Chapter 10
Standard Costs and Variances

Solutions to Questions

10-1 A quantity standard indicates how much of an input should be used to make a unit of output. A price standard indicates how much the input should cost.

10-2 Separating an overall variance into a price variance and a quantity variance provides more information. Moreover, price and quantity variances are usually the responsibilities of different managers.

10-3 The materials price variance is usually the responsibility of the purchasing manager. The materials quantity and labor efficiency variances are usually the responsibility of production managers and supervisors.

10-4 The materials price variance can be computed when materials are purchased or when they are placed into production. It is usually better to compute the variance when materials are purchased because that is when the purchasing manager, who has responsibility for this variance, has completed his work. In addition, recording the price variance when materials are purchased allows the company to carry its raw materials inventory at standard cost, which simplifies bookkeeping.

10-5 This combination of variances may indicate that inferior quality materials were purchased at a discounted price, but the low-quality materials created production problems.

10-6 If standards are used to find who to blame for problems, they can breed resentment and undermine morale. Standards should not be used to find someone to blame for problems.

10-7 Several factors other than the contractual rate paid to workers can cause a labor rate variance. For example, skilled workers with high hourly rates of pay can be given duties that require little skill and that call for low hourly rates of pay, resulting in an unfavorable rate variance. Or unskilled or untrained workers can be assigned to tasks that should be filled by more skilled workers with higher rates of pay, resulting in a favorable rate variance. Unfavorable rate variances can also arise from overtime work at premium rates.

10-8 If poor quality materials create production problems, a result could be excessive labor time and therefore an unfavorable labor efficiency variance. Poor quality materials would not ordinarily affect the labor rate variance.

10-9 If overhead is applied using direct labor-hours, then the variable overhead efficiency variance and the direct labor efficiency variance will always be favorable or unfavorable together. Both variances are computed by comparing the number of direct labor-hours actually worked to the standard hours allowed. That is, in each case the formula is:

\[
\text{Efficiency variance} = SR(AH - SH)
\]

Only the “SR” part of the formula, the standard rate, differs between the two variances.

10-10 If labor is a fixed cost in the short run and demand is insufficient to keep everyone busy (and workers are not laid off), it will result in an unfavorable labor efficiency variance. To avoid this unfavorable variance, managers may choose to produce at capacity (rather than reducing output to match customer demand).
which leads to a build up of work in process and finished goods inventories.
# Chapter 10: Applying Excel

The completed worksheet is shown below.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
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<td>4</td>
<td>Exhibit 10-1: Standard Cost Card</td>
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<tr>
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<td>$22.00 per hour</td>
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<td>$21.60 per hour</td>
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<td>14</td>
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<td>18</td>
<td>Exhibit 10-4: Standard Cost Variance Analysis—Direct Materials</td>
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<td>6,500 pounds x</td>
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<td>Exhibit 10-5: Standard Cost Variance Analysis—Direct Labor</td>
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<td>Exhibit 10-6: Standard Cost Variance Analysis—Variable Manufacturing Overhead</td>
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<td>1,050 hours x</td>
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Chapter 10: Applying Excel (continued)

The completed worksheet, with formulas displayed, is shown below.

![Completed Worksheet](image)

Note: The formulas to compute whether a variance is Favorable or Unfavorable use the IF() function. For example, in cell C26, the formula is =IF(F22>F23,"U",IF(F22<F23,"F",""')). This formula first checks whether the actual quantity of input at the standard price (cell F22) exceeds the standard quantity allowed for the actual output at the standard price (cell F23). If it does, the function returns the value U, which is displayed in cell C26. Otherwise, the formula checks whether the standard quantity allowed for the actual output at the standard price (cell F23) exceeds the actual quantity of input at the standard price (cell F22). If it does, the function returns the value F, which is displayed in cell C26. Otherwise, nothing is displayed in cell C26.
Chapter 10: Applying Excel (continued)

1. With the changes in data, the result is:

<table>
<thead>
<tr>
<th>A</th>
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<td>Standard Price</td>
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<td>2.9 pounds</td>
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<td>Variable manufacturing overhead</td>
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<td>12</td>
<td>Actual direct materials cost</td>
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<td>13</td>
<td>Actual direct labor cost</td>
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<td>$3,80 per pound</td>
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<tr>
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<td>Exhibit 10-4: Standard Cost Variance Analysis – Direct Materials</td>
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<tr>
<td>21</td>
<td>Actual Quantity of Input, at Actual Price</td>
<td>6,500 pounds</td>
<td>$3.80 per pound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Actual Quantity of Input, at Standard Price</td>
<td>6,500 pounds</td>
<td>$4.00 per pound</td>
<td></td>
<td></td>
<td></td>
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<td>26</td>
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<td>U</td>
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<td>U</td>
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<td>29</td>
<td>Exhibit 10-5: Standard Cost Variance Analysis – Direct Labor</td>
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<td>1,050 hours</td>
<td>$21.60 per hour</td>
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<td>31</td>
<td>Actual Hours of Input, at Standard Rate</td>
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<td>32</td>
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<td>$22.00 per hour</td>
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<td>36</td>
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<td>38</td>
<td>Exhibit 10-6: Standard Cost Variance Analysis – Variable Manufacturing Overhead</td>
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</tr>
<tr>
<td>39</td>
<td>Actual Hours of Input, at Actual Rate</td>
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<td>$6.80 per hour</td>
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<tr>
<td>40</td>
<td>Actual Hours of Input, at Standard Rate</td>
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<td>Standard Hours Allowed for the Actual Output, at Standard Rate</td>
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</tbody>
</table>

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a. The materials quantity variance is $2,800 U. This variance is the difference between the amount of materials that should have been used to make the actual output and the actual amount of materials used, all evaluated at the standard price. This variance is unfavorable because 6,500 pounds were used, but 5,800 pounds should have been used.

b. The labor rate variance is $420 F. This variance is the difference between the standard labor rate and the actual labor rate, multiplied by the actual labor hours. It is favorable because the actual labor rate was $21.60 per hour, whereas the standard labor rate was $22.00 per hour.
2. With the revised data, the worksheet should look like this:

![Excel Worksheet](image)

Parts a, b, and c:
- Materials price variance .................. $635 U
- Materials quantity variance ................. $200 U
- Labor rate variance ........................... $102 U
- Labor efficiency variance .................. $660 F
- Variable overhead rate variance ........... $1,020 F
- Variable overhead efficiency variance .. $180 F

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1. The raw materials cost included in the planning budget is $1,000,000 (\(= 25,000 \text{ pounds} \times 5 \text{ pounds per unit} \times $8.00 \text{ per pound} = $1,000,000\)).

2, 3, and 4.

The raw materials cost included in the flexible budget (\(\text{SQ} \times \text{SP} = $1,200,000\)), the materials price variance ($80,000 F), and the materials quantity variance ($80,000 U), can be computed using the general model for cost variances as follows:

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price ((\text{AQ} \times \text{AP}))</th>
<th>Actual Quantity of Input, at Standard Price ((\text{AQ} \times \text{SP}))</th>
<th>Standard Quantity Allowed for Actual Output, at Standard Price ((\text{SQ} \times \text{SP}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>160,000 pounds (\times) $7.50 per pound = $1,200,000</td>
<td>160,000 pounds (\times) $8.00 per pound = $1,280,000</td>
<td>150,000 pounds(^*) (\times) $8.00 per pound = $1,200,000</td>
</tr>
</tbody>
</table>

Materials price variance = $80,000 F

Materials quantity variance = $80,000 U

Spending variance = $0

\(^*\)30,000 units \(\times\) 5 pounds per unit = 150,000 pounds

Alternatively, the variances can be computed using the formulas:

\[
\text{Materials price variance} = \text{AQ} (\text{AP} - \text{SP}) = 160,000 \text{ pounds} ($7.50 \text{ per pound} - $8.00 \text{ per pound}) = $80,000 \text{ F}
\]

\[
\text{Materials quantity variance} = \text{SP} (\text{AQ} - \text{SQ}) = $8.00 \text{ per pound} (160,000 \text{ pounds} - 150,000 \text{ pounds}) = $80,000 \text{ U}
\]
The Foundational 15 (continued)

5. and 6.

