

### *Similarities between Job-Order and Process Costing*

Much of what you learned in the previous chapter about costing and cost flows applies equally well to process costing in this chapter. We are not throwing out all that we have learned about costing and starting from “scratch” with a whole new system. The similarities between job-order and process costing can be summarized as follows:

1. Both systems have the same basic purposes—to assign material, labor, and manufacturing overhead costs to products and to provide a mechanism for computing unit product costs.
2. Both systems use the same basic manufacturing accounts, including Manufacturing Overhead, Raw Materials, Work in Process, and Finished Goods.
3. The flow of costs through the manufacturing accounts is basically the same in both systems.

As can be seen from this comparison, much of the knowledge that you have already acquired about costing is applicable to a process costing system. Our task now is to refine and extend your knowledge to process costing.

### *Differences between Job-Order and Process Costing*

There are three differences between job-order and process costing. First, process costing is used when a company produces a continuous flow of units that are indistinguishable from one another. Job-order costing is used when a company produces many different jobs that have unique production requirements. Second, under process costing, it makes no sense to try to identify materials, labor, and overhead costs with a particular customer order (as we did with job-order costing) because each order is just one of many that are filled from a continuous flow of virtually identical units from the production line. Accordingly, process costing accumulates costs by department (rather than by order) and assigns these costs uniformly to all units that pass through the department during a period. Job cost sheets (which we used for job-order costing) are not used to accumulate

Job-Order Costing	Process Costing
<ol style="list-style-type: none"> <li>1. Many different jobs are worked on during each period, with each job having different production requirements.</li> <li>2. Costs are accumulated by individual job.</li> <li>3. Unit costs are computed <i>by job</i> on the job cost sheet.</li> </ol>	<ol style="list-style-type: none"> <li>1. A single product is produced either on a continuous basis or for long periods of time. All units of product are identical.</li> <li>2. Costs are accumulated by department.</li> <li>3. Unit costs are computed <i>by department</i>.</li> </ol>

**EXHIBIT 4-1**  
Differences between Job-Order and Process Costing

costs. Third, process costing systems compute unit costs by department. This differs from job-order costing where unit costs are computed by job on the job cost sheet. Exhibit 4-1 summarizes the differences just described.

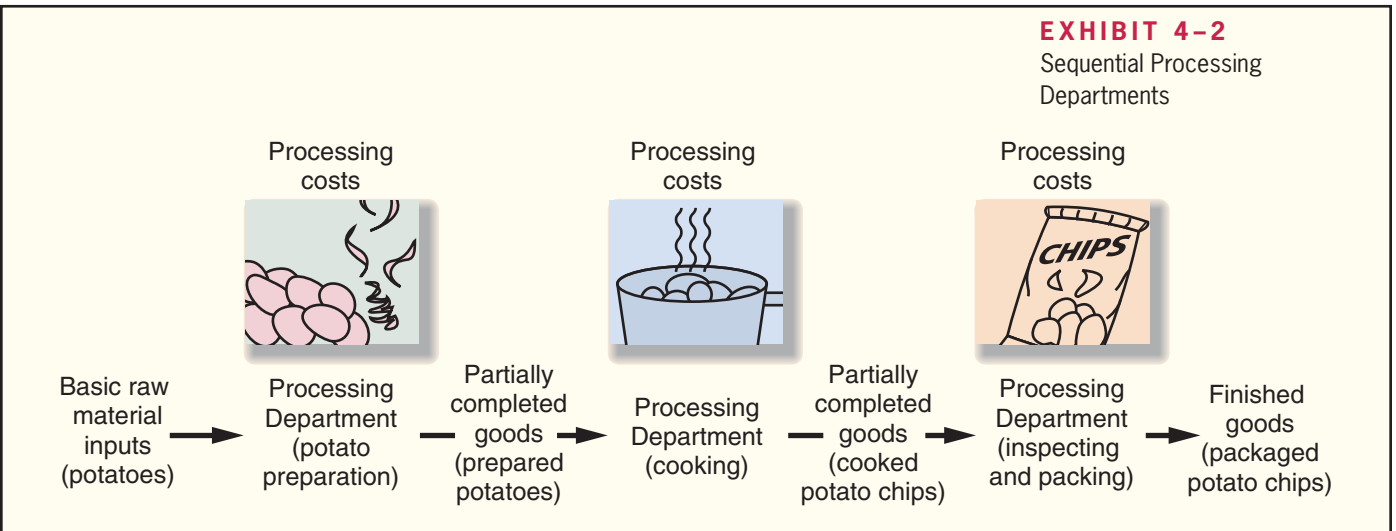
## Cost Flows in Process Costing

Before going through a detailed example of process costing, it will be helpful to see how, in a general way, manufacturing costs flow through a process costing system.

### Processing Departments

A **processing department** is an organizational unit where work is performed on a product and where materials, labor, or overhead costs are added to the product. For example, a **Nalley's** potato chip factory might have three processing departments—one for preparing potatoes, one for cooking, and one for inspecting and packaging. A brick factory might have two processing departments—one for mixing and molding clay into brick form and one for firing the molded brick. Some products and services may go through a number of processing departments, while others may go through only one or two. Regardless of the number of processing departments, they all have two essential features. First, the activity in the processing department is performed uniformly on all of the units passing through it. Second, the output of the processing department is homogeneous; in other words, all of the units produced are identical.

Products in a process costing environment, such as bricks or potato chips, typically flow in sequence from one department to another as in Exhibit 4-2.



## IN BUSINESS



### MONKS MAKE A LIVING SELLING BEER

The Trappist monks of St. Sixtus monastery in Belgium have been brewing beer since 1839. Customers must make an appointment with the monastery to buy a maximum of two 24-bottle cases per month. The scarce and highly prized beer sells for more than \$15 per 11-ounce bottle.

The monk's brewing ingredients include water, malt, hops, sugar, and yeast. The sequential steps of the beer-making process include grinding and crushing the malt grain, brewing by adding water to the crushed malt, filtering to separate a liquid called wort from undissolved grain particles, boiling to sterilize the wort (including adding sugar to increase the density of the wort), fermentation by adding yeast to convert sugar into alcohol and carbon dioxide, storage where the beer is aged for at least three weeks, and bottling where more sugar and yeast are added to enable two weeks of additional fermentation in the bottle.

Unlike growth-oriented for-profit companies, the monastery has not expanded its production capacity since 1946, seeking instead to sell just enough beer to sustain the monks' modest lifestyle.

Source: John W. Miller, "Trappist Command: Thou Shalt Not Buy Too Much of Our Beer," *The Wall Street Journal*, November 29, 2007, pp. A1 and A14.

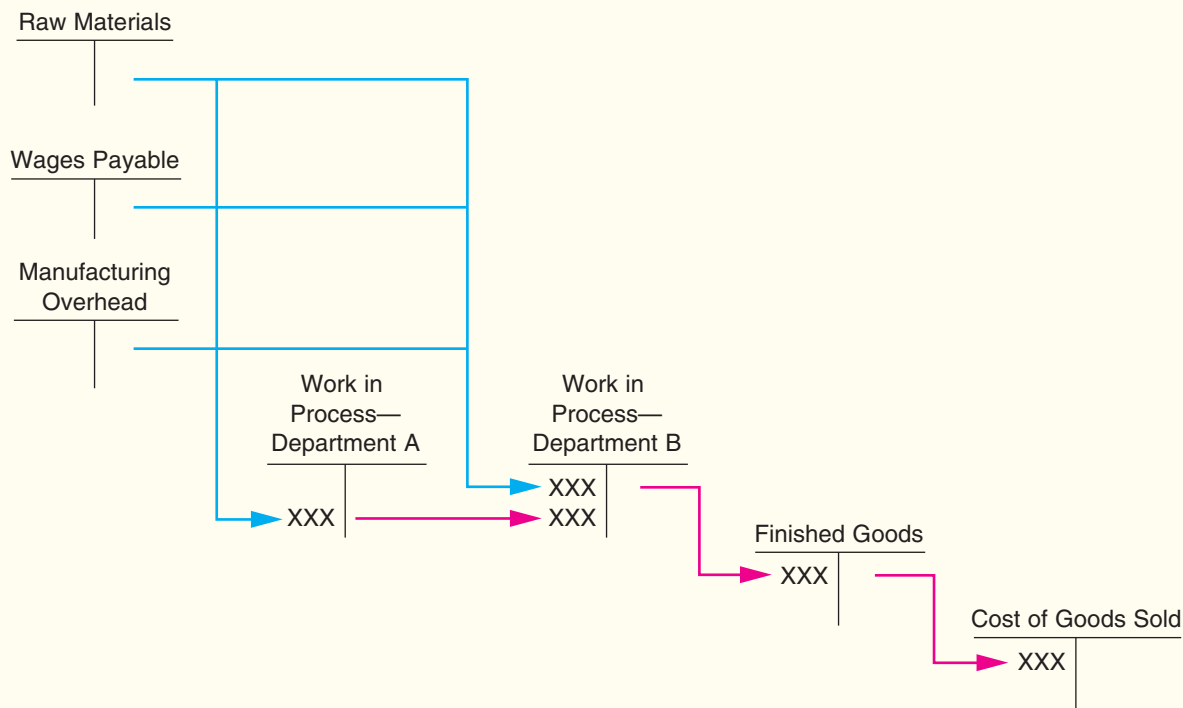
### The Flow of Materials, Labor, and Overhead Costs

Cost accumulation is simpler in a process costing system than in a job-order costing system. In a process costing system, instead of having to trace costs to hundreds of different jobs, costs are traced to only a few processing departments.

A T-account model of materials, labor, and overhead cost flows in a process costing system is shown in Exhibit 4-3. Several key points should be noted from this exhibit. First, note that a separate Work in Process account is maintained for *each processing department*. In contrast, in a job-order costing system the entire company may

#### EXHIBIT 4-3

T-Account Model of Process Costing Flows



have only one Work in Process account. Second, note that the completed production of the first processing department (Department A in the exhibit) is transferred to the Work in Process account of the second processing department (Department B). After further work in Department B, the completed units are then transferred to Finished Goods. (In Exhibit 4–3, we show only two processing departments, but a company can have many processing departments.)

Finally, note that materials, labor, and overhead costs can be added in *any* processing department—not just the first. Costs in Department B’s Work in Process account consist of the materials, labor, and overhead costs incurred in Department B plus the costs attached to partially completed units transferred in from Department A (called transferred-in costs).

## Materials, Labor, and Overhead Cost Entries

To complete our discussion of cost flows in a process costing system, in this section we show journal entries relating to materials, labor, and overhead costs at Megan’s Classic Cream Soda, a company that has two processing departments—Formulating and Bottling. In the Formulating Department, ingredients are checked for quality and then mixed and injected with carbon dioxide to create bulk cream soda. In the Bottling Department, bottles are checked for defects, filled with cream soda, capped, visually inspected again for defects, and then packed for shipping.

### LEARNING OBJECTIVE 1

Record the flow of materials, labor, and overhead through a process costing system.

**Materials Costs** As in job-order costing, materials are drawn from the storeroom using a materials requisition form. Materials can be added in any processing department, although it is not unusual for materials to be added only in the first processing department, with subsequent departments adding only labor and overhead costs.

At Megan’s Classic Cream Soda, some materials (i.e., water, flavors, sugar, and carbon dioxide) are added in the Formulating Department and some materials (i.e., bottles, caps, and packing materials) are added in the Bottling Department. The journal entry to record the materials used in the first processing department, the Formulating Department, is as follows:

Work in Process—Formulating . . . . .	XXX	XXX
Raw Materials . . . . .	XXX	XXX

The journal entry to record the materials used in the second processing department, the Bottling Department, is as follows:

Work in Process—Bottling . . . . .	XXX	XXX
Raw Materials . . . . .	XXX	XXX

**Labor Costs** In process costing, labor costs are traced to departments—not to individual jobs. The following journal entry records the labor costs in the Formulating Department at Megan’s Classic Cream Soda:

Work in Process—Formulating . . . . .	XXX	XXX
Salaries and Wages Payable . . . . .	XXX	XXX

A similar entry would be made to record labor costs in the Bottling Department.

**Overhead Costs** In process costing, as in job-order costing, predetermined overhead rates are usually used. Manufacturing overhead cost is applied according to the amount of the allocation base that is incurred in the department. The following journal entry records the overhead cost applied in the Formulating Department:

Work in Process—Formulating . . . . .	XXX	XXX
Manufacturing Overhead . . . . .	XXX	XXX

A similar entry would be made to apply manufacturing overhead costs in the Bottling Department.

**Completing the Cost Flows** Once processing has been completed in a department, the units are transferred to the next department for further processing, as illustrated in the T-accounts in Exhibit 4–3. The following journal entry transfers the cost of partially completed units from the Formulating Department to the Bottling Department:

Work in Process—Bottling . . . . .	XXX	
Work in Process—Formulating . . . . .		XXX

After processing has been completed in the Bottling Department, the costs of the completed units are transferred to the Finished Goods inventory account:

Finished Goods . . . . .	XXX	
Work in Process—Bottling . . . . .		XXX

Finally, when a customer’s order is filled and units are sold, the cost of the units is transferred to Cost of Goods Sold:

Cost of Goods Sold . . . . .	XXX	
Finished Goods . . . . .		XXX

To summarize, the cost flows between accounts are basically the same in a process costing system as they are in a job-order costing system. The only difference at this point is that in a process costing system each department has a separate Work in Process account.

IN BUSINESS



**THE DIFFERENCE BETWEEN LABOR RATES AND LABOR COST**

The emergence of China as a global competitor has increased the need for managers to understand the difference between labor rates and labor cost. Labor rates reflect the amount paid to employees per hour or month. Labor costs measure the employee compensation paid per unit of output. For example, **Tenneco** has plants in Shanghai, China, and Litchfield, Michigan, that both manufacture exhaust systems for automobiles. The monthly labor rate per employee at the Shanghai plant ranges from \$210–\$250, whereas the same figure for the Litchfield plant ranges from \$1,880–\$4,064. A naïve interpretation of these labor rates would be to automatically assume that the Shanghai plant is the lower labor cost facility. A wiser comparison of the two plants’ labor costs would account for the fact that the Litchfield plant produced 1.4 million exhaust systems in 2005 compared to 400,000 units at the Shanghai plant, while having only 20% more employees than the Shanghai plant.

