# MANAGEMENT ACCOUNTING CONCEPTS AND TECHNIQUES

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## CHAPTER 14: Work-in-Process

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**Equivalent unit calculations**

How does a company that uses an assembly-line or batch manufacturing process determine the cost of work-in-process at period-end, when there are hundreds or thousands of units of inventory at varying stages of completion? The answer relies on the concept of an **equivalent unit**. For example, four units that are each half-finished are equivalent to two complete units. Eight units that are each 25% finished are also equivalent to two complete units. In both examples, the cost accounting terminology is that there are two equivalent units in work-in-process. Similarly, if two units are 50% complete and four units are 25% complete, there are still two equivalent units in work-in-process. What does it mean for a unit of inventory to be 50% complete? It means that 50% of the inputs required to make the unit have been incurred.

In some manufacturing environments, materials enter the production process early, while labor and other inputs are incurred more evenly throughout the process. For example, an apparel manufacturer cuts all of the fabric for the batch at the beginning of the production process, while sewing operator labor is incurred more-or-less evenly from the time the fabric is cut until the garments are completed. In this situation, companies frequently calculate equivalent units separately for materials and conversion costs (labor and overhead). In fact, companies can calculate equivalent units separately for as many different types of inputs as desired, breaking materials and labor into subcategories. However, the additional accuracy of the cost accounting information thus obtained seldom justifies the additional costs to track it.

The following nine examples illustrate how equivalent units are used to calculate the cost of work-in-process, beginning with a simple setting and progressing to more complicated scenarios. Each example involves a company that assembles personal computers from purchased components. As shown in some of these examples, the company’s assumption about inventory flow is relevant.

**Example 1:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Beginning Inventory** | **Activity during the week** |  | **Ending**  **Inventory** |
| **Units** | 0 | Units made and shipped (sold): 10 |  | 0 |
| **Costs incurred** | $0\* | Materials: Conversion costs: | $1,900  940 |  |

\*Throughout these examples, the box for “costs incurred—beginning inventory” reports the beginning balance in the WIP account for the week.

**Question:** What is the cost per unit for each unit made and sold?

**Answer:**

Total costs: $1,900 + $940 = $2,840

Cost per unit: $2,840 ÷ 10 units = $284 per unit.

Since there is no ending inventory, there is no work-in-process, and no equivalent unit calculations are necessary. The cost of ending inventory is zero.

Since 10 units were sold, the cost of goods sold is $284 x 10 = $2,840.

**Example 2:** This example introduces ending work-in-process.

**Question:** What is the cost of goods sold? What is the cost of ending work-in-process?

**Answer:**

Unable to determine without knowing the extent to which the partially-finished unit is completed.

**Example 3:** Same as Example 2, but with additional information about the status of ending work-in-process.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Beginning Inventory** | **Activity during the week** |  | **Ending**  **Inventory** |
| **Units** | 0 | Units started: 10  Units completed and shipped: 9 |  | Finished units: 0  Partially finished units: 1 (it is 50% complete with respect to both materials and conversion costs) |
| **Costs incurred** | $0 | Materials: Conversion costs: | $1,900  940 |  |

**Questions:** What is cost of goods sold? What is the cost of ending work-in-process?

**Answer:**

Total costs: $1,900 + $940 = $2,840

Equivalent units: 9 completed units + 1 unit 50% complete = 9.5 equivalent units

Cost per unit: $2,840 ÷ 9.5 units = $299 per equivalent unit

Cost of goods sold: 9 units were sold. The cost of goods sold is $299 x 9 = $2,691.

Work-in-process: $299 per unit x 1 unit 50% complete = $149.50

**Example 4:** This example separates materials from conversion costs (labor and overhead).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Beginning Inventory** | **Activity during the week** |  |  | **Ending**  **Inventory** |
| **Units** | 0 | Units started:  Units completed:  Units shipped |  | 10  9  9 | Finished units: 0  Partially finished units: 1  (it is 100% complete  with respect to materials, 40% complete with respect to conversion costs. |
| **Costs incurred** | $0 | Materials: Conversion Costs: | $1,900  940 |  |  |

**Questions:** What is cost of goods sold? What is the cost of ending work-in-process?

**Answer:**

|  |  |
| --- | --- |
| Equivalent Units  Materials:    Conversion costs:    Cost per equivalent unit  Materials:  Conversion costs:  Total:    Cost of goods sold:    Work-in-process  Materials:  Conversion costs:  Total: | 10 units (9 sold plus 1 unit in WIP 100% complete with respect to materials)  9.4 units (9 sold plus 1 unit in WIP 40% complete with respect to conversion costs)    $1,900 ÷ 10 equivalent units = $190 per equivalent unit  $940 ÷ 9.4 equivalent units = $100 per equivalent unit  $190 for materials + $100 for conversion costs = $290    $290 x 9 units sold = $2,610      $190 x 1 unit 100% complete = $190  $100 x 1 unit 40% complete = $40  $190 + $40 = $230 |