The materials price variance ($85,000 F) and the materials quantity variance ($80,000 U) can be computed as follows:

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>170,000 pounds × $7.50 per pound</td>
<td>170,000 pounds × $8.00 per pound</td>
<td>150,000 pounds* × $8.00 per pound</td>
</tr>
<tr>
<td>= $1,275,000</td>
<td>= $1,360,000</td>
<td>= $1,200,000</td>
</tr>
</tbody>
</table>

Materials price variance = $85,000 F

Materials quantity variance = $80,000 U

*30,000 units × 5 pounds per unit = 150,000 units

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
   = 170,000 pounds ($7.50 per pound – $8.00 per pound)
   = $85,000 F

Materials quantity variance = SP (AQ – SQ)
   = $8.00 per pound (160,000 pounds – 150,000 pounds)
   = $80,000 U
The Foundational 15 (continued)

7. The direct labor cost included in the planning budget is $700,000 (= 25,000 units × 2 hours per unit × $14.00 per hour = $700,000).

8, 9, 10, and 11.

The direct labor cost included in the flexible budget (SH × SR = $840,000), the labor rate variance ($55,000 U), the labor efficiency variance ($70,000 F), and the labor spending variance ($15,000 F) can be computed using the general model for cost variances as follows:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at Actual Rate</th>
<th>Actual Hours of Input, at Standard Rate</th>
<th>Standard Hours Allowed for Actual Output, at Standard Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AH × AR)</td>
<td>(AH × SR)</td>
<td>(SH × SR)</td>
</tr>
<tr>
<td>55,000 hours × $15 per hour</td>
<td>55,000 hours × $14.00 per hour</td>
<td>60,000 hours* × $14.00 per hour</td>
</tr>
<tr>
<td>= $825,000</td>
<td>= $770,000</td>
<td>= $840,000</td>
</tr>
</tbody>
</table>

Labor rate variance = $55,000 U

Labor efficiency variance = $70,000 F

Spending variance = $15,000 F

*30,000 units × 2.0 hours per unit = 60,000 hours

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
= 55,000 hours ($15.00 per hour – $14.00 per hour)
= $55,000 U

Labor efficiency variance = SR (AH – SH)
= $14.00 per hour (55,000 hours – 60,000 hours)
= $70,000 F
The Foundational 15 (continued)

12. The variable manufacturing overhead cost included in the planning budget is $250,000 (= 50,000 hours × $5.00 per hour = $250,000).

13, 14, and 15.

The variable overhead cost included in the flexible budget (SH × SR = $300,000), the variable overhead rate variance ($5,500 U), and the variable overhead efficiency variance ($25,000 F) can be computed using the general model for cost variances as follows:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55,000 hours × $5.10 per hour**</td>
<td>55,000 hours × $5.00 per hour</td>
<td>60,000 hours* × $5.00 per hour</td>
</tr>
<tr>
<td>= $280,500</td>
<td>= $275,000</td>
<td>= $300,000</td>
</tr>
</tbody>
</table>

Variable overhead rate variance = $5,500 U
Variable overhead efficiency variance = $25,000 F

Spending variance = $19,500 F

*30,000 units × 2.0 hours per unit = 60,000 hours
** $280,500 ÷ 55,000 hours = $5.10 per hour

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR* – SR)
= 55,000 hours ($5.10 per hour – $5.00 per hour)
= $5,500 U

*$280,500 ÷ 55,000 hours = $5.10 per hour

Variable overhead efficiency variance = SR (AH – SH)
= $5.00 per hour (55,000 hours – 60,000 hours)
= $25,000 F
Exercise 10-1 (20 minutes)

1. Number of helmets produced (a) ......................... 35,000
   Standard kilograms of plastic per helmet (b) ....... 0.6
   Standard quantity of kilograms allowed (a) × (b) ... 21,000

2. Standard quantity of kilograms allowed (a) .......... 21,000
   Standard cost per kilogram (b) ........................ $8
   Standard cost allowed for actual output (a) × (b) .. $168,000

3. Actual cost incurred (given) (a) ......................... $171,000
   Total standard cost allowed (b) ........................ $168,000
   Materials spending variance (a) – (b) ............... $3,000 U

4. Actual Quantity of Input, at Actual Price (AQ × AP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Standard Quantity Allowed for Output, at Standard Price (SQ × SP)
22,500 kilograms × $8 per kilogram = $180,000
$171,000
Materials price variance, $9,000 F
Materials quantity variance, $12,000 U
Spending variance, $3,000 U

*35,000 helmets × 0.6 kilograms per helmet = 21,000 kilograms

Alternatively, the variances can be computed using the formulas:

   Materials price variance = AQ (AP – SP)
   22,500 kilograms ($7.60 per kilogram* – $8.00 per kilogram)
   = $9,000 F

   * $171,000 ÷ 22,500 kilograms = $7.60 per kilogram

   Materials quantity variance = SP (AQ – SQ)
   $8 per kilogram (22,500 kilograms – 21,000 kilograms)
   = $12,000 U
Exercise 10-2 (20 minutes)

1. Number of meals prepared (a) .................. 4,000
   Standard direct labor-hours per meal (b) .... 0.25
   Standard labor-hours allowed (a) × (b) .... 1,000

2. Standard labor-hours allowed (a) ............ 1,000
   Standard direct labor cost per hour (b) .... $19.75
   Standard labor cost allowed (a) × (b) ..... $19,750

3. Actual cost incurred (a) ....................... $19,200
   Standard labor cost allowed (b) ............ $19,750
   Labor spending variance (a) – (b) .......... $550 F

4. Actual Hours of Input, at the Actual Rate
   Actual Hours of Input, at the Standard Rate
   Standard Hours Allowed for Output, at the Standard Rate
   (AH × AR)                                  (AH × SR)                                  (SH × SR)
   960 hours ×                                  960 hours ×                                  1,000 hours ×
   $20.00 per hour                             $19.75 per hour                             $19.75 per hour
   = $19,200                                  = $18,960                                  = $19,750

   Labor rate variance, $240 U
   Labor efficiency variance, $790 F
   Spending variance, $550 F

   Alternatively, the variances can be computed using the formulas:
   Labor rate variance = AH(AR – SR)
       = 960 hours ($20.00 per hour – $19.75 per hour)
       = $240 U

   Labor efficiency variance = SR(AH – SH)
       = $19.75 per hour (960 hours – 1,000 hours)
       = $790 F
Exercise 10-3 (20 minutes)

1. Number of items shipped (a) ...................... 120,000
   Standard labor-hours per item (b) .................. 0.02
   Standard quantity of labor-hours allowed (a) × (b) 2,400

2. Standard quantity of labor-hours allowed (a) .... 2,400
   Standard variable overhead cost per hour (b) ...... $3.25
   Standard variable overhead cost allowed (a) × (b) $7,800

3. Actual variable overhead cost incurred (a) .......... $7,360
   Standard variable overhead cost allowed (b) ...... $7,800
   Variable overhead spending variance (a) – (b)...... $440 F

4. Actual Hours of Input, at the Actual Rate
   Actual Hours of Input, at the Standard Rate
   Standard Hours Allowed for Output, at the Standard Rate
   \[
   \begin{array}{ccc}
   \text{AH} \times \text{AR} & \text{AH} \times \text{SR} & \text{SH} \times \text{SR} \\
   2,300 \times \$3.20 & 2,300 \times \$3.25 & 2,400 \times \$3.25 \\
   = \$7,360 & = \$7,475 & = \$7,800 \\
   \end{array}
   \]

   Variable overhead rate variance, $115 F
   Variable overhead efficiency variance, $325 F
   Spending variance, $440 F

   *$7,360 ÷ 2,300 hours = $3.20 per hour
   ** 120,000 items × 0.02 hours per unit = 2,400 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance:
   \[ \text{AH}(\text{AR} – \text{SR}) = 2,300 \text{ hours} \times (\$3.20 \text{ per hour} – \$3.25 \text{ per hour}) \]
   \[ = \$115 \text{ F} \]

Variable overhead efficiency variance:
   \[ \text{SR}(\text{AH} – \text{SH}) = \$3.25 \text{ per hour} \times (2,300 \text{ hours} – 2,400 \text{ hours}) \]
   \[ = \$325 \text{ F} \]
**Exercise 10-4 (30 minutes)**

1. Number of units manufactured (a) ...................... 20,000
   Standard labor time per unit
   (18 minutes ÷ 60 minutes per hour) (b) .............. 0.3
   Standard labor-hours allowed (a) × (b) ............... 6,000

2. Standard labor-hours allowed (a) 6,000
   Standard direct labor rate per hour (b) ............... $17
   Standard labor cost allowed (a) × (b) ............... $102,000

3. Actual direct labor cost (a) ......................... $102,350
   Standard labor cost allowed (b) ....................... $102,000
   Labor spending variance (a) – (b) ..................... $350 U

4. Actual Hours of Input, at the Actual Rate
   (AH × AR)
   | Actual Hours of Input, at the Standard Rate
   | (AH × SR) | Standard Hours Allowed for Output, at the Standard Rate
   | (SH × SR) |
   | 5,750 hours × $17.00 per hour | 6,000 hours* × $17.00 per hour |
   | = $97,750 | = $102,000 |
   | $102,350 | |