Source: Alex Taylor III, “A Tale of Two Factories,” *Fortune*, September 18, 2006, pp. 118–126.

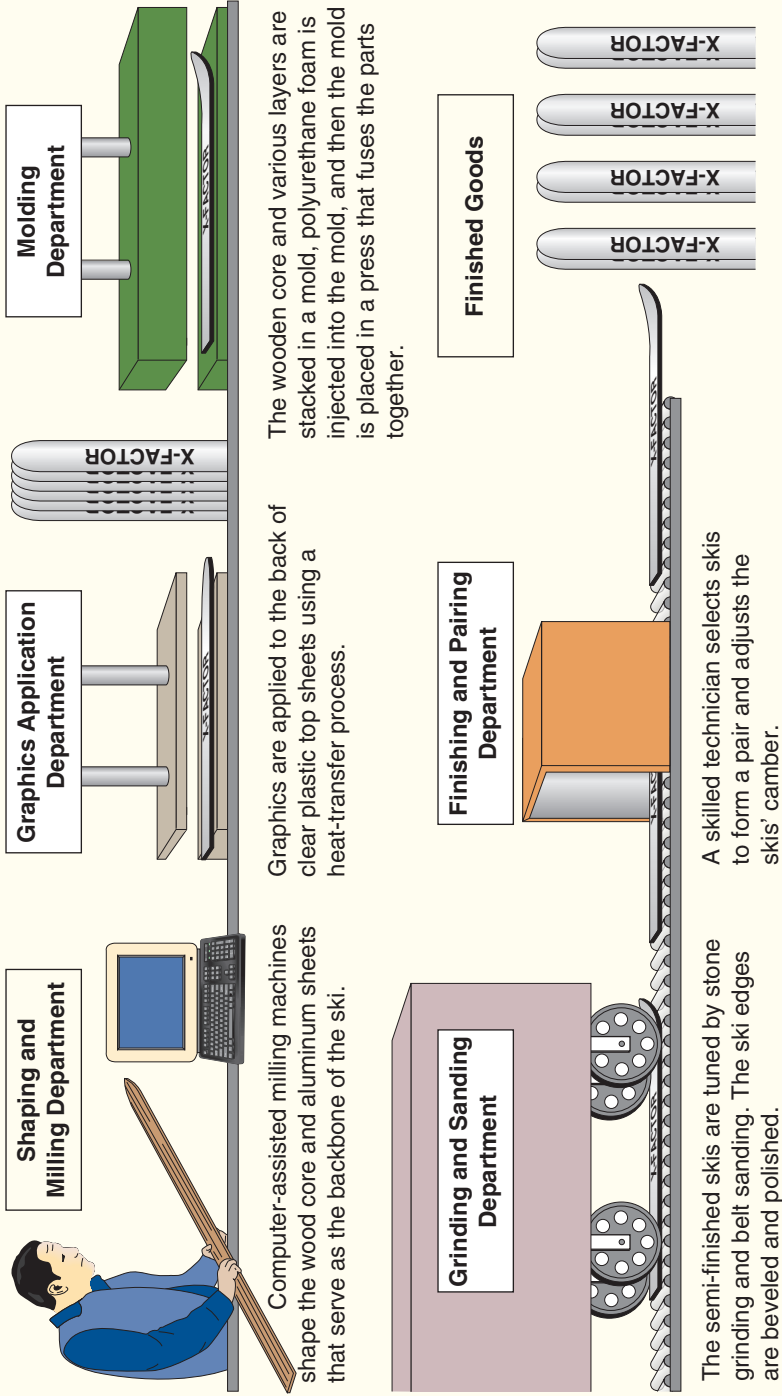
We now turn our attention to Double Diamond Skis, a company that manufactures a high-performance deep-powder ski, and that uses process costing to determine its unit product costs. The company’s production process is illustrated in Exhibit 4–4. Skis go through a sequence of five processing departments, starting with the Shaping and Milling Department and ending with the Finishing and Pairing Department. The basic idea in process costing is to add together all of the costs incurred in a department during a period and then to spread those costs uniformly across the units processed in that department during that period. As we shall see, applying this simple idea involves a few complications.

**Equivalent Units of Production**

After materials, labor, and overhead costs have been accumulated in a department, the department’s output must be determined so that unit product costs can be computed. The difficulty is that a department usually has some partially completed units in its ending

**EXHIBIT 4-4**

The Production Process at Double Diamond Skis\*



\*Adapted from Bill Gout, Jesse James Doquilo, and Studio M D, "Capped Crusaders," *Skiing*, October 1993, pp. 138-144.

inventory. It does not seem reasonable to count these partially completed units as equivalent to fully completed units when counting the department's output. Therefore, these partially completed units are translated into an *equivalent* number of fully completed units. In process costing, this translation is done using the following formula:

$$\text{Equivalent units} = \text{Number of partially completed units} \times \text{Percentage completion}$$

As the formula states, **equivalent units** is the product of the number of partially completed units and the percentage completion of those units with respect to the processing in the department. Roughly speaking, the equivalent units is the number of complete units that could have been obtained from the materials and effort that went into the partially complete units.

For example, suppose the Molding Department at Double Diamond has 500 units in its ending work in process inventory that are 60% complete with respect to processing in the department. These 500 partially complete units are equivalent to 300 fully complete units ( $500 \times 60\% = 300$ ). Therefore, the ending work in process inventory contains 300 equivalent units. These equivalent units are added to any units completed during the period to determine the department's output for the period—called the *equivalent units of production*.

Equivalent units of production for a period can be computed in different ways. In this chapter, we discuss the *weighted-average method*. In Appendix 4A, we discuss the *FIFO method*. The **FIFO method** of process costing is a method in which equivalent units and unit costs relate only to work done during the current period. In contrast, the **weighted-average method** blends together units and costs from the current period with units and costs from the prior period. In the weighted-average method, the **equivalent units of production** for a department are the number of units transferred to the next department (or to finished goods) plus the equivalent units in the department's ending work in process inventory.

### Weighted-Average Method

Under the weighted-average method, a department's equivalent units are computed as follows:

#### Weighted-Average Method (a separate calculation is made for each cost category in each processing department)

$$\text{Equivalent units of production} = \text{Units transferred to the next department or to finished goods} + \text{Equivalent units in ending work in process inventory}$$

Note that the computation of the equivalent units of production involves adding the number of units transferred out of the department to the equivalent units in the department's ending inventory. There is no need to compute the equivalent units for the units transferred out of the department—they are 100% complete with respect to the work done in that department or they would not be transferred out. In other words, each unit transferred out of the department is counted as one equivalent unit.

Consider the Shaping and Milling Department at Double Diamond. This department uses computerized milling machines to precisely shape the wooden core and metal sheets that will be used to form the backbone of the ski. (See Exhibit 4–4 for an overview of the production process at Double Diamond.) The activity shown at the top of the next page took place in the department in May.

Note the use of the term *conversion* in the table on the next page. **Conversion cost**, as defined in an earlier chapter, is direct labor cost plus manufacturing overhead cost. In process costing, conversion cost is often treated as a single element of product cost.

Note that the beginning work in process inventory was 55% complete with respect to materials costs and 30% complete with respect to conversion costs. This means that 55% of the materials costs required to complete the units in the department had

#### LEARNING OBJECTIVE 2

Compute the equivalent units of production using the weighted-average method.



Shaping and Milling Department	Units	Percent Complete	
		Materials	Conversion
Beginning work in process . . . . .	200	55%	30%
Units started into production during May . . . . .	5,000		
Units completed during May and transferred to the next department . . . . .	4,800	100%*	100%*
Ending work in process . . . . .	400	40%	25%

\*We always assume that units transferred out of a department are 100% complete with respect to the processing done in that department.

already been incurred. Likewise, 30% of the conversion costs required to complete the units had already been incurred.

Two equivalent unit figures must be computed—one for materials and one for conversion. These computations are shown in Exhibit 4–5.

Note that the computations in Exhibit 4–5 ignore the fact that the units in the beginning work in process inventory were partially complete. For example, the 200 units in beginning inventory were already 30% complete with respect to conversion costs. Nevertheless, the weighted-average method is concerned only with the 4,900 equivalent units that are in ending inventories and in units transferred to the next department; it is not concerned with the fact that the beginning inventory was already partially complete. In other words, the 4,900 equivalent units computed using the weighted-average method include work that was accomplished in prior periods. This is a key point concerning the weighted-average method and it is easy to overlook.

Exhibit 4–6 provides another way of looking at the computation of equivalent units of production. This exhibit depicts the equivalent units computation for conversion costs. Study it carefully before going on.

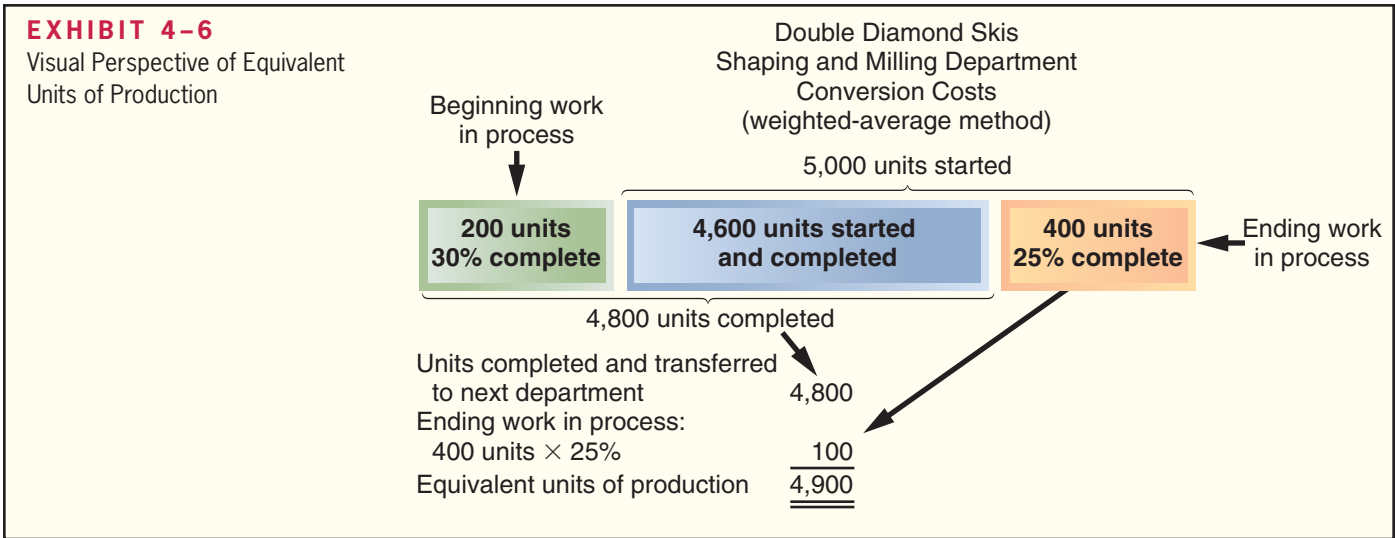
Shaping and Milling Department	Materials	Conversion
Units transferred to the next department. . . . .	4,800	4,800
Ending work in process:		
Materials: 400 units × 40% complete . . . . .	160	
Conversion: 400 units × 25% complete . . . . .		100
Equivalent units of production. . . . .	<u>4,960</u>	<u>4,900</u>

**EXHIBIT 4–5**  
Equivalent Units of Production:  
Weighted-Average Method

## CUTTING CONVERSION COSTS

**Cemex SA**, the world's third largest cement maker, owns 54 plants. Each of these plants consumes 800 tons of fuel a day heating kilns to 2,700 degrees Fahrenheit. Consequently, energy costs account for 40% of the company's overall conversion costs. Historically, Cemex relied exclusively on coal to heat its kilns; however, faced with soaring coal prices and shrinking profits, the company desperately needed a cheaper fuel. Cemex turned its attention to an oil industry waste product called *petroleum coke* that burns hotter than coal and costs half as much. The company spent about \$150 million to convert its kilns to burn petroleum coke. Overall, Cemex has cut its energy bills by 17%, helping it earn higher profit margins than its biggest rivals.

Source: John Lyons, "Expensive Energy? Burn Other Stuff, One Firm Decides," *The Wall Street Journal*, September 1, 2004, pp. A1 and A8.



## Compute and Apply Costs

**LEARNING OBJECTIVE 3**  
Compute the cost per equivalent unit using the weighted-average method.

In the last section we computed the equivalent units of production for materials and for conversion at Double Diamond Skis. In this section we will compute the cost per equivalent unit for materials and for conversion. We will then use these costs to value ending work in process and finished goods inventories. Exhibit 4-7 displays all of the data concerning May’s operations in the Shaping and Milling Department that we will need to complete these tasks.

### Cost per Equivalent Unit—Weighted-Average Method

In the weighted-average method, the cost per equivalent unit is computed as follows:

**Weighted-Average Method**  
(a separate calculation is made for each cost category in each processing department)

$$\text{Cost per equivalent unit} = \frac{\text{Cost of beginning work in process inventory} + \text{Cost added during the period}}{\text{Equivalent units of production}}$$

**EXHIBIT 4-7**  
Shaping and Milling Department  
Data for May Operations

Work in process, beginning:	
Units in process . . . . .	200
Completion with respect to materials . . . . .	55%
Completion with respect to conversion . . . . .	30%
Costs in the beginning inventory:	
Materials cost . . . . .	\$ 9,600
Conversion cost . . . . .	<u>5,575</u>
Total cost in the beginning inventory . . . . .	<u>\$15,175</u>
Units started into production during the period . . . . .	5,000
Units completed and transferred out . . . . .	4,800
Costs added to production during the period:	
Materials cost . . . . .	\$368,600
Conversion cost . . . . .	<u>350,900</u>
Total cost added in the department . . . . .	<u>\$719,500</u>
Work in process, ending:	
Units in process . . . . .	400
Completion with respect to materials . . . . .	40%
Completion with respect to conversion . . . . .	25%

Note that the numerator is the sum of the cost of beginning work in process inventory and of the cost added during the period. Thus, the weighted-average method blends together costs from the prior and current periods. That is why it is called the weighted-average method; it averages together units and costs from both the prior and current periods.