**Example 5:** This example introduces beginning inventory.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Beginning Inventory** | **Activity during the week** |  |  | **Ending**  **Inventory** |
| **Units** | Finished units: 1 | Units started:  Units completed:  Units shipped: |  | 10  10  10 | Finished units: 1 |
| **Costs incurred** | $300 beginning balance in finished goods inventory | Materials: Conversion Costs: | $1,900  940 |  |  |

**Questions:** What is cost of goods sold? What is the ending balance in finished goods inventory?

**Answer:** Although total costs to account for is easily calculated ($300 + $1,900 + $940 = $3,140), it is impossible to determine the break-out between cost of goods sold and finished goods inventory without knowing the company’s inventory flow assumption.

**Example 6:** Data and questions are the same as in Example 5. Assume the company uses the FIFO (first in, first out) inventory flow assumption.

**Answer:** The cost per unit for production this week is $284, as calculated in Example 1.

|  |  |
| --- | --- |
| Cost of goods sold:      Ending balance in finished goods:  All costs are accounted for: | (1 unit at $300) + (9 units at $284)  = $300 + $2,556 = $2,856    1 unit at $284 = $284  $2,856 + $284 = $3,140 |

**Example 7:** Data and questions are the same as in Example 5. Assume the company uses the LIFO (last in, first out) inventory flow assumption.

**Answer:**

Cost of goods sold: 10 units at $284 = $2,840

Ending balance in finished goods: 1 unit at $300 = $300

All costs are accounted for: $2,840 + $300 = $3,140

**Example 8:** Data and questions are the same as in Example 5. Assume the company uses the weighted average method for calculating cost of goods sold.

**Answer:** The weighted average method averages between the cost of goods on hand at the beginning of the period, and the cost of goods produced during the period.

|  |  |
| --- | --- |
| Total costs to account for:    Total equivalent units:    Cost per equivalent unit:    Cost of goods sold:    Ending balance in finished goods:    All costs are accounted for: | $3,140    1 unit from beginning inventory + 10 units made = 11 units    $3,140 ÷ 11 units = $285.45    10 units at $285.45 = $2,854.50    1 unit at $285.45 = $285.45    $2,854.50 + $285.45 = $3,140 |

**Example 9:** This example has partially finished units in both beginning inventory and ending inventory. Assume the company uses the weighted average method.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Beginning**  **Inventory** | **Activity during the week** |  | **Ending**  **Inventory** |
| **Units** | 1 unit that is 50% complete with respect to both materials and conversion costs | The 1 unit coming into the period is completed. 10 units are started and completed. 1 unit is started but not completed. |  | 1 unit 20% complete with respect to both materials and conversion costs. |
| **Costs incurred** | $150 beginning balance in work-in-process | Materials: Conversion costs: | $1,900  940 |  |

**Questions:** What is the cost of each unit made? What is the cost of ending work-in-process? If each unit completed is also sold, what is cost of goods sold?

**Answer:**

|  |  |
| --- | --- |
| Total costs to account for:    Total equivalent units:      Cost per equivalent unit:    Ending work-in-process:    Cost of goods sold: | $150 + $1,900 + $940 = $2,990    11 units finished during the period plus one unit that is 20% complete = 11.2 units    $2,990 ÷ 11.2 equivalent units = $266.96    $266.96 per unit x 1 unit 20% complete = $53.39    $266.96 x 11 units = $2936.56 |

**Note:** One might think that the calculation of equivalent units needs to include the beginning inventory that is 50% complete. However, we would be double-counting if we did so, because the unit that is 50% complete in beginning inventory is one of the 11 units identified as finished during the period in the equivalent unit calculation. In the schedule below, the costs to account for are highlighted in green, and the physical units to account for are highlighted in yellow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Beginning**  **Inventory** | **Activity during the week** |  | **Ending**  **Inventory** |
| **Units** | 1 unit 50% complete with respect to both materials and conversion costs | The **1** unit coming into the period is completed. **10** units are started and completed. 1 unit is started but not completed. |  | **1** unit **20%** completewith respect to both materials and conversion costs. |
| **Costs incurred** | **$150** beginning balance in WIP | Materials: Conversion costs: | **$1,900**  **940** |  |

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