   Labor rate variance,  
   $4,600 U

   Labor efficiency variance,  
   $4,250 F

   Spending variance,  
   $350 U

*20,000 units × 0.3 hours per unit = 6,000 hours

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
5,750 hours ($17.80 per hour* – $17.00 per hour) = $4,600 U
*$102,350 ÷ 5,750 hours = $17.80 per hour

Labor efficiency variance = SR (AH – SH)
$17.00 per hour (5,750 hours – 6,000 hours) = $4,250 F
**Exercise 10-4 (continued)**

<table>
<thead>
<tr>
<th>5. Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5,750 hours × $4.00 per hour</td>
<td>6,000 hours × $4.00 per hour</td>
</tr>
<tr>
<td></td>
<td>$21,850</td>
<td>$23,000</td>
</tr>
<tr>
<td></td>
<td>$24,000</td>
<td></td>
</tr>
</tbody>
</table>

$21,850

Variable overhead rate variance, $1,150 F

Variable overhead efficiency variance, $1,000 F

Spending variance, $2,150 F

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR – SR)

5,750 hours ($3.80 per hour* – $4.00 per hour) = $1,150 F

*$21,850 ÷ 5,750 hours = $3.80 per hour

Variable overhead efficiency variance = SR (AH – SH)

$4.00 per hour (5,750 hours – 6,000 hours) = $1,000 F
Exercise 10-5 (20 minutes)

1. If the labor spending variance is $200 unfavorable, and the labor rate variance is $150 favorable, then the labor efficiency variance must be $350 unfavorable, because the labor rate and labor efficiency variances taken together always equal the spending variance. Knowing that the labor efficiency variance is $350 unfavorable, one approach to the solution would be:

   Labor efficiency variance = SR (AH – SH)
   $25.00 per hour (AH – 125 hours*) = $350 U
   $25.00 per hour × AH – $3,125 = $350**
   $25.00 per hour × AH = $3,475
   \[ AH = \frac{$3,475}{25.00\text{ per hour}} \]
   \[ AH = 139\text{ hours} \]

   *50 jobs × 2.5 hours per job = 125 hours
   **When used with the formula, unfavorable variances are positive and favorable variances are negative.

2. Labor rate variance = AH (AR – SR)
   139 hours (AR – $25.00 per hour) = $150 F
   139 hours × AR – $3,475 = –$150*
   139 hours × AR = $3,325
   \[ AR = \frac{$3,325}{139\text{ hours}} \]
   \[ AR = $23.92\text{ per hour (rounded)} \]

   *When used with the formula, unfavorable variances are positive and favorable variances are negative.
Exercise 10-5 (continued)

An alternative approach would be to work from known to unknown data in the columnar model for variance analysis:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>139 hours × $23.92 per hour = $3,325</td>
<td>139 hours × $25.00 per hour* = $3,475</td>
<td>125 hours§ × $25.00 per hour* = $3,125</td>
</tr>
</tbody>
</table>

Labor rate variance, $150 F*  
Labor efficiency variance, $350 U  
Spending variance, $200 U*  

§50 tune-ups* × 2.5 hours per tune-up* = 125 hours  
*Given
Exercise 10-6 (20 minutes)

<table>
<thead>
<tr>
<th>Actual Quantity</th>
<th>Actual Price</th>
<th>Standard Quantity Allowed for Output, at Standard Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AQ × AP)</td>
<td>(AQ × SP)</td>
<td>(SQ × SP)</td>
</tr>
<tr>
<td>20,000 pounds ×</td>
<td>20,000 pounds ×</td>
<td>18,400 pounds* ×</td>
</tr>
<tr>
<td>$2.35 per pound</td>
<td>$2.50 per pound</td>
<td>$2.50 per pound</td>
</tr>
<tr>
<td>= $47,000</td>
<td>= $50,000</td>
<td>= $46,000</td>
</tr>
</tbody>
</table>

Materials price variance, $3,000 F
Materials quantity variance, $4,000 U
Spending variance, $1,000 U

*4,000 units × 4.6 pounds per unit = 18,400 pounds

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
20,000 pounds ($2.35 per pound – $2.50 per pound) = $3,000 F

Materials quantity variance = SP (AQ – SQ)
$2.50 per pound (20,000 pounds – 18,400 pounds) = $4,000 U

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## Exercise 10-6 (continued)

2. **Actual Hours of Input, at the Actual Rate**
   \[ (AH \times AR) \]

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Standard Rate</th>
<th>Standard Hours Allowed for Output, at the Standard Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Hours of Input, at the Standard Rate</td>
<td>Standard Hours Allowed for Output, at the Standard Rate</td>
</tr>
<tr>
<td>(AH \times SR)</td>
<td>(SH \times SR)</td>
</tr>
<tr>
<td>750 hours ×</td>
<td>800 hours* ×</td>
</tr>
<tr>
<td>$18.00 per hour</td>
<td>$18.00 per hour</td>
</tr>
<tr>
<td>= $13,500</td>
<td>= $14,400</td>
</tr>
</tbody>
</table>

   **\$14,925**
   - Labor rate variance, \$1,425 U
   - Labor efficiency variance, \$900 F
   - Spending variance, \$525 U

*4,000 units × 0.2 hours per unit = 800 hours

Alternatively, the variances can be computed using the formulas:

- **Labor rate variance** = \( AH \times (AR - SR) \)
  - 750 hours \( \times (\$19.90\text{ per hour} - \$18.00\text{ per hour}) = \$1,425 \text{ U} \)
  - \( \$14,925 \div 750 \text{ hours} = \$19.90\text{ per hour} \)

- **Labor efficiency variance** = \( SR \times (AH - SH) \)
  - \$18.00\text{ per hour} \( \times (750 \text{ hours} - 800 \text{ hours}) = \$900 \text{ F} \)
Exercise 10-7 (15 minutes)

Notice in the solution below that the materials price variance is computed for the entire amount of materials purchased, whereas the materials quantity variance is computed only for the amount of materials used in production.

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price</th>
<th>Actual Quantity of Input, at Standard Price</th>
<th>Standard Quantity Allowed for Output, at Standard Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AQ × AP)</td>
<td>(AQ × SP)</td>
<td>(SQ × SP)</td>
</tr>
<tr>
<td>20,000 pounds × $2.35 per pound</td>
<td>20,000 pounds × $2.50 per pound</td>
<td>13,800 pounds* × $2.50 per pound</td>
</tr>
<tr>
<td>= $47,000</td>
<td>= $50,000</td>
<td>= $34,500</td>
</tr>
</tbody>
</table>

Materials price variance, $3,000 F

14,750 pounds × $2.50 per pound = $36,875

Materials quantity variance, $2,375 U

*3,000 units × 4.6 pounds per unit = 13,800 pounds

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
20,000 pounds ($2.35 per pound – $2.50 per pound) = $3,000 F

Materials quantity variance = SP (AQ – SQ)
$2.50 per pound (14,750 pounds – 13,800 pounds) = $2,375 U
Exercise 10-8 (30 minutes)

1. a. Notice in the solution below that the materials price variance is computed on the entire amount of materials purchased, whereas the materials quantity variance is computed only on the amount of materials used in production.

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price ((AQ \times AP))</th>
<th>Actual Quantity of Input, at Standard Price ((AQ \times SP))</th>
<th>Standard Quantity Allowed for Output, at Standard Price ((SQ \times SP))</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000 microns \times $1.48 per micron (= $37,000)</td>
<td>25,000 microns \times $1.50 per micron (= $37,500)</td>
<td>18,000 microns* \times $1.50 per micron (= $27,000)</td>
</tr>
</tbody>
</table>

\[\text{Materials price variance, } $500 \text{ F}\]
\[\text{Materials quantity variance, } $3,000 \text{ U}\]

*3,000 toys \(\times 6\) microns per toy = 18,000 microns

Alternatively, the variances can be computed using the formulas:

- Materials price variance = \(AQ \times (AP - SP)\)
  \[25,000 \text{ microns } \times (\$1.48 \text{ per micron} - \$1.50 \text{ per micron}) = \$500 \text{ F}\]