The costs per equivalent unit for materials and for conversion are computed below for the Shaping and Milling Department for May:

Shaping and Milling Department Costs per Equivalent Unit		
	Materials	Conversion
Cost of beginning work in process inventory . . . . .	\$ 9,600	\$ 5,575
Costs added during the period . . . . .	368,600	350,900
Total cost (a) . . . . .	<u>\$378,200</u>	<u>\$356,475</u>
Equivalent units of production (see the computations in the previous section) (b) . . . . .	4,960	4,900
Cost per equivalent unit (a) ÷ (b) . . . . .	\$76.25	\$72.75

### Applying Costs—Weighted-Average Method

The costs per equivalent unit are used to value units in ending inventory and units that are transferred to the next department. For example, each unit transferred out of Double Diamond's Shaping and Milling Department to the Graphics Application Department, as depicted in Exhibit 4-4, will carry with it a cost of \$149.00 (\$76.25 for materials cost and \$72.75 for conversion cost). Because 4,800 units were transferred out in May to the next department, the total cost assigned to those units would be \$715,200 (= 4,800 units × \$149.00 per unit).

A complete accounting of the costs of both ending work in process inventory and the units transferred out appears below:

Shaping and Milling Department Costs of Ending Work in Process Inventory and the Units Transferred Out			
	Materials	Conversion	Total
Ending work in process inventory:			
Equivalent units of production (materials:			
400 units × 40% complete; conversion:			
400 units × 25% complete) (a) . . . . .	160	100	
Cost per equivalent unit (see above) (b) . . . . .	\$76.25	\$72.75	
Cost of ending work in process inventory (a) × (b)	\$12,200	\$7,275	\$19,475
Units completed and transferred out:			
Units transferred to the next department (a) . . . .	4,800	4,800	
Cost per equivalent unit (see above) (b) . . . . .	\$76.25	\$72.75	
Cost of units transferred out (a) × (b) . . . . .	\$366,000	\$349,200	\$715,200

In each case, the equivalent units are multiplied by the cost per equivalent unit to determine the cost assigned to the units. This is done for each cost category—in this case, materials and conversion. The equivalent units for the units completed and transferred out are simply the number of units transferred to the next department because they would not have been transferred unless they were complete.

#### LEARNING OBJECTIVE 4

Assign costs to units using the weighted-average method.

**LEARNING OBJECTIVE 5**

Prepare a cost reconciliation report.

**Cost Reconciliation Report**

The costs assigned to ending work in process inventory and to the units transferred out reconcile with the costs we started with in Exhibit 4–7 as shown below:

Shaping and Milling Department Cost Reconciliation	
Costs to be accounted for:	
Cost of beginning work in process inventory (Exhibit 4–7) . . . . .	\$ 15,175
Costs added to production during the period (Exhibit 4–7) . . . . .	<u>719,500</u>
Total cost to be accounted for . . . . .	<u>\$734,675</u>
Costs accounted for as follows:	
Cost of ending work in process inventory (see page 151) . . . . .	\$ 19,475
Cost of units transferred out (see page 151) . . . . .	<u>715,200</u>
Total cost accounted for . . . . .	<u>\$734,675</u>

The \$715,200 cost of the units transferred to the next department, Graphics Application, will be accounted for in that department as “costs transferred in.” It will be treated in the process costing system as just another category of costs like materials or conversion costs. The only difference is that the costs transferred in will always be 100% complete with respect to the work done in the Graphics Applications Department. Costs are passed on from one department to the next in this fashion, until they reach the last processing department, Finishing and Pairing. When the products are completed in this last department, their costs are transferred to finished goods.

**Operation Costing**

The costing systems discussed in Chapters 3 and 4 represent the two ends of a continuum. On one end is job-order costing, which is used by companies that produce many different products in one facility. On the other end is process costing, which is used by companies that produce homogeneous products in large quantities. Between these two extremes there are many hybrid systems that include characteristics of both job-order and process costing. One of these hybrids is called *operation costing*.

**Operation costing** is used in situations where products have some common characteristics and some individual characteristics. Shoes, for example, have common characteristics in that all styles involve cutting and sewing that can be done on a repetitive basis, using the same equipment and following the same basic procedures. Shoes also have individual characteristics—some are made of expensive leathers and others may be made using inexpensive synthetic materials. In a situation such as this, where products have some common characteristics but also must be processed individually, operation costing may be used to determine product costs.

As mentioned above, operation costing is a hybrid system that employs aspects of both job-order and process costing. Products are typically processed in batches when operation costing is used, with each batch charged for its own specific materials. In this sense, operation costing is similar to job-order costing. However, labor and overhead costs are accumulated by operation or by department, and these costs are assigned to units as in process costing. If shoes are being produced, each shoe is charged the same per unit conversion cost, regardless of the style involved, but it is charged with its specific materials cost. Thus, the company is able to distinguish between styles in terms of materials, but it is able to employ the simplicity of a process costing system for labor and overhead costs.

Examples of other products for which operation costing may be used include electronic equipment (such as semiconductors), textiles, clothing, and jewelry (such as rings, bracelets, and medallions). Products of this type are typically produced in batches, but they can vary considerably from model to model or from style to style in terms of the cost of materials.

## Summary

Process costing is used in situations where homogeneous products or services are produced on a continuous basis. Costs flow through the manufacturing accounts in basically the same way in a process costing system as in a job-order costing system. However, costs are accumulated by department rather than by job in process costing.

In process costing, the equivalent units of production must be determined for each cost category in each department. Under the weighted-average method, the equivalent units of production equals the number of units transferred out to the next department or to finished goods plus the equivalent units in ending work in process inventory. The equivalent units in ending inventory equals the product of the number of partially completed units in ending work in process inventory and their percentage of completion with respect to the specific cost category.

Under the weighted-average method, the cost per equivalent unit for a specific cost category is computed by adding the cost of beginning work in process inventory and the cost added during the period and then dividing the result by the equivalent units of production. The cost per equivalent unit is then used to value the ending work in process inventory and the units transferred out to the next department or to finished goods.

The cost reconciliation report reconciles the cost of beginning inventory and the costs added to production during the period to the cost of ending inventory and the cost of units transferred out.

Costs are transferred from one department to the next until the last processing department. At that point, the cost of completed units is transferred to finished goods.

## Review Problem: Process Cost Flows and Costing Units

Luxguard Home Paint Company produces exterior latex paint, which it sells in one-gallon containers. The company has two processing departments—Base Fab and Finishing. White paint, which is used as a base for all the company's paints, is mixed from raw ingredients in the Base Fab Department. Pigments are then added to the basic white paint, the pigmented paint is squirted under pressure into one-gallon containers, and the containers are labeled and packed for shipping in the Finishing Department. Information relating to the company's operations for April follows:

- Issued raw materials for use in production: Base Fab Department, \$851,000; and Finishing Department, \$629,000.
- Incurred direct labor costs: Base Fab Department, \$330,000; and Finishing Department, \$270,000.
- Applied manufacturing overhead cost: Base Fab Department, \$665,000; and Finishing Department, \$405,000.
- Transferred basic white paint from the Base Fab Department to the Finishing Department, \$1,850,000.
- Transferred paint that had been prepared for shipping from the Finishing Department to Finished Goods, \$3,200,000.

*Required:*

- Prepare journal entries to record items (a) through (e) above.
- Post the journal entries from (1) above to T-accounts. The balance in the Base Fab Department's Work in Process account on April 1 was \$150,000; the balance in the Finishing Department's Work in Process account was \$70,000. After posting entries to the T-accounts, find the ending balance in each department's Work in Process account.
- Determine the cost of ending work in process inventories and of units transferred out of the Base Fab Department in April. The following additional information is available regarding production in the Base Fab Department during April:

Production data:	
Units (gallons) in process, April 1: materials 100% complete;	
labor and overhead 60% complete . . . . .	30,000
Units (gallons) started into production during April . . . . .	420,000
Units (gallons) completed and transferred to the	
Finishing Department . . . . .	370,000
Units (gallons) in process, April 30: materials 50% complete;	
labor and overhead 25% complete . . . . .	80,000
Cost data:	
Work in process inventory, April 1:	
Materials . . . . .	\$ 92,000
Labor . . . . .	21,000
Overhead . . . . .	37,000
Total cost of work in process . . . . .	<u>\$ 150,000</u>
Cost added during April:	
Materials . . . . .	\$ 851,000
Labor . . . . .	330,000
Overhead . . . . .	665,000
Total cost added during April . . . . .	<u>\$1,846,000</u>

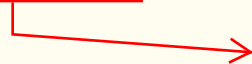
4. Prepare a cost reconciliation report for April.

**Solution to Review Problem**

1. a.	Work in Process—Base Fab Department . . . . .	851,000	
	Work in Process—Finishing Department . . . . .	629,000	
	Raw Materials . . . . .		1,480,000
b.	Work in Process—Base Fab Department . . . . .	330,000	
	Work in Process—Finishing Department . . . . .	270,000	
	Salaries and Wages Payable . . . . .		600,000
c.	Work in Process—Base Fab Department . . . . .	665,000	
	Work in Process—Finishing Department . . . . .	405,000	
	Manufacturing Overhead . . . . .		1,070,000
d.	Work in Process—Finishing Department . . . . .	1,850,000	
	Work in Process—Base Fab Department . . . . .		1,850,000
e.	Finished Goods . . . . .	3,200,000	
	Work in Process—Finishing Department . . . . .		3,200,000

2.	<b>Raw Materials</b>		<b>Salaries and Wages Payable</b>			
	Bal.	XXX	(a)	1,480,000	(b)	600,000
	<b>Work in Process— Base Fab Department</b>		<b>Manufacturing Overhead</b>			
	Bal.	150,000	(d)	1,850,000	(Various actual costs)	(c)
	(a)	851,000				1,070,000
	(b)	330,000				
	(c)	665,000				
	Bal.	146,000				
	<b>Work in Process—Finishing Department</b>		<b>Finished Goods</b>			
	Bal.	70,000	(e)	3,200,000	Bal.	XXX
	(a)	629,000			(e)	3,200,000
	(b)	270,000				
	(c)	405,000				
	(d)	1,850,000				
	Bal.	24,000				

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3. First, we must compute the equivalent units of production for each cost category:

Base Fab Department Equivalent Units of Production			
	Materials	Labor	Overhead
Units transferred to the next department . . . . .	370,000	370,000	370,000
Ending work in process inventory (materials: 80,000 units × 50% complete; labor: 80,000 units × 25% complete; overhead: 80,000 units × 25% complete) . . . . .	<u>40,000</u>	<u>20,000</u>	<u>20,000</u>
Equivalent units of production . . . . .	<u>410,000</u>	<u>390,000</u>	<u>390,000</u>

Then we must compute the cost per equivalent unit for each cost category:

Base Fab Department Costs per Equivalent Unit			
	Materials	Labor	Overhead
<b>Costs:</b>			
Cost of beginning work in process inventory . . . . .	\$ 92,000	\$ 21,000	\$ 37,000
Costs added during the period . . . . .	<u>851,000</u>	<u>330,000</u>	<u>665,000</u>
Total cost (a) . . . . .	<u>\$943,000</u>	<u>\$351,000</u>	<u>\$702,000</u>
Equivalent units of production (b) . . . . .	410,000	390,000	390,000
Cost per equivalent unit (a) ÷ (b) . . . . .	\$2.30	\$0.90	\$1.80

The costs per equivalent unit can then be applied to the units in ending work in process inventory and the units transferred out as follows:

Base Fab Department Costs of Ending Work in Process Inventory and the Units Transferred Out				
	Materials	Labor	Overhead	Total
<b>Ending work in process inventory:</b>				
Equivalent units of production . . . . .	40,000	20,000	20,000	
Cost per equivalent unit . . . . .	\$2.30	\$0.90	\$1.80	
Cost of ending work in process inventory . . . . .	\$92,000	\$18,000	\$36,000	\$146,000
<b>Units completed and transferred out:</b>				
Units transferred to the next department . . . . .	370,000	370,000	370,000	
Cost per equivalent unit . . . . .	\$2.30	\$0.90	\$1.80	
Cost of units completed and transferred out . . . . .	\$851,000	\$333,000	\$666,000	\$1,850,000

4.