- Materials quantity variance = \(SP \times (AQ - SQ)\)
  \[\$1.50 \text{ per micron} \times (20,000 \text{ microns} - 18,000 \text{ microns}) = \$3,000 \text{ U}\]
**Exercise 10-8** (continued)

b. Direct labor variances:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate ((AH \times AR))</th>
<th>Actual Hours of Input, at the Standard Rate ((AH \times SR))</th>
<th>Standard Hours Allowed for Output, at the Standard Rate ((SH \times SR))</th>
</tr>
</thead>
<tbody>
<tr>
<td>$88,000</td>
<td>4,000 hours × $21.00 per hour = $84,000</td>
<td>3,900 hours* × $21.00 per hour = $81,900</td>
</tr>
<tr>
<td>Labor rate variance, $4,000 U</td>
<td>Labor efficiency variance, $2,100 U</td>
<td>Spending variance, $6,100 U</td>
</tr>
</tbody>
</table>

*3,000 toys × 1.3 hours per toy = 3,900 hours

Alternatively, the variances can be computed using the formulas:

**Labor rate variance** = \(AH \times (AR - SR)\)
4,000 hours \((\$22.00 per hour^* - \$21.00 per hour)\) = $4,000 U

**Labor efficiency variance** = \(SR \times (AH - SH)\)
$21.00 per hour \((4,000 hours - 3,900 hours)\) = $2,100 U
Exercise 10-8 (continued)

2. A variance usually has many possible explanations. In particular, we should always keep in mind that the standards themselves may be incorrect. Some of the other possible explanations for the variances observed at Dawson Toys appear below:

Materials Price Variance Since this variance is favorable, the actual price paid per unit for the material was less than the standard price. This could occur for a variety of reasons including the purchase of a lower grade material at a discount, buying in an unusually large quantity to take advantage of quantity discounts, a change in the market price of the material, or particularly sharp bargaining by the purchasing department.

Materials Quantity Variance Since this variance is unfavorable, more materials were used to produce the actual output than were called for by the standard. This could also occur for a variety of reasons. Some of the possibilities include poorly trained or supervised workers, improperly adjusted machines, and defective materials.

Labor Rate Variance Since this variance is unfavorable, the actual average wage rate was higher than the standard wage rate. Some of the possible explanations include an increase in wages that has not been reflected in the standards, unanticipated overtime, and a shift toward more highly paid workers.

Labor Efficiency Variance Since this variance is unfavorable, the actual number of labor hours was greater than the standard labor hours allowed for the actual output. As with the other variances, this variance could have been caused by any of a number of factors. Some of the possible explanations include poor supervision, poorly trained workers, low-quality materials requiring more labor time to process, and machine breakdowns. In addition, if the direct labor force is essentially fixed, an unfavorable labor efficiency variance could be caused by a reduction in output due to decreased demand for the company’s products.

It is worth noting that all of these variances could have been caused by the purchase of low quality materials at a cut-rate price.
**Problem 10-9** (45 minutes)

This problem is more difficult than it looks. Allow ample time for discussion.

1. | Actual Quantity of Input, at Actual Price (AQ × AP) | Actual Quantity of Input, at Standard Price (AQ × SP) | Standard Quantity Allowed for Output, at Standard Price (SQ × SP) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12,000 yards × $4.00 per yard*</td>
<td>11,200 yards** × $4.00 per yard*</td>
<td>11,200 yards** × $4.00 per yard*</td>
</tr>
<tr>
<td>$45,600</td>
<td>$48,000</td>
<td>$44,800</td>
</tr>
</tbody>
</table>

   | Materials price variance, $2,400 F | Materials quantity variance, $3,200 U | Spending variance, $800 U |

   * $22.40 ÷ 5.6 yards = $4.00 per yard
   ** 2,000 sets × 5.6 yards per set = 11,200 yards

Alternatively, the variances can be computed using the formulas:

- Materials price variance = AQ (AP – SP)
  12,000 yards ($3.80 per yard* – $4.00 per yard) = $2,400 F
  *$45,600 ÷ 12,000 yards = $3.80 per yard

- Materials quantity variance = SP (AQ – SQ)
  $4.00 per yard (12,000 yards – 11,200 yards) = $3,200 U
Problem 10-9 (continued)

2. Many students will miss parts 2 and 3 because they will try to use product costs as if they were hourly costs. Pay particular attention to the computation of the standard direct labor time per unit and the standard direct labor rate per hour.

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,800 hours × $18.00 per hour*</td>
<td>3,000 hours** × $18.00 per hour*</td>
<td></td>
</tr>
<tr>
<td>$49,000</td>
<td>$50,400</td>
<td></td>
</tr>
</tbody>
</table>

Labor rate variance, $1,400 F

Labor efficiency variance, $3,600 F

Spending variance, $5,000 F

* 2,850 standard hours ÷ 1,900 sets = 1.5 standard hours per set, $27.00 standard cost per set ÷ 1.5 standard hours per set = $18.00 standard rate per hour.

** 2,000 sets × 1.5 standard hours per set = 3,000 standard hours.

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
2,800 hours ($17.50 per hour* – $18.00 per hour) = $1,400 F

*$49,000 ÷ 2,800 hours = $17.50 per hour

Labor efficiency variance = SR (AH – SH)
$18.00 per hour (2,800 hours – 3,000 hours) = $3,600 F
### Problem 10-9 (continued)

3. **Actual Hours of Input, at the Actual Rate**
   \[(AH \times AR)\]  
   \[
   \begin{array}{lll}
   \text{Actual Hours of Input, at the Standard Rate} & \text{Standard Hours Allowed for Output, at the Standard Rate} \\
   (AH \times SR) & (SH \times SR) \\
   2,800 \text{ hours} \times & 3,000 \text{ hours} \times \\
   $2.40 \text{ per hour}^* & $2.40 \text{ per hour}^* \\
   = $6,720 & = $7,200 \\
   \end{array}
   \]

- **Variable overhead rate variance**, $280 \text{ U}$
- **Variable overhead efficiency variance**, $480 \text{ F}$
- **Spending variance**, $200 \text{ F}$

*$3.60 \text{ standard cost per set} \div 1.5 \text{ standard hours per set} = $2.40 \text{ standard rate per hour}$

Alternatively, the variances can be computed using the formulas:

- **Variable overhead rate variance** = \(AH \times (AR - SR)\)
  
  \[2,800 \text{ hours} \times ($2.50 \text{ per hour}^* - $2.40 \text{ per hour}) = $280 \text{ U}\]
  
  \*$7,000 \div 2,800 \text{ hours} = $2.50 \text{ per hour}$

- **Variable overhead efficiency variance** = \(SR \times (AH - SH)\)
  
  \[$2.40 \text{ per hour} \times (2,800 \text{ hours} - 3,000 \text{ hours}) = $480 \text{ F}\]
**Problem 10-10** (45 minutes)

1. 

<table>
<thead>
<tr>
<th></th>
<th>Standard Quantity or Hours</th>
<th>Standard Price or Rate</th>
<th>Standard Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alpha6:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct materials—X442</td>
<td>1.8 kilos</td>
<td>$3.50 per kilo</td>
<td>$6.30</td>
</tr>
<tr>
<td></td>
<td>Direct materials—Y661</td>
<td>2.0 liters</td>
<td>$1.40 per liter</td>
</tr>
<tr>
<td>Direct labor—Sintering</td>
<td>0.20 hours</td>
<td>$19.80 per hour</td>
<td>3.96</td>
</tr>
<tr>
<td>Direct labor—Finishing</td>
<td>0.80 hours</td>
<td>$19.20 per hour</td>
<td>15.36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>28.42</strong></td>
</tr>
<tr>
<td><strong>Zeta7:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct materials—X442</td>
<td>3.0 kilos</td>
<td>$3.50 per kilo</td>
<td>$10.50</td>
</tr>
<tr>
<td>Direct materials—Y661</td>
<td>4.5 liters</td>
<td>$1.40 per liter</td>
<td>6.30</td>
</tr>
<tr>
<td>Direct labor—Sintering</td>
<td>0.35 hours</td>
<td>$19.80 per hour</td>
<td>6.93</td>
</tr>
<tr>
<td>Direct labor—Finishing</td>
<td>0.90 hours</td>
<td>$19.20 per hour</td>
<td>17.28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>41.01</strong></td>
</tr>
</tbody>
</table>
Problem 10-10 (continued)

2. The computations to follow will require the standard quantities allowed for the actual output for each material.

**Standard Quantity Allowed**

<table>
<thead>
<tr>
<th>Material</th>
<th>Production of Alpha</th>
<th>Production of Zeta</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X442: Material X</td>
<td>1.8 kilos per unit</td>
<td>3.0 kilos per unit</td>
<td>2,700 kilos</td>
</tr>
<tr>
<td></td>
<td>× 1,500 units</td>
<td>× 2,000 units</td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>2,700 kilos</td>
<td>6,000 kilos</td>
<td>8,700 kilos</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Production of Alpha</th>
<th>Production of Zeta</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y661: Material Y</td>
<td>2.0 liters per unit</td>
<td>4.5 liters per unit</td>
<td>3,000 liters</td>
</tr>
<tr>
<td></td>
<td>× 1,500 units</td>
<td>× 2,000 units</td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>3,000 liters</td>
<td>9,000 liters</td>
<td>12,000 liters</td>
</tr>
</tbody>
</table>

**Direct materials variances—Material X442:**

**Materials price variance** = \( AQ \times (AP - SP) \)

\[
= 14,500 \text{ kilos} \times ($3.60 - $3.50) \\
= $1,450 U \\
\]

\[\text{*$52,200 \div 14,500 \text{ kilos} = $3.60 \text{ per kilo}^*}\]

**Materials quantity variance** = \( SP \times (AQ - SQ) \)

\[
= $3.50 \text{ per kilo} \times (8,500 \text{ kilos} - 8,700 \text{ kilos}) \\
= $700 F \\
\]

**Direct materials variances—Material Y661:**

**Materials price variance** = \( AQ \times (AP - SP) \)

\[
= 15,500 \text{ liters} \times ($1.35 - $1.40) \\
= $775 F \\
\]

\[\text{*$20,925 \div 15,500 \text{ liters} = $1.35 \text{ per liter}^*}\]

**Materials quantity variance** = \( SP \times (AQ - SQ) \)

\[
= $1.40 \text{ per liter} \times (13,000 \text{ liters} - 12,000 \text{ liters}) \\
= $1,400 U \\
\]
**Problem 10-10 (continued)**

3. The computations to follow will require the standard quantities allowed for the actual output for direct labor in each department.

*Standard Hours Allowed*

**Sintering:**
Production of Alpha6 (0.20 hours per unit × 1,500 units) = \(300\) hours
Production of Zeta7 (0.35 hours per unit × 2,000 units) = \(700\) hours
Total

**Finishing:**
Production of Alpha6 (0.80 hours per unit × 1,500 units) = \(1,200\) hours
Production of Zeta7 (0.90 hours per unit × 2,000 units) = \(1,800\) hours
Total

**Direct labor variances—Sintering:**

Labor rate variance = \(AH \times (AR - SR)\)
= 1,200 hours \((22.50 \text{ per hour} - 19.80 \text{ per hour})\)
= $3,240 \text{ U}

\(*27,000 ÷ 1,200 \text{ hours} = 22.50 \text{ per hour}\)

Labor efficiency variance = \(SR \times (AH - SH)\)
= $19.80 \text{ per hour} \times (1,200 \text{ hours} - 1,000 \text{ hours})
= $3,960 \text{ U}

**Direct labor variances—Finishing:**

Labor rate variance = \(AH \times (AR - SR)\)
= 2,850 hours \((21.00 \text{ per hour} - 19.20 \text{ per hour})\)
= $5,130 \text{ U}

\(*59,850 ÷ 2,850 \text{ hours} = 21.00 \text{ per hour}\)

Labor efficiency variance = \(SR \times (AH - SH)\)
= $19.20 \text{ per hour} \times (2,850 \text{ hours} - 3,000 \text{ hours})
= $2,880 \text{ F}
Problem 10-11 (45 minutes)

1. a. Materials quantity variance = SP (AQ – SQ)
   $11.00 per foot (AQ – 9,600 feet*) = $4,400 U
   $11.00 per foot × AQ – $105,600 = $4,400**
   $11.00 per foot × AQ = $110,000
   AQ = 10,000 feet

   * $3,200 units × 3 foot per unit = 9,600 feet
   ** When used with the formula, unfavorable variances are positive and favorable variances are negative.

   Therefore, $111,300 ÷ 10,000 feet = $11.13 per foot

b. Materials price variance = AQ (AP – SP)
   10,000 feet ($11.13 per foot – $11.00 per foot) = $1,300 U

   The total variance for materials is:
   Materials price variance .................. $1,300 U
   Materials quantity variance ............ 4,400 U
   Spending variance ....................... $5,700 U

   Alternative approach to parts (a) and (b):

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 feet × $11.13 per foot = $111,300*</td>
<td>10,000 feet × $11.00 per foot* = $110,000</td>
<td>9,600 feet** × $11.00 per foot = $105,600</td>
</tr>
</tbody>
</table>

   Materials price variance, $1,300 U
   Materials quantity variance, $4,400 U*
   Spending variance, $5,700 U

   * Given
   ** 3,200 units × 3 foot per unit = 9,600 feet
Problem 10-11 (continued)

2. a. Labor rate variance = AH (AR – SR)
   4,900 hours ($19.50 per hour* – SR) = $2,450 F**
   $95,550 – 4,900 hours × SR = −$2,450***
   4,900 hours × SR = $98,000
   SR = $20.00

   * $95,550 ÷ 4,900 hours = $19.50 per hour
   ** Labor Spending Variance = Labor Rate Variance + Labor Efficiency Variance
      $450 F = LRV + $2,000 U.
      Labor Rate Variance = $2,450 F
   *** When used with the formula, unfavorable variances are positive and favorable variances are negative.

   b. Labor efficiency variance = SR (AH – SH)
      $20.00 per hour (4,900 hours – SH) = $2,000 U
      $98,000 – $20.00 per hour × SH = $2,000*
      $20.00 per hour × SH = $96,000
      SH = 4,800 hours

   * When used with the formula, unfavorable variances are positive and favorable variances are negative.

   Alternative approach to parts (a) and (b):

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$95,550*</td>
<td>4,900 hours* × $20.00 per hour = $98,000</td>
<td>4,800 hours × $20.00 per hour = $96,000</td>
</tr>
<tr>
<td>Labor rate variance, $2,450 F</td>
<td>Labor efficiency variance, $2,000 U*</td>
<td>Spending variance, $450 F*</td>
</tr>
</tbody>
</table>

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*Given

c. The standard hours allowed per unit of product are:
4,800 hours ÷ 3,200 units = 1.5 hours per unit

**Problem 10-12** (45 minutes)

1. The standard quantity of plates allowed for tests performed during the month would be:

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood tests</td>
<td>1,800</td>
</tr>
<tr>
<td>Smears</td>
<td>2,400</td>
</tr>
<tr>
<td>Total</td>
<td>4,200</td>
</tr>
<tr>
<td>Plates per test</td>
<td>× 2</td>
</tr>
<tr>
<td>Standard quantity</td>
<td>8,400</td>
</tr>
</tbody>
</table>

The variance analysis for plates would be:

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,000 plates × $5.00 per plate = $60,000</td>
<td>8,400 plates × $5.00 per plate = $42,000</td>
<td></td>
</tr>
<tr>
<td>$56,400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Materials price variance, $3,600 F**
- **Materials quantity variance, $10,500 U**

* 12,000 purchased – 1,500 unused = 10,500 used

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
12,000 plates ($4.70 per plate* – $5.00 per plate) = $3,600 F

*$56,400 ÷ 12,000 plates = $4.70 per plate.

Materials quantity variance = SP (AQ – SQ)
$5.00 per plate (10,500 plates – 8,400 plates) = $10,500 U
**Problem 10-12** (continued)

2. a. The standard hours allowed for tests performed during the month would be:

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Hours per Test</th>
<th>Test Count</th>
<th>Standard Hours Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood tests</td>
<td>0.3</td>
<td>1,800</td>
<td>540 hours</td>
</tr>
<tr>
<td>Smears</td>
<td>0.15</td>
<td>2,400</td>
<td>360 hours</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>900 hours</strong></td>
</tr>
</tbody>
</table>

The variance analysis would be:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,150 hours × $20.00 per hour</td>
<td>900 hours × $20.00 per hour</td>
<td></td>
</tr>
<tr>
<td>$21,850</td>
<td>$23,000</td>
<td></td>
</tr>
</tbody>
</table>

Labor rate variance, $1,150 F

Labor efficiency variance, $5,000 U

Spending variance, $3,850 U

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
1,150 hours ($19.00 per hour* – $20.00 per hour) = $1,150 F

*$21,850 ÷ 1,150 hours = $19.00 per hour

Labor efficiency variance = SR (AH – SH)
$20.00 per hour (1,150 hours – 900 hours) = $5,000 U
Problem 10-12 (continued)

b. The policy probably should not be continued. Although the hospital is saving $1 per hour by employing more assistants than senior technicians, this savings is more than offset by other factors. Too much time is being taken in performing lab tests, as indicated by the large unfavorable labor efficiency variance. And, it seems likely that most (or all) of the hospital’s unfavorable quantity variance for plates is traceable to inadequate supervision of assistants in the lab.