Base Fab Department Cost Reconciliation	
<b>Costs to be accounted for:</b>	
Cost of beginning work in process inventory . . . . .	\$ 150,000
Costs added to production during the period . . . . .	<u>1,846,000</u>
Total cost to be accounted for . . . . .	<u>\$1,996,000</u>
<b>Costs accounted for as follows:</b>	
Cost of ending work in process inventory . . . . .	\$ 146,000
Cost of units transferred out . . . . .	<u>1,850,000</u>
Total cost accounted for . . . . .	<u>\$1,996,000</u>

## Glossary

- Conversion cost** Direct labor cost plus manufacturing overhead cost. (p. 148)
- Equivalent units** The product of the number of partially completed units and their percentage of completion with respect to a particular cost. Equivalent units are the number of complete whole units that could be obtained from the materials and effort contained in partially completed units. (p. 148)
- Equivalent units of production (weighted-average method)** The units transferred to the next department (or to finished goods) during the period plus the equivalent units in the department's ending work in process inventory. (p. 148)
- FIFO method** A process costing method in which equivalent units and unit costs relate only to work done during the current period. (p. 148)
- Operation costing** A hybrid costing system used when products have some common characteristics and some individual characteristics. (p. 152)
- Process costing** A costing method used when essentially homogeneous products are produced on a continuous basis. (p. 142)
- Processing department** An organizational unit where work is performed on a product and where materials, labor, or overhead costs are added to the product. (p. 143)
- Weighted-average method** A process costing method that blends together units and costs from both the current and prior periods. (p. 148)

## Questions

- 4-1 Under what conditions would it be appropriate to use a process costing system?
- 4-2 In what ways are job-order and process costing similar?
- 4-3 Why is cost accumulation simpler in a process costing system than it is in a job-order costing system?
- 4-4 How many Work in Process accounts are maintained in a company that uses process costing?
- 4-5 Assume that a company has two processing departments—Mixing followed by Firing. Prepare a journal entry to show a transfer of work in process from the Mixing Department to the Firing Department.
- 4-6 Assume that a company has two processing departments—Mixing followed by Firing. Explain what costs might be added to the Firing Department's Work in Process account during a period.
- 4-7 What is meant by the term *equivalent units of production* when the weighted-average method is used?
- 4-8 Watkins Trophies, Inc., produces thousands of medallions made of bronze, silver, and gold. The medallions are identical except for the materials used in their manufacture. What costing system would you advise the company to use?

Multiple-choice questions are provided on the text website at [www.mhhe.com/garrison14e](http://www.mhhe.com/garrison14e).



Available with McGraw-Hill's **Connect™ Accounting**.

LEARNING OBJECTIVES 2, 3, 4, 5

The Excel worksheet form that appears below is to be used to recreate the extended example on pages 146–152. Download the workbook containing this form from the Online Learning Center at [www.mhhe.com/garrison14e](http://www.mhhe.com/garrison14e). On the website you will also receive instructions about how to use this worksheet form.

	A	B	C	D	E
1	Chapter 4: Applying Excel				
2					
3	<b>Data</b>				
4	Work in process, beginning:				
5	Units in process	200			
6	Completion with respect to materials	55%			
7	Completion with respect to conversion	30%			
8	Costs in the beginning inventory:				
9	Materials cost	\$9,600			
10	Conversion cost	\$5,575			
11	Units started into production during the period	5,000			
12	Costs added to production during the period:				
13	Materials cost	\$368,600			
14	Conversion cost	\$350,900			
15	Work in process, ending:				
16	Units in process	400			
17	Completion with respect to materials	40%			
18	Completion with respect to conversion	25%			
19					
20	Enter a formula into each of the cells marked with a ? below				
21					
22	<b>Weighted Average method:</b>				
23					
24	<b>Equivalent Units of Production</b>				
25		Materials	Conversion		
26	Units transferred to the next department	?	?		
27	Ending work in process:				
28	Materials	?			
29	Conversion		?		
30	Equivalent units of production			?	
31					
32	<b>Costs per Equivalent Unit</b>				
33		Materials	Conversion		
34	Cost of beginning work in process inventory	?	?		
35	Costs added during the period	?	?		
36	Total cost	?	?		
37	Equivalent units of production	?	?		
38	Cost per equivalent unit	?	?		
39					
40	<b>Costs of Ending Work in Process Inventory and the Units Transferred Out</b>				
41		Materials	Conversion	Total	
42	Ending work in process inventory:				
43	Equivalent units of production	?	?		
44	Cost per equivalent unit	?	?		
45	Cost of ending work in process inventory	?	?	?	
46					
47	Units completed and transferred out:				
48	Units transferred to the next department	?	?		
49	Cost per equivalent unit	?	?		
50	Cost of units transferred out	?	?	?	
51					
52	<b>Cost Reconciliation</b>				
53	Costs to be accounted for:				
54	Cost of beginning work in process inventory	?			
55	Costs added to production during the period	?			
56	Total cost to be accounted for	?			
57	Costs to be accounted for as follows:				
58	Cost of ending work in process inventory	?			
59	Cost of units transferred out	?			
60	Total cost accounted for	?			
61					

You should proceed to the requirements below only after completing your worksheet.

Required:

1. Check your worksheet by changing the beginning work in process inventory to 100 units, the units started into production during the period to 2,500 units, and the units in ending work in process inventory to 200 units, keeping all of the other data the same as in the original example. If your worksheet is operating properly, the cost per equivalent unit for materials should now be \$152.50 and the cost per equivalent unit for conversion should be \$145.50. If you do not get these answers, find the errors in your worksheet and correct them.

How much is the total cost of the units transferred out? Did it change? Why or why not?

2. Enter the following data from a different company into your worksheet:

Work in process, beginning:	
Units in process . . . . .	200
Completion with respect to materials . . . . .	100%
Completion with respect to conversion . . . . .	20%
Costs in the beginning inventory:	
Materials cost . . . . .	\$2,000
Conversion cost . . . . .	\$800
Units started into production during the period . . . . .	1,800
Costs added to production during the period:	
Materials cost . . . . .	\$18,400
Conversion cost . . . . .	\$38,765
Work in process, ending:	
Units in process . . . . .	100
Completion with respect to materials . . . . .	100%
Completion with respect to conversion . . . . .	30%

- What is the cost of the units transferred out?
3. What happens to the cost of the units transferred out in part (2) above if the percentage completion with respect to conversion for the beginning inventory is changed from 20% to 40% and everything else remains the same? What happens to the cost per equivalent unit for conversion? Explain.

## Exercises



All applicable exercises are available with McGraw-Hill's **Connect™ Accounting**.

### EXERCISE 4–1 Process Costing Journal Entries [LO1]

Arizona Brick Corporation produces bricks in two processing departments—Molding and Firing. Information relating to the company's operations in March follows:

- Raw materials were issued for use in production: Molding Department, \$28,000; and Firing Department, \$5,000.
- Direct labor costs were incurred: Molding Department, \$18,000; and Firing Department, \$5,000.
- Manufacturing overhead was applied: Molding Department, \$24,000; and Firing Department, \$37,000.
- Unfired, molded bricks were transferred from the Molding Department to the Firing Department. According to the company's process costing system, the cost of the unfired, molded bricks was \$67,000.
- Finished bricks were transferred from the Firing Department to the finished goods warehouse. According to the company's process costing system, the cost of the finished bricks was \$108,000.
- Finished bricks were sold to customers. According to the company's process costing system, the cost of the finished bricks sold was \$106,000.

*Required:*

Prepare journal entries to record items (a) through (f) above.

### EXERCISE 4–2 Computation of Equivalent Units—Weighted-Average Method [LO2]

Lindex Company uses a process costing system. The following data are available for one department for October:

	Units	Percent Completed	
		Materials	Conversion
Work in process, October 1 . . . . .	50,000	90%	60%
Work in process, October 31 . . . . .	30,000	70%	50%

The department started 390,000 units into production during the month and transferred 410,000 completed units to the next department.

*Required:*

Compute the equivalent units of production for October, assuming that the company uses the weighted-average method of accounting for units and costs.

**EXERCISE 4-3 Cost Per Equivalent Unit—Weighted-Average Method [L03]**

Billinstaff Industries uses the weighted-average method in its process costing system. Data for the Assembly Department for May appear below:

	Materials	Labor	Overhead
Work in process, May 1 . . . . .	\$14,550	\$23,620	\$118,100
Cost added during May . . . . .	\$88,350	\$14,330	\$71,650
Equivalent units of production . . . . .	1,200	1,100	1,100

*Required:*

1. Compute the cost per equivalent unit for materials, for labor, and for overhead.
2. Compute the total cost per equivalent whole unit.

**EXERCISE 4-4 Applying Costs to Units—Weighted-Average Method [L04]**

Data concerning a recent period's activity in the Prep Department, the first processing department in a company that uses process costing, appear below:

	Materials	Conversion
Equivalent units of production in ending work in process . . . . .	300	100
Cost per equivalent unit . . . . .	\$31.56	\$9.32

A total of 1,300 units were completed and transferred to the next processing department during the period.

*Required:*

Compute the cost of the units transferred to the next department during the period and the cost of ending work in process inventory.

**EXERCISE 4-5 Cost Reconciliation Report—Weighted-Average Method [L05]**

Lech-Zurs Bakerie Corporation uses a process costing system. The Baking Department is one of the processing departments in its apple strudel manufacturing facility. In July in the Baking Department, the cost of beginning work in process inventory was \$4,830, the cost of ending work in process inventory was \$1,120, and the cost added to production was \$25,650.

*Required:*

Prepare a cost reconciliation report for the Baking Department for July.

**EXERCISE 4-6 Equivalent Units and Cost per Equivalent Unit—Weighted-Average Method [L02, L03]**

Kalox, Inc., manufactures an antacid product that passes through two departments. Data for May for the first department follow:

	Gallons	Materials	Labor	Overhead
Work in process, May 1 . . . . .	80,000	\$68,600	\$30,000	\$48,000
Gallons started in process . . . . .	760,000			
Gallons transferred out . . . . .	790,000			
Work in process, May 31 . . . . .	50,000			
Cost added during May . . . . .		\$907,200	\$370,000	\$592,000

The beginning work in process inventory was 80% complete with respect to materials and 75% complete with respect to labor and overhead. The ending work in process inventory was 60% complete with respect to materials and 20% complete with respect to labor and overhead.

Required:

Assume that the company uses the weighted-average method of accounting for units and costs.

1. Compute the equivalent units for May's activity for the first department.
2. Determine the costs per equivalent unit for May.

**EXERCISE 4–7 Comprehensive Exercise; Second Production Department—Weighted-Average Method [LO2, LO3, LO4, LO5]**

Papyrutech Corporation produces fine papers in three production departments—Pulping, Drying, and Finishing. In the Pulping Department, raw materials such as wood fiber and rag cotton are mechanically and chemically treated to separate their fibers. The result is a thick slurry of fibers. In the Drying Department, the wet fibers transferred from the Pulping Department are laid down on porous webs, pressed to remove excess liquid, and dried in ovens. In the Finishing Department, the dried paper is coated, cut, and spooled onto reels. The company uses the weighted-average method in its process costing system. Data for October for the Drying Department follow:

	Units	Percent Completed	
		Pulping	Conversion
Work in process inventory, October 1 . . . . .	4,000	100%	60%
Work in process inventory, October 31 . . . . .	6,000	100%	75%
Pulping cost in work in process inventory, October 1 . . . . .			\$1,500
Conversion cost in work in process inventory, October 1 . . . . .			\$400
Units transferred to the next production department . . . . .			146,000
Pulping cost added during October . . . . .			\$59,300
Conversion cost added during October . . . . .			\$22,100

No materials are added in the Drying Department. Pulping cost represents the costs of the wet fibers transferred in from the Pulping Department. Wet fiber is processed in the Drying Department in batches; each unit in the above table is a batch, and one batch of wet fibers produces a set amount of dried paper that is passed on to the Finishing Department.

Required:

1. Determine the equivalent units for October for pulping and conversion.
2. Compute the costs per equivalent unit for October for pulping and conversion.
3. Determine the total cost of ending work in process inventory and the total cost of units transferred to the Finishing Department in October.
4. Prepare a cost reconciliation report for the Drying Department for October.

**EXERCISE 4–8 Process Costing Journal Entries [LO1]**

Schneider Brot is a bread-baking company located in Aachen, Germany, near the Dutch border. The company uses a process costing system for its single product—a popular pumpernickel bread. Schneider Brot has two processing departments—Mixing and Baking. The T-accounts below show the flow of costs through the two departments in April (all amounts are in the currency euros):

Work in Process—Mixing			
Balance 4/1	10,000	Transferred out	760,000
Direct materials	330,000		
Direct labor	260,000		
Overhead	190,000		

Work in Process—Baking			
Balance 4/1	20,000	Transferred out	980,000
Transferred in	760,000		
Direct labor	120,000		
Overhead	90,000		

Required:

Prepare journal entries showing the flow of costs through the two processing departments during April.

**EXERCISE 4–9 Cost Assignment; Cost Reconciliation—Weighted-Average Method [LO2, LO4, LO5]**

Kenton Industrial Corporation uses the weighted-average method in its process costing system. During April, the Baker Assembly Department completed its processing of 18,000 units and transferred them to the next department. The cost of beginning inventory and the costs added during April amounted to \$855,000 in total. The ending inventory in April consisted of 1,500 units, which were 90% complete with respect to materials and 40% complete with respect to labor and overhead. The costs per equivalent unit for the month were as follows:

	Materials	Labor	Overhead
Cost per equivalent unit . . . . .	\$24.00	\$7.00	\$14.00

Required:

1. Compute the equivalent units of materials, labor, and overhead in the ending inventory for the month.
2. Compute the cost of ending inventory and of the units transferred to the next department for April.
3. Prepare a cost reconciliation for April. (Note: You will not be able to break the cost to be accounted for into the cost of beginning inventory and costs added during the month.)

**EXERCISE 4–10 Equivalent Units—Weighted-Average Method [LO2]**

Societe Clemeau, a company located in Lyons, France, manufactures cement for the construction industry. Data relating to the kilograms of cement processed through the Mixing Department, the first department in the production process, are provided below for May:

	Kilograms of Cement	Percent Completed	
		Materials	Conversion
Work in process, May 1 . . . . .	80,000	80%	20%
Work in process, May 31 . . . . .	50,000	40%	10%
Started into production during May . . . . .	300,000		

Required:

1. Compute the number of kilograms of cement completed and transferred out of the Mixing Department during May.
2. Compute the equivalent units of production for materials and for conversion for May.

**EXERCISE 4–11 Equivalent Units and Cost per Equivalent Unit—Weighted-Average Method [LO2, LO3, LO4]**

Solex Company produces a high-quality insulation material that passes through two production processes. Data for June for the first process follow:

	Units	Completion with Respect to Materials	Completion with Respect to Conversion
Work in process inventory, June 1 . . . . .	60,000	75%	40%
Work in process inventory, June 30 . . . . .	40,000	50%	25%
Materials cost in work in process inventory, June 1 . . . . .		\$56,600	
Conversion cost in work in process inventory, June 1 . . . . .		\$14,900	
Units started into production . . . . .		280,000	
Units transferred to the next process . . . . .		300,000	
Materials cost added during June . . . . .		\$385,000	
Conversion cost added during June . . . . .		\$214,500	

Required:

1. Assume that the company uses the weighted-average method of accounting for units and costs. Determine the equivalent units for June for the first process.