3. The variable overhead variances follow:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,150 hours × $6.00 per hour</td>
<td>900 hours × $6.00 per hour</td>
</tr>
<tr>
<td></td>
<td>$7,820</td>
<td>= $6,900</td>
</tr>
<tr>
<td>Variable overhead rate variance, $920 U</td>
<td>Variable overhead efficiency variance, $1,500 U</td>
<td>Spending variance, $2,420 U</td>
</tr>
</tbody>
</table>

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR – SR)
1,150 hours ($6.80 per hour* – $6.00 per hour) = $920 U

* $7,820 ÷ 1,150 hours = $6.80 per hour

Variable overhead efficiency variance = SR (AH – SH)
$6.00 per hour (1,150 hours – 900 hours) = $1,500 U

Yes, the two variances are closely related. Both are computed by comparing actual labor time to the standard hours allowed for the output of the period. Thus, if the labor efficiency variance is favorable (or unfavorable), then the variable overhead efficiency variance will also be favorable (or unfavorable).
Problem 10-13 (45 minutes)

1. a.

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Actual Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21,600 feet** × $3.30 per foot = $71,280</td>
<td>21,600 feet** × $3.00 per foot = $64,800</td>
<td></td>
</tr>
</tbody>
</table>

Materials price variance = $6,480 U

Materials quantity variance = $0

Spending variance = $6,480 U

* 12,000 units × 1.80 feet per unit = 21,600 feet

** 12,000 units × 1.80 feet per unit = 21,600 feet

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
= 21,600 feet ($3.30 per foot – $3.00 per foot)
= $6,480 U

Materials quantity variance = SP (AQ – SQ)
= $3.00 per foot (21,600 feet – 21,600 feet)
= $0
Problem 10-13 (continued)

1. b.

<table>
<thead>
<tr>
<th>Actual Hours of Input, at Actual Rate</th>
<th>Actual Hours of Input, at Standard Rate</th>
<th>Standard Hours Allowed for Actual Output, at Standard Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AH × AR)</td>
<td>(AH × SR)</td>
<td>(SH × SR)</td>
</tr>
<tr>
<td>11,040 hours** × $17.50 per hour</td>
<td>11,040 hours** × $18.00 per hour</td>
<td>10,800 hours* × $18.00 per hour</td>
</tr>
<tr>
<td>= $193,200</td>
<td>= $198,720</td>
<td>= $194,400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labor rate variance</th>
<th>Labor efficiency variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5,520 F</td>
<td>$4,320 U</td>
</tr>
</tbody>
</table>

Spending variance = $1,200 F

* 12,000 units × 0.90 hours per unit = 10,800 hours

** 12,000 units × 0.92 hours per unit = 11,040 hours

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
= 11,040 hours ($17.50 per hour – $18.00 per hour)
= $5,520 F

Labor efficiency variance = SR (AH – SH)
= $18.00 per hour (11,040 hours – 10,800 hours)
= $4,320 U
Problem 10-13 (continued)

1. c.

<table>
<thead>
<tr>
<th>Actual Hours of Input, at Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Actual Output, at Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11,040 hours** × $4.50 per hour = $49,680</td>
<td>11,040 hours** × $5.00 per hour = $55,200</td>
<td>10,800 hours* × $5.00 per hour = $54,000</td>
</tr>
</tbody>
</table>

Variable overhead rate variance = $5,520 F
Variable overhead efficiency variance = $1,200 U

Spending variance = $4,320 F

* 12,000 units × 0.90 hours per unit = 10,800 hours
** 12,000 units × 0.92 hours per unit = 11,040 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR – SR)
= 11,040 hours ($4.50 per hour – $5.00 per hour)
= $5,520 F

Variable overhead efficiency variance = SR (AH – SH)
= $5.00 per hour (11,040 hours – 10,800 hours)
= $1,200 U

2.

Materials:
Price variance ($6,480 ÷ 12,000 units)............ $0.54 U
Quantity variance ($0 ÷ 12,000 units)............. 0.00 $0.54 U

Labor:
Rate variance ($5,520 ÷ 12,000 units)............ 0.46 F
Efficiency variance ($4,320 ÷ 12,000 units).... 0.36 U 0.10 F

Variable overhead:
Rate variance ($5,520 ÷ 12,000 units)............ 0.46 F
Efficiency variance ($1,200 ÷ 12,000 units).... 0.10 U 0.36 F
Excess of actual over standard cost per unit ...... $0.08 U
Problem 10-13 (continued)

3. Both the labor efficiency and variable overhead efficiency variances are affected by inefficient use of labor time.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess of actual over standard cost per unit</td>
<td>$0.08 U</td>
</tr>
<tr>
<td>Less portion attributable to labor inefficiency:</td>
<td></td>
</tr>
<tr>
<td>Labor efficiency variance</td>
<td>0.36 U</td>
</tr>
<tr>
<td>Variable overhead efficiency variance</td>
<td>0.10 U</td>
</tr>
<tr>
<td>Portion due to other variances</td>
<td>0.46 U</td>
</tr>
<tr>
<td>Portion due to other variances</td>
<td>$0.38 F</td>
</tr>
</tbody>
</table>

In sum, had it not been for the apparent inefficient use of labor time, the total variance in unit cost for the month would have been favorable by $0.38 rather than unfavorable by $0.08.

4. Although the excess of actual cost over standard cost is only $0.08 per unit, the details of the variances are significant. The materials price variance is $6,480 U and it warrants further investigation. The labor efficiency variance is $4,320 U and the variable overhead efficiency variance is $1,200 U. Taken together, these latter two variances highlight an opportunity for the company to pursue process improvement opportunities that would improve efficiency.
**Problem 10-14** (45 minutes)

1. **a.** In the solution below, the materials price variance is computed on the entire amount of materials purchased whereas the materials quantity variance is computed only on the amount of materials used in production:

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price</th>
<th>Actual Quantity of Input, at Standard Price</th>
<th>Standard Quantity Allowed for Output, at Standard Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AQ × AP)</td>
<td>(AQ × SP)</td>
<td>(SQ × SP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12,000 ounces × $20.00 per ounce</td>
<td>9,375 ounces × $20.00 per ounce</td>
<td></td>
</tr>
</tbody>
</table>

\[ (12,000 \text{ ounces} \times 20.00 \text{ per ounce}) = 240,000 \]
\[ (9,375 \text{ ounces} \times 20.00 \text{ per ounce}) = 187,500 \]

\[ \text{Materials price variance, } \$15,000 \text{ F} \]
\[ \text{Materials quantity variance, } \$2,500 \text{ U} \]

\[ 9,500 \text{ ounces} \times 20.00 \text{ per ounce} = 190,000 \]

\[ *3,750 \text{ units} \times 2.5 \text{ ounces per unit} = 9,375 \text{ ounces} \]

Alternatively, the variances can be computed using the formulas:

\[ \text{Materials price variance} = \text{AQ} (\text{AP} - \text{SP}) \]
\[ 12,000 \text{ ounces} (\$18.75 \text{ per ounce} - 20.00 \text{ per ounce}) = 15,000 \text{ F} \]
\[ *225,000 \div 12,000 \text{ ounces} = 18.75 \text{ per ounce} \]

\[ \text{Materials quantity variance} = \text{SP} (\text{AQ} - \text{SQ}) \]
\[ 20.00 \text{ per ounce} (9,500 \text{ ounces} - 9,375 \text{ ounces}) = 2,500 \text{ U} \]

**b.** Yes, the contract probably should be signed. The new price of $18.75 per ounce is substantially lower than the old price of $20.00 per ounce, resulting in a favorable price variance of $15,000 for the month. Moreover, the material from the new supplier appears to cause little or no problem in production as shown by the small
materials quantity variance for the month.
### Problem 10-14 (continued)

2. a.