2. Compute the costs per equivalent unit for June for the first process.
3. Determine the total cost of ending work in process inventory and the total cost of units transferred to the next process in June.

**EXERCISE 4–12 Equivalent Units—Weighted-Average Method [L02]**

Gulf Fisheries, Inc., processes tuna for various distributors. Two departments are involved—Cleaning and Packing. Data relating to pounds of tuna processed in the Cleaning Department during May are given below:

	Pounds of Tuna	Percent Completed	
		Materials	Labor and Overhead
Work in process, May 1 . . . . .	30,000	100%	55%
Work in process, May 31 . . . . .	20,000	100%	90%
*Labor and overhead only.			

A total of 480,000 pounds of tuna were started into processing during May. All materials are added at the beginning of processing in the Cleaning Department.

*Required:*

Compute the equivalent units for May for both materials and labor and overhead assuming that the company uses the weighted-average method of accounting for units.

**Problems**



All applicable problems are available with McGraw-Hill's **Connect™ Accounting**.

**PROBLEM 4–13 Comprehensive Problem Weighted-Average Method [L02, L03, L04, L05]**

The PVC Company manufactures a high-quality plastic pipe that goes through three processing stages prior to completion.

Information on work in the first department, Cooking, is given below for May:

Production data:	
Pounds in process, May 1: materials 100% complete; conversion 90% complete . . . . .	70,000
Pounds started into production during May . . . . .	350,000
Pounds completed and transferred to the next department . . . . .	?
Pounds in process, May 31: materials 75% complete; conversion 25% complete . . . . .	40,000
Cost data:	
Work in process inventory, May 1:	
Materials cost . . . . .	\$86,000
Conversion cost . . . . .	\$36,000
Cost added during May:	
Materials cost . . . . .	\$447,000
Conversion cost . . . . .	\$198,000

The company uses the weighted-average method.

*Required:*

1. Compute the equivalent units of production.
2. Compute the costs per equivalent unit for the month.
3. Determine the cost of ending work in process inventory and of the units transferred out to the next department.
4. Prepare a cost reconciliation report for the month.

**PROBLEM 4-14 Comprehensive Problem—Weighted-Average Method [LO2, LO3, LO4, LO5]**

Honeybutter, Inc., manufactures a product that goes through two departments prior to completion—the Mixing Department followed by the Packaging Department. The following information is available about work in the first department, the Mixing Department, during June.

	A	B	C	D	E
1			<i>Percent Completed</i>		
2		<i>Units</i>	<i>Materials</i>	<i>Conversion</i>	
3	Work in process, beginning	70,000	70%	40%	
4	Started into production	460,000			
5	Completed and transferred out	450,000			
6	Work in process, ending	80,000	75%	25%	
7					
8			<i>Materials</i>	<i>Conversion</i>	
9	Work in process, beginning		\$36,550	\$13,500	
10	Cost added during June		\$391,850	\$287,300	
11					
12					

Required:

Assume that the company uses the weighted-average method.

- Determine the equivalent units for June for the Mixing Department.
- Compute the costs per equivalent unit for June for the Mixing Department.
- Determine the total cost of ending work in process inventory and the total cost of units transferred to the Packaging Department.
- Prepare a cost reconciliation report for the Mixing Department for June.

**PROBLEM 4-15 Analysis of Work in Process T-account—Weighted-Average Method [LO1, LO2, LO3, LO4]**

Brady Products manufactures a silicone paste wax that goes through three processing departments—Cracking, Blending, and Packing. All raw materials are introduced at the start of work in the Cracking Department. The Work in Process T-account for the Cracking Department for a recent month is given below:

Work in Process—Cracking Department			
Inventory, May 1	63,700	Completed and transferred to the Blending Department	?
Materials	397,600		
Conversion	187,600		
Inventory, May 31	?		

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We have changed the dashed lines to solid lines as per mail instructed date 11/02/2010. Please confirm.

The May 1 work in process inventory consisted of 35,000 pounds with \$43,400 in materials cost and \$20,300 in conversion cost. The May 1 work in process inventory was 100% complete with respect to materials and 80% complete with respect to conversion. During May, 280,000 pounds were started into production. The May 31 inventory consisted of 45,000 pounds that were 100% complete with respect to materials and 60% complete with respect to conversion. The company uses the weighted-average method to account for units and costs.

Required:

1. Determine the equivalent units of production for May.
2. Determine the costs per equivalent unit for May.
3. Determine the cost of the units completed and transferred to the Blending Department during May.

**PROBLEM 4-16 Cost Flows [LO1]**

Nature's Way, Inc., keeps one of its production facilities busy making a perfume called Essence de la Vache. The perfume goes through two processing departments: Blending and Bottling.

The following incomplete Work in Process account is provided for the Blending Department for March:

We have changed the dashed lines to solid lines as per mail instructed date 11/02/2010. Please confirm.

Work in Process—Blending		
March 1 balance	32,800	
Materials	147,600	Completed and transferred to Bottling (760,000 ounces) ?
Direct labor	73,200	
Overhead	481,000	
March 31 balance	?	

The \$32,800 beginning inventory in the Blending Department consisted of the following elements: materials, \$8,000; direct labor, \$4,000; and overhead applied, \$20,800.

Costs incurred during March in the Bottling Department were: materials used, \$45,000; direct labor, \$17,000; and overhead cost applied to production, \$108,000.

Required:

1. Prepare journal entries to record the costs incurred in both the Blending Department and Bottling Department during March. Key your entries to items (a) through (g) below:
  - a. Raw materials were issued for use in production.
  - b. Direct labor costs were incurred.
  - c. Manufacturing overhead costs for the entire factory were incurred, \$596,000. (Credit Accounts Payable and use a single Manufacturing Overhead control account for the entire factory.)
  - d. Manufacturing overhead was applied to production using a predetermined overhead rate.
  - e. Units that were complete with respect to processing in the Blending Department were transferred to the Bottling Department, \$722,000.
  - f. Units that were complete with respect to processing in the Bottling Department were transferred to Finished Goods, \$920,000.
  - g. Completed units were sold on account for \$1,400,000. The cost of goods sold was \$890,000.
2. Post the journal entries from (1) above to T-accounts. The following account balances existed at the beginning of March. (The beginning balance in the Blending Department's Work in Process account is given above.)

Raw Materials .....	\$198,600
Work in Process—Bottling Department .....	\$49,000
Finished Goods .....	\$20,000

After posting the entries to the T-accounts, find the ending balances in the inventory accounts and the manufacturing overhead account.



**PROBLEM 4-17 Comprehensive Problem; Second Production Department—Weighted-Average Method [LO2, LO3, LO4, LO5]**

Bohemian Links Inc. produces sausages in three production departments—Mixing, Casing and Curing, and Packaging. In the Mixing Department, meats are prepared and ground and then mixed with spices. The spiced meat mixture is then transferred to the Casing and Curing Department, where the mixture is force-fed into casings and then hung and cured in climate-controlled smoking chambers. In the Packaging Department, the cured sausages are sorted, packed, and labeled. The



company uses the weighted-average method in its process costing system. Data for April for the Casing and Curing Department follow:

	Units	Percent Completed		
		Mixing	Materials	Conversion
Work in process inventory, April 1 . . . . .	1	100%	60%	50%
Work in process inventory, April 30 . . . . .	1	100%	20%	10%

	Mixing	Materials	Conversion
Work in process inventory, April 1 . . . . .	\$1,640	\$26	\$105
Cost added during April . . . . .	\$94,740	\$8,402	\$61,197

Mixing cost represents the costs of the spiced meat mixture transferred in from the Mixing Department. The spiced meat mixture is processed in the Casing and Curing Department in batches; each unit in the above table is a batch, and one batch of spiced meat mixture produces a set amount of sausages that are passed on to the Packaging Department. During April, 60 batches (i.e., units) were completed and transferred to the Packaging Department.

Required:

1. Determine the equivalent units for April for mixing, materials, and conversion. Do not round off your computations.
2. Compute the costs per equivalent unit for April for mixing, materials, and conversion.
3. Determine the total cost of ending work in process inventory and the total cost of units transferred to the Packaging Department in April.
4. Prepare a cost reconciliation report for the Casing and Curing Department for April.

**PROBLEM 4-18 Interpreting a Report—Weighted-Average Method [LO2, LO3, LO4]**

Bell Computers, Ltd., located in Liverpool, England, assembles a standardized personal computer from parts it purchases from various suppliers. The production process consists of several steps, starting with assembly of the “mother” circuit board, which contains the central processing unit. This assembly takes place in the CPU Assembly Department. The company recently hired a new accountant who prepared the following report for the department for May using the weighted-average method:



Units to be accounted for:	
Work in process, May 1: materials 90% complete; conversion 80% complete . . . . .	5,000
Started into production . . . . .	29,000
Total units . . . . .	<u>34,000</u>
Units accounted for as follows:	
Transferred to next department . . . . .	30,000
Work in process, May 31: materials 75% complete; conversion 50% complete . . . . .	4,000
Total units . . . . .	<u>34,000</u>

Cost Reconciliation	
Cost to be accounted for:	
Work in process, May 1 . . . . .	£ 13,400
Cost added in the department . . . . .	87,800
Total cost to be accounted for . . . . .	<u>£101,200</u>
Cost accounted for as follows:	
Work in process, May 31 . . . . .	£ 8,200
Transferred to next department . . . . .	93,000
Total cost accounted for . . . . .	<u>£101,200</u>

The company's management would like some additional information about May's operation in the CPU Assembly Department. (The currency in England is the pound, which is denoted by the symbol £.)

Required:

1. How many units were started and completed during May?
2. What were the equivalent units for May for materials and conversion costs?
3. What were the costs per equivalent unit for May? The following additional data are available concerning the department's costs:

	Materials	Conversion	Total
Work in process, May 1 . . . . .	£9,000	£4,400	£13,400
Costs added during May . . . . .	£57,000	£30,800	£87,800

4. Verify the accountant's ending work in process inventory figure (£8,200) given in the report.
5. The new manager of the CPU Assembly Department was asked to estimate the incremental cost of processing an additional 1,000 units through the department. He took the unit cost for an equivalent whole unit you computed in (3) above and multiplied this figure by 1,000. Will this method yield a valid estimate of incremental cost? Explain.

All applicable cases are available with McGraw-Hill's *Connect™ Accounting*.



**CASE 4-19 Ethics and the Manager; Understanding the Impact of Percentage Completion on Profit**  
**[LO2, LO3, LO4]**

Thad Kostowski and Carol Lee are production managers in the Appliances Division of Mesger Corporation, which has several dozen plants scattered in locations throughout the world. Carol manages the plant located in Kansas City, Missouri, while Thad manages the plant in Roseville, Oregon. Production managers are paid a salary and get an additional bonus equal to 10% of their base salary if the entire division meets or exceeds its target profits for the year. The bonus is determined in March after the company's annual report has been prepared and issued to stockholders.

Late in February, Carol received a phone call from Thad that went like this:

**Thad:** How's it going, Carol?

**Carol:** Fine, Thad. How's it going with you?

**Thad:** Great! I just got the preliminary profit figures for the division for last year and we are within \$62,500 of making the year's target profits. All we have to do is to pull a few strings, and we'll be over the top!

**Carol:** What do you mean?

**Thad:** Well, one thing that would be easy to change is your estimate of the percentage completion of your ending work in process inventories.

**Carol:** I don't know if I should do that, Thad. Those percentage completion numbers are supplied by Jean Jackson, my lead supervisor. I have always trusted her to provide us with good estimates. Besides, I have already sent the percentage completion figures to the corporate headquarters.

**Thad:** You can always tell them there was a mistake. Think about it, Carol. All of us managers are doing as much as we can to pull this bonus out of the hat. You may not want the bonus check, but the rest of us sure could use it.

The final processing department in Carol's production facility began the year with no work in process inventories. During the year, 270,000 units were transferred in from the prior processing department and 250,000 units were completed and sold. Costs transferred in from the prior department totaled \$49,221,000. No materials are added in the final processing department. A total of \$16,320,000 of conversion cost was incurred in the final processing department during the year.

Required:

1. Jean Jackson estimated that the units in ending inventory in the final processing department were 25% complete with respect to the conversion costs of the final processing department. If this estimate of the percentage completion is used, what would be the cost of goods sold for the year?
2. Does Thad Kostowski want the estimated percentage completion to be increased or decreased? Explain why.

- What percentage completion figure would result in increasing the reported net operating income by \$62,500 over the net operating income that would be reported if the 25% figure were used?
- Do you think Carol Lee should go along with the request to alter estimates of the percentage completion? Why or why not?

**CASE 4–20 Second Department—Weighted-Average Method [L02, L03, L04]**

Durall Company manufactures a plastic gasket that is used in automobile engines. The gaskets go through three processing departments: Mixing, Forming, and Stamping. The company's accountant (who is very inexperienced) has prepared a summary of production and costs for the Forming Department for October as follows:



**excel**

Forming Department costs:	
Work in process inventory, October 1, 8,000 units:	
materials 100% complete; conversion $\frac{7}{8}$ complete . . . . .	\$ 22,420*
Costs transferred in from the Mixing Department . . . . .	81,480
Material added during October (added when processing is 50% complete in the Forming Department) . . . . .	27,600
Conversion costs added during October . . . . .	96,900
Total departmental costs . . . . .	<u>\$228,400</u>
Forming Department costs assigned to:	
Units completed and transferred to the Stamping Department, 100,000 units at \$2.284 each . . . . .	\$228,400
Work in process inventory, October 31, 5,000 units: conversion $\frac{2}{5}$ complete . . . . .	<u>—</u>
Total departmental costs assigned . . . . .	<u>\$228,400</u>
*Consists of cost transferred in, \$8,820; materials cost, \$3,400; and conversion costs, \$10,200.	

After mulling over the data above, Durall's president commented, "I can't understand what's happening here. Despite a concentrated effort at cost reduction, our unit cost actually went up in the Forming Department last month. With that kind of performance, year-end bonuses are out of the question for the people in that department."

The company uses the weighted-average method in its process costing.

*Required:*

- Prepare a report for the Forming Department for October showing how much cost should have been assigned to the units completed and transferred to the Stamping Department and to the ending work in process inventory.
- Explain to the president why the unit cost appearing on the report prepared by the accountant is so high.

## Appendix 4A: FIFO Method

The FIFO method of process costing differs from the weighted-average method in two ways: (1) the computation of equivalent units, and (2) the way in which costs of beginning inventory are treated. The FIFO method is generally considered more accurate than the weighted-average method, but it is more complex. The complexity is not a problem for computers, but the FIFO method is a little more difficult to understand and to learn than the weighted-average method.

### Equivalent Units—FIFO Method

The computation of equivalent units under the FIFO method differs from the computation under the weighted-average method in two ways.

#### LEARNING OBJECTIVE 6

Compute the equivalent units of production using the FIFO method.

First, the “units transferred out” is divided into two parts. One part consists of the units from the beginning inventory that were completed and transferred out, and the other part consists of the units that were both *started* and *completed* during the current period.

Second, full consideration is given to the amount of work expended during the current period on units in the *beginning* work in process inventory as well as on units in the ending inventory. Thus, under the FIFO method, both beginning and ending inventories are converted to an equivalent units basis. For the beginning inventory, the equivalent units represent the work done to *complete* the units; for the ending inventory, the equivalent units represent the work done to bring the units to a stage of partial completion at the end of the period (the same as with the weighted-average method).

The formula for computing the equivalent units of production under the FIFO method is more complex than under the weighted-average method:

$$\begin{aligned}
 & \textbf{FIFO Method} \\
 & \textbf{(a separate calculation is made for each cost category} \\
 & \textbf{in each processing department)} \\
 \\
 \text{Equivalent units of production} &= \text{Equivalent units to complete beginning work in process} \\
 & \text{inventory*} \\
 & \quad + \text{Units started and completed during the period} \\
 & \quad + \text{Equivalent units in ending work in process inventory} \\
 \\
 \text{*Equivalent units to} & \quad \text{Units in beginning} & \quad \left( \begin{array}{l} \text{Percentage completion} \\ \text{complete beginning work} = \text{work in process} \times \left( 100\% - \text{of beginning work in} \right. \\ \text{in process inventory} & \text{inventory} & \left. \text{process inventory} \right)
 \end{array} \right)
 \end{aligned}$$

Or, the equivalent units of production can also be determined as follows:

$$\begin{aligned}
 \text{Equivalent units of production} &= \text{Units transferred out} \\
 & \quad + \text{Equivalent units in ending work in process} \\
 & \quad \text{inventory} \\
 & \quad - \text{Equivalent units in beginning work in process} \\
 & \quad \text{inventory}
 \end{aligned}$$

To illustrate the FIFO method, refer again to the data for the Shaping and Milling Department at Double Diamond Skis. The department completed and transferred 4,800 units to the Graphics Application Department during May. Because 200 of these units came from the beginning inventory, the Shaping and Milling Department must have started and completed 4,600 units during May. The 200 units in the beginning inventory were 55% complete with respect to materials and only 30% complete with respect to conversion costs when the month started. Thus, to complete these units the department must have added another 45% of materials costs ( $100\% - 55\% = 45\%$ ) and another 70% of conversion costs ( $100\% - 30\% = 70\%$ ). Following this line of reasoning, the equivalent units for the department for May would be computed as shown in Exhibit 4A-1.

### Comparison of Equivalent Units of Production under the Weighted-Average and FIFO Methods

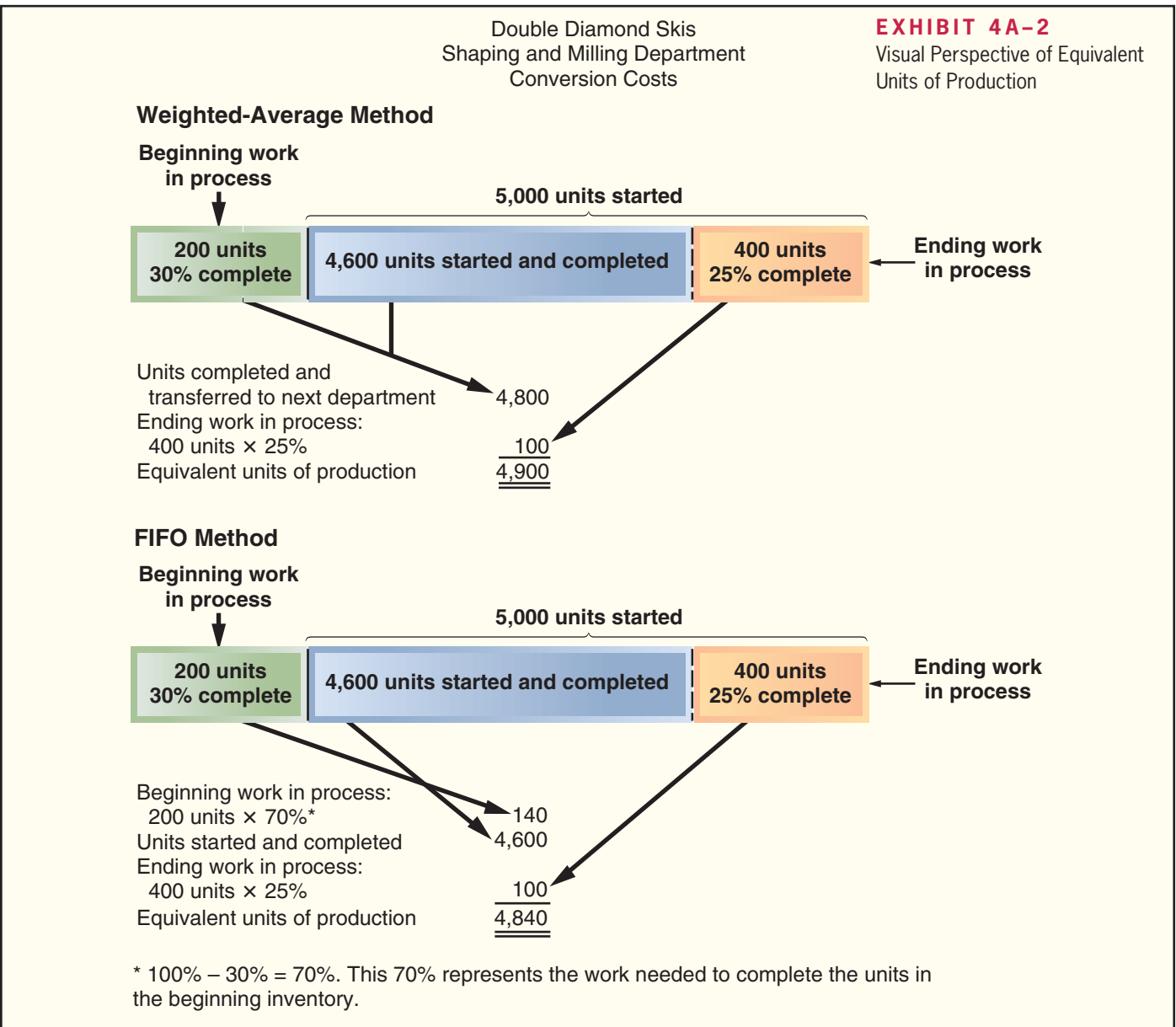
Stop at this point and compare the data in Exhibit 4A-1 with the data in Exhibit 4-5 in the chapter, which shows the computation of equivalent units under the weighted-average method. Also refer to Exhibit 4A-2, which compares the two methods.

The essential difference between the two methods is that the weighted-average method blends work and costs from the prior period with work and costs in the current

	Materials	Conversion
To complete beginning work in process:		
Materials: 200 units × (100% – 55%)*	90	
Conversion: 200 units × (100% – 30%)*		140
Units started and completed during the period	4,600 <sup>†</sup>	4,600 <sup>†</sup>
Ending work in process:		
Materials: 400 units × 40% complete	160	
Conversion: 400 units × 25% complete		100
Equivalent units of production	<u>4,850</u>	<u>4,840</u>

**EXHIBIT 4A-1**  
Equivalent Units of Production:  
FIFO Method

\*This is the work needed to complete the units in beginning inventory.  
<sup>†</sup>5,000 units started – 400 units in ending work in process = 4,600 units started and completed. This can also be computed as 4,800 units completed and transferred to the next department – 200 units in beginning work in process inventory. The FIFO method assumes that the units in beginning inventory are finished first.



period, whereas the FIFO method separates the two periods. To see this more clearly, consider the following reconciliation of the two calculations of equivalent units:

Shaping and Milling Department	Materials	Conversion
Equivalent units—weighted-average method . . . . .	4,960	4,900
Less equivalent units in beginning inventory:		
200 units × 55% . . . . .	110	
200 units × 30% . . . . .		60
Equivalent units of production—FIFO method . . . . .	<u>4,850</u>	<u>4,840</u>

From the above, it is evident that the FIFO method removes the equivalent units that were already in beginning inventory from the equivalent units as defined using the weighted-average method. Thus, the FIFO method isolates the equivalent units that are due to work performed during the current period. The weighted-average method blends together the equivalent units already in beginning inventory with the equivalent units that are due to work performed in the current period.

### Cost per Equivalent Unit—FIFO Method

In the FIFO method, the cost per equivalent unit is computed as follows:

**FIFO Method**  
(a separate calculation is made for each cost category in each processing department)

$$\text{Cost per equivalent unit} = \frac{\text{Cost added during the period}}{\text{Equivalent units of production}}$$

Unlike the weighted-average method, in the FIFO method the cost per equivalent unit is based only on the costs incurred in the department in the current period.

The costs per equivalent unit for materials and for conversion are computed below for the Shaping and Milling Department for May:

Shaping and Milling Department Costs per Equivalent Unit—FIFO method		
	Materials	Conversion
Cost added during the period (a) . . . . .	\$368,600	\$350,900
Equivalent units of production (b) . . . . .	4,850	4,840
Cost per equivalent unit (a) ÷ (b) . . . . .	\$76.00	\$72.50

### Applying Costs—FIFO Method

The costs per equivalent unit are used to value units in ending inventory and units that are transferred to the next department. For example, each unit transferred out of the Shaping and Milling Department to the Graphics Application Department will carry with it a cost of \$148.50—\$76.00 for materials cost and \$72.50 for conversion cost. Because 4,800 units were transferred out in May to the next department, the total cost assigned to those units would be \$712,800 (4,800 units × \$148.50 per unit).

A complete accounting of the costs of both ending work in process inventory and the units transferred out appears on the next page. It is more complicated than the weighted-average method. This is because the cost of the units transferred out consists of three separate components: (1) the cost of beginning work in process inventory; (2) the cost to complete the units in beginning work in process inventory; and (3) the cost of units started and completed during the period.

#### LEARNING OBJECTIVE 7

Compute the cost per equivalent unit using the FIFO method.

#### LEARNING OBJECTIVE 8

Assign costs to units using the FIFO method.

Shaping and Milling Department Costs of Ending Work in Process Inventory and Units Transferred Out—FIFO Method			
	Materials	Conversion	Total
<b>Ending work in process inventory:</b>			
Equivalent units of production (see Exhibit 4A–1) (a) . . . . .	160	100	
Cost per equivalent unit (see page 169) (b) . . . . .	\$76.00	\$72.50	
Cost of ending work in process inventory (a) × (b) . . . . .	\$12,160	\$7,250	<u>\$19,410</u>
<b>Units transferred out:</b>			
<b>Cost in beginning work in process inventory . . .</b>	\$9,600	\$5,575	\$15,175
<b>Cost to complete the units in beginning work in process inventory:</b>			
Equivalent units of production required to complete the units in beginning inventory (see Exhibit 4A–1) (a) . . . . .	90	140	
Cost per equivalent unit (see page 169) (b) . . .	\$76.00	\$72.50	
Cost to complete the units in beginning inventory (a) × (b) . . . . .	\$6,840	\$10,150	\$16,990
<b>Cost of units started and completed this period:</b>			
Units started and completed this period (see Exhibit 4A–1) (a) . . . . .	4,600	4,600	
Cost per equivalent unit (see page 169) (b) . . .	\$76.00	\$72.50	
Cost of units started and completed this period (a) × (b) . . . . .	\$349,600	\$333,500	<u>\$683,100</u>
Total cost of units transferred out . . . . .			<u>\$715,265</u>

Again, note that the cost of the units transferred out consists of three distinct components—the cost of beginning work in process inventory, the cost to complete the units in beginning inventory, and the cost of units started and completed during the period. This is a major difference between the weighted-average and FIFO methods.

### Cost Reconciliation Report—FIFO Method

The costs assigned to ending work in process inventory and to the units transferred out reconcile with the costs we started with in Exhibit 4–7 as shown below:

Shaping and Milling Department Cost Reconciliation	
<b>Costs to be accounted for:</b>	
Cost of beginning work in process inventory (Exhibit 4–7) . . . . .	\$ 15,175
Costs added to production during the period (Exhibit 4–7) . . . . .	<u>719,500</u>
Total cost to be accounted for . . . . .	<u>\$734,675</u>
<b>Costs accounted for as follows:</b>	
Cost of ending work in process inventory (see above) . . . . .	\$ 19,410
Cost of units transferred out (see above) . . . . .	<u>715,265</u>
Total cost accounted for . . . . .	<u>\$734,675</u>

The \$715,265 cost of the units transferred to the next department, Graphics Application, will be accounted for in that department as “costs transferred in.” As in the weighted-average method, this cost will be treated in the process costing system as just another category of costs, like materials or conversion costs. The only difference is that the costs transferred in will always be 100% complete with respect to the work done in

#### LEARNING OBJECTIVE 9

Prepare a cost reconciliation report using the FIFO method.

the Graphics Applications Department. Costs are passed on from one department to the next in this fashion, until they reach the last processing department, Finishing and Pairing. When the products are completed in this last department, their costs are transferred to finished goods.