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,600 hours* × $22.00 per hour = $123,200</td>
<td>5,600 hours × $22.50 per hour = $126,000</td>
<td>5,250 hours** × $22.50 per hour = $118,125</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Labor rate variance, $2,800 F</th>
<th>Labor efficiency variance, $7,875 U</th>
<th>Spending Variance, $5,075 U</th>
</tr>
</thead>
<tbody>
<tr>
<td>alternative methods</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*35 technicians × 160 hours per technician = 5,600 hours
**3,750 units × 1.4 hours per technician = 5,250 hours

Alternatively, the variances can be computed using the formulas:

- **Labor rate variance** = AH (AR – SR)
  - 5,600 hours ($22.00 per hour – $22.50 per hour) = $2,800 F

- **Labor efficiency variance** = SR (AH – SH)
  - $22.50 per hour (5,600 hours – 5,250 hours) = $7,875 U

b. No, the new labor mix probably should not be continued. Although it decreases the average hourly labor cost from $22.50 to $22.00, thereby causing a $2,800 favorable labor rate variance, this savings is more than offset by a large unfavorable labor efficiency variance for the month. Thus, the new labor mix increases overall labor costs.
### Problem 10-14 (continued)

3. **Actual Hours of Input, at the Actual Rate**
   
   \[ AH \times AR \]

   **Actual Hours of Input, at the Standard Rate**
   
   \[ AH \times SR \]

   **Standard Hours Allowed for Output, at the Standard Rate**
   
   \[ SH \times SR \]

<table>
<thead>
<tr>
<th></th>
<th>Actual Hours of Input, at the Actual Rate</th>
<th>Actual Hours of Input, at the Standard Rate</th>
<th>Standard Hours Allowed for Output, at the Standard Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(5,600) hours* \times $3.50 per hour</td>
<td>(5,250) hours** \times $3.50 per hour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($18,200)</td>
<td>($19,600)</td>
<td>($18,375)</td>
</tr>
<tr>
<td>Variable overhead rate variance</td>
<td>$1,400 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable overhead efficiency variance</td>
<td>$1,225 U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spending Variance</td>
<td>$175 F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Based on direct labor hours:

35 technicians \(\times\) 160 hours per technician = 5,600 hours

** 3,750 units \(\times\) 1.4 hours per unit = 5,250 hours

Alternatively, the variances can be computed using the formulas:

- **Variable overhead rate variance** = \(AH \times (AR - SR)\)
  
  \[ 5,600 \text{ hours} \times (\$3.25 \text{ per hour}^* - \$3.50 \text{ per hour}) = \$1,400 \text{ F} \]
  
  \(^*\) \(\$18,200 \div 5,600 \text{ hours} = \$3.25 \text{ per hour} \)

- **Variable overhead efficiency variance** = \(SR \times (AH - SH)\)
  
  \[ $3.50 \text{ per hour} \times (5,600 \text{ hours} - 5,250 \text{ hours}) = \$1,225 \text{ U} \]

Both the labor efficiency variance and the variable overhead efficiency variance are computed by comparing actual labor-hours to standard labor-hours. Thus, if the labor efficiency variance is unfavorable, then the variable overhead efficiency variance will be unfavorable as well.
**Problem 10-15** (45 minutes)

1. a.

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60,000 pounds × $4.95 per pound = $297,000</td>
<td>60,000 pounds × $5.00 per pound = $300,000</td>
<td>45,000 pounds × $5.00 per pound = $225,000</td>
</tr>
</tbody>
</table>

Materials price variance, $3,000 F

\[ 60,000 \text{ pounds} \times ($4.95 - $5.00) = -$3,000 \]

Materials quantity variance, $21,000 U

\[ 5.00 \text{ per pound} \times (49,200 - 45,000) = $21,000 \]
Problem 10-15 (continued)

b.

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11,800 hours × $17.00 per hour</td>
<td>11,800 hours × $16.00 per hour</td>
<td>12,000 hours* × $16.00 per hour</td>
</tr>
<tr>
<td>= $200,600</td>
<td>= $188,800</td>
<td>= $192,000</td>
</tr>
</tbody>
</table>

Labor rate variance, $11,800 U

Labor efficiency variance, $3,200 F

Spending variance, $8,600 U

*15,000 pools × 0.8 hours per pool = 12,000 hours

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
11,800 hours ($17.00 per hour – $16.00 per hour) = $11,800 U

Labor efficiency variance = SR (AH – SH)
$16.00 per hour (11,800 hours – 12,000 hours) = $3,200 F
**Problem 10-15** (continued)

c.  
<table>
<thead>
<tr>
<th></th>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$18,290</td>
<td>5,900 hours × $3.00 per hour = $17,700</td>
<td>6,000 hours* × $3.00 per hour = $18,000</td>
</tr>
<tr>
<td>Variable overhead rate variance, $590 U</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable overhead efficiency variance, $300 F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spending variance, $290 U</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*15,000 pools × 0.4 hours per pool = 6,000 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR – SR)  
5,900 hours ($3.10 per hour* – $3.00 per hour) = $590 U  
*$18,290 ÷ 5,900 hours = $3.10 per hour

Variable overhead efficiency variance = SR (AH – SH)  
$3.00 per hour (5,900 hours – 6,000 hours) = $300 F
2. Summary of variances:

<table>
<thead>
<tr>
<th>Variance</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material price variance</td>
<td>$3,000</td>
</tr>
<tr>
<td>Material quantity variance</td>
<td>21,000</td>
</tr>
<tr>
<td>Labor rate variance</td>
<td>11,800</td>
</tr>
<tr>
<td>Labor efficiency variance</td>
<td>3,200</td>
</tr>
<tr>
<td>Variable overhead rate variance</td>
<td>590</td>
</tr>
<tr>
<td>Variable overhead efficiency variance</td>
<td>300</td>
</tr>
<tr>
<td>Net variance</td>
<td>$26,890</td>
</tr>
</tbody>
</table>

The net unfavorable variance of $26,890 for the month caused the plant's variable cost of goods sold to increase from the budgeted level of $435,000 to $461,890:

- Budgeted cost of goods sold at $29 per pool .......... $435,000
- Add the net unfavorable variance, as above .......... 26,890
- Actual cost of goods sold ................................ $461,890

This $26,890 net unfavorable variance also accounts for the difference between the budgeted net operating income and the actual net operating income for the month.

- Budgeted net operating income ......................... $ 6,000
- Deduct the net unfavorable variance added to cost of goods sold for the month ......................... 26,890
- Net operating loss ....................................... $(20,890)

3. The two most significant variances are the materials quantity variance and the labor rate variance. Possible causes of the variances include:

- Labor rate variance: Outdated standards, change in pay scale, overtime pay.
Problem 10-16 (60 minutes)

1. Standard cost for March production:
   Materials .......................................................... $16,800
   Direct labor ......................................................... 21,000
   Variable manufacturing overhead ......................... 4,200
   Total standard cost (a) ..................................... $42,000
   Number of backpacks produced (b) ..................... 1,000
   Standard cost of a single backpack (a) ÷ (b) .......... $42.00

2. Standard cost of a single backpack (above) ............. $42.00
   Deduct difference between standard and actual cost ...... 0.15
   Actual cost per backpack ...................................... $41.85

3. Total standard cost of materials during March (a) .... $16,800
   Number of backpacks produced during March (b) ...... 1,000
   Standard materials cost per backpack (a) ÷ (b) ........ $16.80
   Standard materials cost per yard = $16.80 per backpack
   Standard materials cost per yard = $6.00 per yard
   = 2.8 yards per backpack

4. Standard cost of material used ........... $16,800
   Actual cost of material used ............. 15,000
   Spending variance .................. $ 1,800 F

   The materials price and quantity variances together equal the spending variance. If the materials quantity variance is $1,200 U, then the materials price variance must be $3,000 F:
   Materials price variance .................. $ 3,000 F
   Materials quantity variance ........... 1,200 U
   Spending variance .................. $ 1,800 F
Problem 10-16 (continued)

Alternative Solution:

<table>
<thead>
<tr>
<th>Actual Quantity of Input, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Input, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000 yards × $5.00 per yard = $15,000*</td>
<td>3,000 yards × $6.00 per yard* = $18,000</td>
<td>2,800 yards** × $6.00 per yard* = $16,800*</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
\text{Materials price variance,} & \quad $3,000 \text{ F} \\
\text{Spending variance,} & \quad $1,800 \text{ F} \\
\text{Materials quantity variance,} & \quad $1,200 \text{ U*}
\end{align*}
\]

* Given
** 1,000 units × 2.8 yards per unit = 2,800 yards

5. The first step in computing the standard direct labor rate is to determine the standard direct labor-hours allowed for the month’s production. The standard direct labor-hours can be computed by working with the variable manufacturing overhead costs, because they are based on direct labor-hours worked:

- Standard variable manufacturing overhead cost for March (a) = $4,200
- Standard variable manufacturing overhead rate per direct labor-hour (b) = $3.00
- Standard direct labor-hours for March (a) ÷ (b) = 1,400

\[
\begin{align*}
\text{Total standard direct labor cost for March} & = \frac{$21,000}{1,400 \text{ DLHs}} \\
& = $15.00 \text{ per DLH}
\end{align*}
\]
Problem 10-16 (continued)

6. Before the labor variances can be computed, it is necessary to compute the actual direct labor cost for the month:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual cost per backpack produced (see requirement 2)</td>
<td>$41.85</td>
</tr>
<tr>
<td>Number of backpacks produced</td>
<td>× 1,000</td>
</tr>
<tr>
<td>Total actual cost of production</td>
<td>$41,850</td>
</tr>
<tr>
<td>Less: Actual cost of materials</td>
<td>$15,000</td>
</tr>
<tr>
<td>Actual cost of variable manufacturing overhead</td>
<td>3,600</td>
</tr>
<tr>
<td>Actual cost of direct labor</td>
<td>$23,250</td>
</tr>
</tbody>
</table>