### A Comparison of Costing Methods

In most situations, the weighted-average and FIFO methods will produce very similar unit costs. If there never are any ending inventories, the two methods will produce identical results. The reason for this is that without any ending inventories, no costs can be carried forward into the next period and the weighted-average method will base unit costs on just the current period's costs—just as in the FIFO method. If there *are* ending inventories, either erratic input prices or erratic production levels would also be required to generate much of a difference in unit costs under the two methods. This is because the weighted-average method will blend the unit costs from the prior period with the unit costs of the current period. Unless these unit costs differ greatly, the blending will not make much difference.

Nevertheless, from the standpoint of cost control, the FIFO method is superior to the weighted-average method. Current performance should be evaluated based on costs of the current period only but the weighted-average method mixes costs of the current period with costs of the prior period. Thus, under the weighted-average method, the manager's apparent performance in the current period is influenced by what happened in the prior period. This problem does not arise under the FIFO method because the FIFO method makes a clear distinction between costs of prior periods and costs incurred during the current period. For the same reason, the FIFO method also provides more up-to-date cost data for decision-making purposes.

On the other hand, the weighted-average method is simpler to apply than the FIFO method, but computers can handle the additional calculations with ease once they have been appropriately programmed.

## Appendix 4A Exercises and Problems



**All applicable exercises and problems are available with McGraw-Hill's *Connect™ Accounting*.**

### EXERCISE 4A-1 Computation of Equivalent Units—FIFO Method [L06]

Refer to the data for Lindex Company in Exercise 4-2.

*Required:*

Compute the equivalent units of production for October assuming that the company uses the FIFO method for accounting for units and costs.

### EXERCISE 4A-2 Cost per Equivalent Unit—FIFO Method [L07]

Resprin Company uses the FIFO method in its process costing system. Data for the Assembly Department for May appear below:

	Materials	Labor	Overhead
Cost added during May . . . . .	\$82,560	\$52,920	\$132,300
Equivalent units of production . . . . .	16,000	14,000	14,000

*Required:*

Compute the cost per equivalent unit for materials, for labor, for overhead, and in total.



**EXERCISE 4A-3 Applying Costs to Units—FIFO Method [LO8]**

Data concerning a recent period's activity in the Mixing Department, the first processing department in a company that uses process costing, appear below:

	Materials	Conversion
Cost of work in process inventory at the beginning of the period . . . . .	\$2,700	\$380
Equivalent units of production in the ending work in process inventory . . . . .	800	200
Equivalent units of production required to complete the beginning work in process inventory . . . . .	400	700
Cost per equivalent unit for the period . . . . .	\$4.40	\$1.30

A total of 8,000 units were completed and transferred to the next processing department during the period. Beginning work in process inventory consisted of 1,000 units and ending work in process inventory consisted of 2,000 units.

*Required:*

Using the FIFO method, compute the cost of the units transferred to the next department during the period and the cost of ending work in process inventory.

**EXERCISE 4A-4 Cost Reconciliation Report—FIFO Method [LO9]**

Kippingier Baking Corporation uses a process costing system in its large-scale baking operations. The Mixing Department is one of the company's processing departments. In the Mixing Department in August, the cost of beginning work in process inventory was \$4,230, the cost of ending work in process inventory was \$3,870, and the cost added to production was \$46,320.

*Required:*

Prepare a cost reconciliation report for the Mixing Department for August.

**EXERCISE 4A-5 Equivalent Units—FIFO Method [LO6]**

Refer to the data for Gulf Fisheries, Inc., in Exercise 4-12.

*Required:*

Compute the equivalent units for May for the Cleaning Department, assuming that the company uses the FIFO method of accounting for units.

**EXERCISE 4A-6 Equivalent Units—FIFO Method [LO6]**

Refer to the data for Societe Clemeau in Exercise 4-10.

*Required:*

1. Compute the number of kilograms of cement completed and transferred out of the Mixing Department during May.
2. Compute the equivalent units of production for materials and for conversion for May.

**EXERCISE 4A-7 Equivalent Units and Cost per Equivalent Unit—FIFO Method [LO6, LO7]**

Refer to the data for Kalox, Inc., in Exercise 4-6.

*Required:*

Assume that the company uses the FIFO method of accounting for units and costs.

1. Compute the equivalent units for May's activity for the first processing department.
2. Determine the costs per equivalent unit for May.

**EXERCISE 4A-8 Computation of Equivalent Units—FIFO Method [L06]**

QualCon, Inc., produces wine bottles for vintners in a process that starts in the Melt and Mold Department. Data concerning that department's operations in the most recent period appear below:

Beginning work in process:	
Units in process . . . . .	400
Stage of completion with respect to materials . . . . .	75%
Stage of completion with respect to conversion . . . . .	25%
Units started into production during the month . . . . .	42,600
Units completed and transferred out . . . . .	42,500
Ending work in process:	
Units in process . . . . .	500
Stage of completion with respect to materials . . . . .	80%
Stage of completion with respect to conversion . . . . .	30%

*Required:*

QualCon uses the FIFO method in its process costing system. Compute the equivalent units of production for the period for the Melt and Mold Department.

**EXERCISE 4A-9 Equivalent Units; Applying Costs—FIFO Method [L06, L07, L08]**

Krollon Company uses the FIFO method in its process costing system. The following data are for the most recent month of operations in one of the company's processing departments:

Units in beginning inventory . . . . .	400		
Units started into production . . . . .	4,300		
Units in ending inventory . . . . .	300		
Units transferred to the next department . . . . .	4,400		
		Materials	Conversion
Percentage completion of beginning inventory . . . . .		70%	30%
Percentage completion of ending inventory . . . . .		80%	40%

According to the company's costing system, the cost of beginning inventory was \$7,886, of which \$4,897 was for materials and the remainder was for conversion cost. The costs added during the month amounted to \$181,652. The costs per equivalent unit for the month were:

	Materials	Conversion
Cost per equivalent unit . . . . .	\$18.20	\$23.25

*Required:*

1. Compute the total cost per equivalent unit for the month.
2. Compute the equivalent units of material and of conversion costs in the ending inventory.
3. Compute the equivalent units of material and of conversion costs that were required to complete the beginning inventory.
4. Determine the number of units started and completed during the month.
5. Determine the costs of ending inventory and units transferred out.

**PROBLEM 4A–10 Equivalent Units; Applying Costs—FIFO Method [L06, L07, L08, L09]**

Reutter Company manufactures a single product and uses process costing. The company's product goes through two processing departments, Etching and Wiring. The following activity was recorded in the Etching Department during July:

Production data:	
Units in process, July 1: materials 60% complete; conversion 30% complete . . . . .	60,000
Units started into production . . . . .	510,000
Units in process, July 31: materials 80% complete; conversion 40% complete . . . . .	70,000
Cost data:	
Work in process inventory, July 1:	
Materials cost . . . . .	\$27,000
Conversion cost . . . . .	\$13,000
Cost added during July:	
Materials cost . . . . .	\$468,000
Conversion cost . . . . .	\$357,000

Materials are added at several stages during the etching process. The company uses the FIFO method.

Required:

- Determine the equivalent units for July for the Etching Department.
- Compute the costs per equivalent unit for July for the Etching Department.
- Determine the total cost of ending work in process inventory and the total cost of units transferred to the next process for the Etching Department in July.
- Prepare a cost reconciliation report for the Etching Department for July.

**PROBLEM 4A–11 Equivalent Units, Cost per Equivalent Unit, Applying Costs—FIFO Method [L06, L07, L08, L09]**

Refer to the data for the Mixing Department in Honeybutter, Inc., in Problem 4–14. Assume that the company uses the FIFO method rather than the weighted-average method in its process costing system.

Required:

- Determine the equivalent units for June for the Mixing Department.
- Compute the costs per equivalent unit for June for the Mixing Department.
- Determine the total cost of ending work in process inventory and the total cost of units transferred to the next process for the Mixing Department in June.
- Prepare a cost reconciliation report for the Mixing Department for June.

**CASE 4A–12 Second Department—FIFO Method [L06, L07, L08]**

Refer to the data for Durall Company in Case 4–20. Assume that the company uses the FIFO method in its process costing system.

Required:

- Prepare a report for the Forming Department for October showing how much cost should have been assigned to the units completed and transferred to the Stamping Department and to the ending work in process inventory.
- Assume that in order to remain competitive, the company undertook a major cost-cutting program during October. Would the effects of this cost-cutting program tend to show up more under the weighted-average method or under the FIFO method? Explain your answer.



## Appendix 4B: Service Department Allocations

Most large organizations have both *operating departments* and *service departments*. The central purposes of the organization are carried out in the operating departments. In contrast, service departments do not directly engage in operating activities. Instead, they provide services or assistance to the operating departments. Examples of operating departments include the Surgery Department at **Mt. Sinai Hospital**, the Geography Department at the **University of Washington**, the Marketing Department at **Allstate Insurance Company**, and production departments at manufacturers such as **Mitsubishi**, **Hewlett-Packard**, and **Michelin**. In process costing, the processing departments are all operating departments. Examples of service departments include Cafeteria, Internal Auditing, Human Resources, Cost Accounting, and Purchasing.

The overhead costs of operating departments commonly include allocations of costs from the service departments. To the extent that service department costs are classified as production costs, they should be included in unit product costs and thus, must be allocated to operating departments in a process costing system.

Three approaches are used to allocate the costs of service departments to other departments: the direct method, the step-down method, and the reciprocal method. These three methods are discussed in the following sections. However, before getting into the details of these methods, we will discuss *interdepartmental services*.

**Interdepartmental Services** Many service departments provide services to each other, as well as to operating departments. For example, the Cafeteria Department provides meals for all employees, including those assigned to other service departments, as well as to employees of the operating departments. In turn, the Cafeteria Department may receive services from other service departments, such as from Custodial Services or from Personnel. Services provided between service departments are known as *interdepartmental* or *reciprocal services*.

### Direct Method

The *direct method* is the simplest of the three cost allocation methods. It ignores the services provided by a service department to other service departments (e.g., interdepartmental services) and allocates all service department costs directly to operating departments. Even if a service department (such as Personnel) provides a large amount of service to another service department (such as the cafeteria), no allocations are made between the two departments. Rather, all costs are allocated *directly* to the operating departments, bypassing the other service departments; hence, the term *direct method*.

For an example of the direct method, consider Mountain View Hospital, which has two service departments and two operating departments as shown below. The hospital allocates its Hospital Administration costs on the basis of employee-hours and its Custodial Services costs on the basis of square feet occupied.

**LEARNING OBJECTIVE 10**  
Allocate service department costs to operating departments using the direct method.



	Service Departments		Operating Departments		Total
	Hospital Administration	Custodial Services	Laboratory	Patient Care	
Departmental costs before allocation . . . . .	\$360,000	\$90,000	\$261,000	\$689,000	\$1,400,000
Employee hours . . . . .	12,000	6,000	18,000	30,000	66,000
Space occupied—square feet . . . . .	10,000	200	5,000	45,000	60,200

**EXHIBIT 4B-1**

## Direct Method of Allocation

	Service Departments		Operating Departments		Total
	Hospital Administration	Custodial Services	Laboratory	Patient Care	
Departmental costs before allocation . . . . .	\$360,000	\$90,000	\$261,000	\$689,000	<u>\$1,400,000</u>
Allocation:					
Hospital Administration costs ( $\frac{18}{48}, \frac{30}{48}$ )* . . . . .	(360,000)		135,000	225,000	
Custodial Services costs ( $\frac{5}{50}, \frac{45}{50}$ )† . . . . .		(90,000)	9,000	81,000	
Total cost after allocation . . . . .	<u>\$ 0</u>	<u>\$ 0</u>	<u>\$405,000</u>	<u>\$995,000</u>	<u>\$1,400,000</u>

\*Based on the employee-hours in the two operating departments, which are 18,000 hours + 30,000 hours = 48,000 hours.

†Based on the square feet occupied by the two operating departments, which is 5,000 square feet + 45,000 square feet = 50,000 square feet.

The direct method of allocating the hospital's service department costs to the operating departments is shown in Exhibit 4B-1. Several things should be noted in this exhibit. First, the employee-hours of the Hospital Administration Department and the Custodial Services Department are ignored when allocating the costs of Hospital Administration using the direct method. *Under the direct method, any of the allocation base attributable to the service departments themselves is ignored; only the amount of the allocation base attributable to the operating departments is used in the allocation.* Note that the same rule is used when allocating the costs of the Custodial Services Department. Even though the Hospital Administration and Custodial Services departments occupy some space, this is ignored when the Custodial Services costs are allocated. Finally, note that after all allocations have been completed, all of the service department costs are contained in the two operating departments.

Although the direct method is simple, it is less accurate than the other methods because it ignores interdepartmental services.

### Step-Down Method

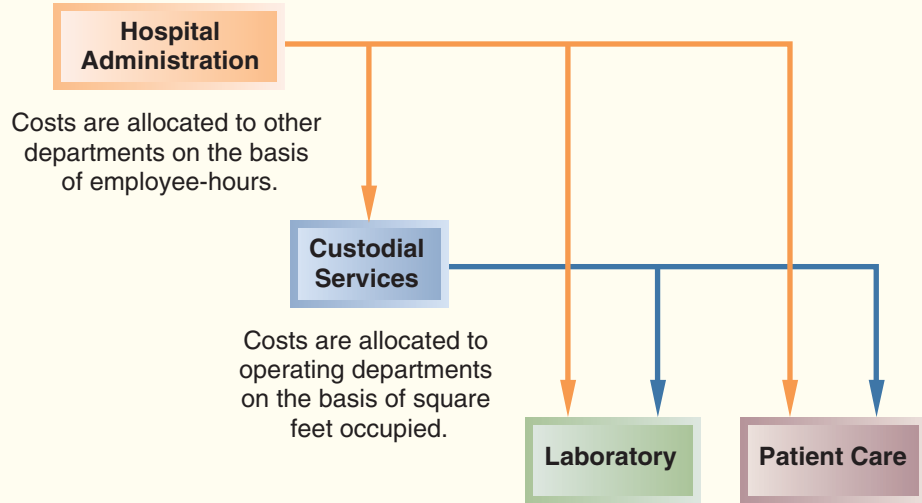
Unlike the direct method, the *step-down method* provides for allocation of a service department's costs to other service departments, as well as to operating departments. The step-down method is sequential. The sequence typically begins with the department that provides the greatest amount of service to other service departments. After its costs have been allocated, the process continues, step by step, ending with the department that provides the least amount of services to other service departments. This step procedure is illustrated in Exhibit 4B-2.

Exhibit 4B-3 shows the details of the step-down method. Note the following three key points about these allocations. First, under Allocation in Exhibit 4B-3, you see two allocations, or steps. In the first step, the costs of Hospital Administration are allocated to another service department (Custodial Services) as well as to the operating departments. In contrast to the direct method, the allocation base for Hospital Administration costs now includes the employee-hours for Custodial Services as well as for the operating departments. However, the allocation base still excludes the employee-hours for Hospital Administration itself. *In both the direct and step-down methods, any amount of the allocation base attributable to the service department whose cost is being allocated is always ignored.* Second, looking again at Exhibit 4B-3, note that in the second step under the Allocation heading, the cost of Custodial Services is allocated to the two operating departments, and none of the cost is allocated to Hospital Administration even though Hospital Administration occupies space in the building. *In the step-down method,*

#### LEARNING OBJECTIVE 11

Allocate service department costs to operating departments using the step-down method.

**EXHIBIT 4B-2**  
Graphic Illustration—Step-Down Method



any amount of the allocation base that is attributable to a service department whose cost has already been allocated is ignored. After a service department’s costs have been allocated, costs of other service departments are not reallocated back to it. Third, note that the cost of Custodial Services allocated to other departments in the second step (\$130,000) in Exhibit 4B-3 includes the costs of Hospital Administration that were allocated to Custodial Services in the first step in Exhibit 4B-3.

**Reciprocal Method**

The *reciprocal method* gives full recognition to interdepartmental services. Under the step-down method only partial recognition of interdepartmental services is possible. The step-down method always allocates costs forward—never backward. The reciprocal method, by contrast, allocates service department costs in *both* directions. Thus, because Custodial Services in the prior example provides services for Hospital Administration, part of Custodial Services’ costs will be allocated *back* to Hospital Administration if the reciprocal method is used. At the same time, part of Hospital Administration’s costs will be allocated *forward* to Custodial Services. Reciprocal allocation requires the use of simultaneous linear equations and is beyond the scope of this book. Examples of the reciprocal method can be found in more advanced cost accounting texts.

**EXHIBIT 4B-3**  
Step-Down Method of Allocation

	Service Departments		Operating Departments		Total
	Hospital Administration	Custodial Services	Laboratory	Patient Care	
Departmental costs before allocation . . . . .	\$360,000	\$ 90,000	\$261,000	\$ 689,000	<u>\$1,400,000</u>
Allocation:					
Hospital Administration costs ( $\frac{6}{54}$ , $\frac{18}{54}$ , $\frac{30}{54}$ )* . . .	(360,000)	40,000	120,000	200,000	
Custodial Services costs ( $\frac{5}{50}$ , $\frac{45}{50}$ )† . . . . .		(130,000)	13,000	117,000	
Total cost after allocation . . . . .	<u>\$ 0</u>	<u>\$ 0</u>	<u>\$394,000</u>	<u>\$1,006,000</u>	<u>\$1,400,000</u>

\*Based on the employee-hours in Custodial Services and the two operating departments, which are 6,000 hours + 18,000 hours + 30,000 hours = 54,000 hours.

†As in Exhibit 4B-1, this allocation is based on the square feet occupied by the two operating departments.

All applicable exercises and problems are available with McGraw-Hill's *Connect™ Accounting*.

**EXERCISE 4B-1 Direct Method [LO10]**

Ignatius College has provided the following data to be used in its service department cost allocations:



	Service Departments		Operating Departments	
	Administration	Physical Plant Services	Undergraduate Programs	Graduate Programs
Departmental costs before allocations . . . . .	\$2,070,000	\$720,000	\$23,650,000	\$2,980,000
Student credit-hours . . . . .			40,000	5,000
Space occupied in square feet . . . . .	30,000	5,000	250,000	50,000

*Required:*

Using the direct method, allocate the costs of the service departments to the two operating departments. Allocate the costs of the Administration Department on the basis of student credit-hours and the costs of the Physical Plant Services Department on the basis of space occupied.

**EXERCISE 4B-2 Step-Down Method [LO11]**

University District Co-op, a whole foods grocery and coffee shop, has provided the following data to be used in its service department cost allocations:



	Service Departments		Operating Departments	
	Administration	Building Services	Groceries	Coffee Shop
Departmental costs before allocations . . . . .	\$200,000	\$60,000	\$3,860,000	\$340,000
Employee-hours . . . . .	480	320	2,720	160
Space occupied in square feet . . . . .	800	1,200	9,500	500

*Required:*

Using the step-down method, allocate the costs of the service departments to the two operating departments. Allocate the costs of the Administration Department first on the basis of employee-hours and then the costs of the Building Services Department on the basis of space occupied.

**EXERCISE 4B-3 Step-Down Method [LO11]**

Arbon Company has three service departments and two operating departments. Selected data concerning the five departments are presented below:

	Service Departments			Operating Departments		
	Administrative	Janitorial	Equipment Maintenance	Prep	Finishing	Total
Costs . . . . .	\$84,000	\$67,800	\$36,000	\$256,100	\$498,600	\$942,500
Number of employees . . . . .	80	60	240	600	300	1,280
Square feet of space occupied . . . . .	3,000	12,000	10,000	20,000	70,000	115,000
Machine-hours . . . . .				10,000	30,000	40,000

The company allocates service department costs by the step-down method in the following order: Administrative (number of employees), Janitorial (space occupied), and Equipment Maintenance (machine-hours).

Required:

Using the step-down method, allocate the service department costs to the operating departments.

#### EXERCISE 4B-4 Direct Method [LO10]

Refer to the data for Arbon Company in Exercise 4B-3.

Required:

Assuming that the company uses the direct method rather than the step-down method to allocate service department costs, how much cost would be assigned to each operating department?



**eXcel**

#### PROBLEM 4B-5 Step-Down Method [LO11]

Pleasant View Hospital has three service departments—Food Services, Administrative Services, and X-ray Services. The costs of these departments are allocated by the step-down method, using the allocation bases and in the order shown below:

Service Department	Costs Incurred	Base for Allocation
Food Services . . . . .	Variable Fixed	Meals served Peak-period needs
Administrative Services . . . . .	Variable Fixed	Files processed 10% X-ray Services, 20% Outpatient Clinic, 30% OB Care, and 40% General Hospital
X-ray Services . . . . .	Variable Fixed	X-rays taken Peak-period needs

Estimated cost and operating data for all departments in the hospital for the forthcoming month are presented in the following table:

	Food Services	Admin. Services	X-Ray Services	Outpatient Clinic	OB Care	General Hospital	Total
Variable costs . . . . .	\$ 73,150	\$ 6,800	\$38,100	\$11,700	\$ 14,850	\$ 53,400	\$198,000
Fixed costs . . . . .	48,000	33,040	59,520	26,958	99,738	344,744	612,000
Total costs . . . . .	<u>\$121,150</u>	<u>\$39,840</u>	<u>\$97,620</u>	<u>\$38,658</u>	<u>\$114,588</u>	<u>\$398,144</u>	<u>\$810,000</u>
Meals served . . . . .		1,000	500		7,000	30,000	38,500
Percent of peak-period Food Services needs . . . . .		2%	1%		17%	80%	100%
Files processed . . . . .			1,500	3,000	900	12,000	17,400
X-rays taken . . . . .				1,200	350	8,400	9,950
Percent of peak-period X-ray Services needs . . . . .				13%	3%	84%	100%

All billing in the hospital is done through the Outpatient Clinic, OB Care, or General Hospital. The hospital's administrator wants the costs of the three service departments allocated to these three billing centers.

Required:

Prepare the cost allocation desired by the hospital administrator. Include under each billing center the direct costs of the center as well as the costs allocated from the service departments.

**eXcel**

#### PROBLEM 4B-6 Step-Down Method versus Direct Method; Predetermined Overhead Rates [LO10, LO11]

Petah, Ltd., of Tel Aviv, Israel, has budgeted costs in its various departments as follows for the coming year:

Factory Administration . . . . .	₪ 540,000
Custodial Services . . . . .	137,520
Personnel . . . . .	57,680
Maintenance . . . . .	90,400
Stamping—overhead . . . . .	752,600
Assembly—overhead . . . . .	351,800
Total overhead cost . . . . .	<u>₪1,930,000</u>



The Israeli currency is the shekel, denoted by ₪. The company allocates service department costs to other departments, *in the order listed below*.

	Number of Employees	Total Labor- Hours	Square Meters of Space Occupied	Direct Labor- Hours	Machine- Hours
Factory Administration . . . . .	22	—	5,000	—	—
Custodial Services . . . . .	8	6,000	2,000	—	—
Personnel . . . . .	10	10,000	3,000	—	—
Maintenance . . . . .	50	44,000	10,000	—	—
Stamping—overhead . . . . .	80	60,000	70,000	40,000	140,000
Assembly—overhead . . . . .	120	180,000	20,000	160,000	20,000
	<u>290</u>	<u>300,000</u>	<u>110,000</u>	<u>200,000</u>	<u>160,000</u>

Stamping and Assembly are operating departments; the other departments are service departments. Factory Administration is allocated on the basis of labor-hours; Custodial Services on the basis of square meters occupied; Personnel on the basis of number of employees; and Maintenance on the basis of machine-hours.

Required:

1. Allocate service department costs to consuming departments by the step-down method. Then compute predetermined overhead rates in the operating departments, using a machine-hours basis in Stamping and a direct labor-hours basis in Assembly.
2. Repeat (1) above, this time using the direct method. Again, compute predetermined overhead rates in Stamping and Assembly.
3. Assume that the company doesn't bother with allocating service department costs but simply computes a single plantwide overhead rate based on total overhead costs (both service department and operating department costs) divided by total direct labor-hours. Compute the plantwide overhead rate.
4. Suppose a job requires machine and labor time as follows:

	Machine-Hours	Direct Labor-Hours
Stamping Department . . . . .	190	25
Assembly Department . . . . .	<u>10</u>	<u>75</u>
Total hours . . . . .	<u>200</u>	<u>100</u>

Using the overhead rates computed in (1), (2), and (3) above, compute the amount of overhead cost that would be assigned to the job if the overhead rates were developed using the step-down method, the direct method, and the plantwide method. (Round allocations to the nearest whole shekel.)

#### CASE 4B-7 Step-Down Method versus Direct Method [LO10, LO11]

"I can't understand what's happening here," said Mike Holt, president of Severson Products, Inc. "We always seem to bid too high on jobs that require a lot of labor time in the Finishing Department, and we always seem to get every job we bid on that requires a lot of machine time in the Milling Department. Yet we don't seem to be making much money on those Milling Department jobs. I wonder if the problem is in our overhead rates."

Severson Products manufactures high-quality wood products to customers' specifications. Some jobs take a large amount of machine work in the Milling Department, and other jobs take a large amount of hand finishing work in the Finishing Department. In addition to the Milling and Finishing departments, the company has three service departments. The costs of these service departments are allocated to other departments *in the order listed on the following page*. (For each service department, use the most appropriate allocation base.)



	Total Labor-Hours	Square Feet of Space Occupied	Number of Employees	Machine-Hours	Direct Labor-Hours
Cafeteria . . . . .	16,000	12,000	25		
Custodial Services . . . . .	9,000	3,000	40		
Machinery Maintenance . . . . .	15,000	10,000	60		
Milling . . . . .	30,000	40,000	100	160,000	20,000
Finishing . . . . .	<u>100,000</u>	<u>20,000</u>	<u>300</u>	<u>40,000</u>	<u>70,000</u>
	<u>170,000</u>	<u>85,000</u>	<u>525</u>	<u>200,000</u>	<u>90,000</u>

Budgeted overhead costs in each department for the current year are as follows:

Cafeteria . . . . .	\$ 320,000*
Custodial Services . . . . .	65,400
Machinery Maintenance . . . . .	93,600
Milling . . . . .	416,000
Finishing . . . . .	<u>166,000</u>
Total budgeted cost . . . . .	<u>\$1,061,000</u>

\*This represents the amount of cost subsidized by the company.

Because of its simplicity, the company has always used the direct method to allocate service department costs to the two operating departments.

Required:

- Using the step-down method, allocate service department costs to the consuming departments. Then compute predetermined overhead rates in the operating departments for the current year using machine-hours as the allocation base in the Milling Department and direct labor-hours as the allocation base in the Finishing Department.
- Repeat (1) above, this time using the direct method. Again compute predetermined overhead rates in the Milling and Finishing Departments.
- Assume that during the current year the company bids on a job that requires machine and labor time as follows:

	Machine-Hours	Direct Labor-Hours
Milling Department . . . . .	2,000	1,600
Finishing Department . . . . .	<u>800</u>	<u>13,000</u>
Total hours . . . . .	<u>2,800</u>	<u>14,600</u>

- Determine the amount of overhead that would be assigned to the job if the company used the overhead rates developed in (1) above. Then determine the amount of overhead that would be assigned to the job if the company used the overhead rates developed in (2) above.
- Explain to the president why the step-down method provides a better basis for computing predetermined overhead rates than the direct method.