With this information, the variances can be computed:

| Actual Hours of Input, at the Actual Rate (AH × AR) | $23,250 |
| Actual Hours of Input, at the Standard Rate (AH × SR) | $15.00 per hour × 1,500 hours = $22,500 |
| Standard Hours Allowed for Output, at the Standard Rate (SH × SR) | $21,000* |
| Labor rate variance, $750 U | Labor efficiency variance, $1,500 U |
| Spending variance, $2,250 U |

*Given
### Problem 10-16 (continued)

7. **Actual Hours of Input, at the Actual Rate (AH × AR)**  
   **Actual Hours of Input, at the Standard Rate (AH × SR)**  
   **Standard Hours Allowed for Output, at the Standard Rate (SH × SR)**  
   
   \[
   \begin{array}{lll}
   \text{Actual Hours of Input, at the Actual Rate (AH × AR)} & \text{Actual Hours of Input, at the Standard Rate (AH × SR)} & \text{Standard Hours Allowed for Output, at the Standard Rate (SH × SR)} \\
   1,500 \text{ hours}^* \times & 1,500 \text{ hours}^* \times & \text{Variable overhead rate variance,} \\
   $3.00 \text{ per hour}^* & $3.00 \text{ per hour}^* & \text{\$900 F} \\
   = \text{\$4,500} & = \text{\$4,200} & \text{Variable overhead efficiency variance,} \\
   & & \text{\$300 U} \\
   \text{Spending variance,} & & \text{\$600 F} \\
   \text{\$3,600}^* & & \\
   \end{array}
   \]

   *Given

8. **Standard Quantity or Hours**  
   **Standard Price or Rate**  
   **Standard Cost**  
   
   \[
   \begin{array}{lll}
   \text{Direct materials} & 2.8 \text{ yards}^1 & \text{\$6 \text{ per yard}} \\
   \text{Direct labor} & 1.4 \text{ hours}^2 & \text{\$15.00 \text{ per hour}^3} \\
   \text{Variable manufacturing overhead} & 1.4 \text{ hours} & \text{\$3 \text{ per hour}} \\
   \text{Total standard cost} & & \text{\$42.00} \\
   \end{array}
   \]

   \(^1\text{From requirement 3.}\)

   \(^2\text{1,400 standard hours (from part 5) ÷ 1,000 backpacks = 1.4 hours per backpack.}\)

   \(^3\text{From requirement 5.}\)
Case 10-17 (60 minutes)

1. The number of units produced can be computed by using the total standard cost applied for the period for any input—direct materials, direct labor, or variable manufacturing overhead. Using the standard cost applied for direct materials, we have:

\[
\frac{\text{Total standard cost applied for the period}}{\text{Standard cost per unit}} = \frac{\$405,000}{\$18 \text{ per unit}} = 22,500 \text{ units}
\]

The same answer can be obtained by using direct labor or variable manufacturing overhead.

2. 138,000 pounds; see below for a detailed analysis.

3. $2.95 per pound; see below for a detailed analysis.

4. 19,400 direct labor-hours; see below for a detailed analysis.

5. $15.75 per direct labor-hour; see below for a detailed analysis.

6. Standard variable overhead cost applied $54,000
   Add: Overhead efficiency variance........... 4,200 U (see below)
   Deduct: Overhead rate variance............... 1,300 F
   Actual variable overhead cost incurred... $56,900
Case 10-17 (continued)

Direct materials analysis:

<table>
<thead>
<tr>
<th>Actual Quantity of Inputs, at Actual Price (AQ × AP)</th>
<th>Actual Quantity of Inputs, at Standard Price (AQ × SP)</th>
<th>Standard Quantity Allowed for Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>138,000 pounds × $2.95 per pound***</td>
<td>138,000 pounds × $3 per pound</td>
<td>135,000 pounds × $3 per pound</td>
</tr>
<tr>
<td>= $407,100</td>
<td>= $414,000</td>
<td>= $405,000</td>
</tr>
</tbody>
</table>

- Materials price variance, $6,900 F
- Materials quantity variance, $9,000 U
- Spending variance, $2,100 U

* 22,500 units × 6 pounds per unit = 135,000 pounds
** $414,000 ÷ $3 per pound = 138,000 pounds
*** $407,100 ÷ 138,000 pounds = $2.95 per pound

Direct labor analysis:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19,400 DLHs × $15.75 per DLH***</td>
<td>19,400 DLHs × $15 per DLH</td>
<td>18,000 DLHs × $15 per DLH</td>
</tr>
<tr>
<td>= $305,550</td>
<td>= $291,000</td>
<td>= $270,000</td>
</tr>
</tbody>
</table>

- Labor rate variance, $14,550 U
- Labor efficiency variance, $21,000 U
- Spending variance, $35,550 U

* 22,500 units × 0.8 DLHs per unit = 18,000 DLHs
** $291,000 ÷ $15 per DLH = 19,400 DLHs
*** $305,550 ÷ 19,400 DLHs = $15.75 per DLH

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**Case 10-17** (continued)

Variable overhead analysis:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH × AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH × SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19,400 DLHs × $3 per DLH = $58,200</td>
<td>18,000 DLHs × $3 per DLH = $54,000</td>
</tr>
</tbody>
</table>

Variable overhead rate variance, $1,300 F
Variable overhead efficiency variance, $4,200 U

* $58,200 – $1,300 = $56,900.
Appendix 10A
Predetermined Overhead Rates and Overhead Analysis in a Standard Costing System

Exercise 10A-1 (15 minutes)

1. Fixed portion of the predetermined overhead rate = \frac{\text{Fixed overhead}}{\text{Denominator level of activity}}
   = \frac{$250,000}{25,000 \text{ DLHs}}
   = $10.00 \text{ per DLH}

2. Budget variance = \text{Actual fixed overhead} - \text{Budgeted fixed overhead}
   = $254,000 - $250,000
   = $4,000 \text{ U}

Volume variance = \frac{\text{Fixed portion of the predetermined overhead rate}}{(\text{Denominator hours} - \text{Standard hours allowed})}
   = $10.00 \text{ per DLH} \times (25,000 \text{ DLHs} - 26,000 \text{ DLHs})
   = $10,000 \text{ F}
Exercise 10A-2 (20 minutes)

1. Predetermined overhead rate = \( \frac{\$3 \text{ per MH} \times 60,000 \text{ MHs} + \$300,000}{60,000 \text{ MHs}} \)

   = \( \frac{\$480,000}{60,000 \text{ MHs}} \)

   = \$8 \text{ per MH}

   Variable portion of the predetermined overhead rate = \( \frac{\$3 \text{ per MH} \times 60,000 \text{ MHs}}{60,000 \text{ MHs}} \)

   = \( \frac{\$180,000}{60,000 \text{ MHs}} \)

   = \$3 \text{ per MH}

   Fixed portion of the predetermined overhead rate = \( \frac{\$300,000}{60,000 \text{ MHs}} \)

   = \$5 \text{ per MH}

2. The standard hours per unit of product are:
   60,000 hours \( \div \) 40,000 units = 1.5 hours per unit

   Given this figure, the standard hours allowed for the actual production would be:
   42,000 units \( \times \) 1.5 hours per unit = 63,000 standard hours allowed
Exercise 10A-2 (continued)

3. Variable overhead rate variance:
   Variable overhead rate variance = (AH \times AR) - (AH \times SR)
   ($185,600) - (64,000 \text{ hours} \times $3 \text{ per hour}) = $6,400 \text{ F}

   Variable overhead efficiency variance:
   Variable overhead efficiency variance = SR (AH - SH)
   $3 \text{ per hour} (64,000 \text{ hours} - 63,000 \text{ hours}) = $3,000 \text{ U}

The fixed overhead variances are as follows:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$302,400</td>
<td>$300,000*</td>
<td>63,000 \text{ hours} \times $5 \text{ per hour} = $315,000</td>
</tr>
</tbody>
</table>

\[ \uparrow \text{ Budget variance, } \$2,400 \text{ U} \]
\[ \uparrow \text{ Volume variance, } \$15,000 \text{ F} \]

*As originally budgeted.

Alternative approach to the budget variance:

\[ \text{Budget variance} = \frac{\text{Actual fixed overhead}}{\text{Budgeted fixed overhead}} = \frac{\$302,400 - $300,000}{\$300,000} = \$2,400 \text{ U} \]

Alternative approach to the volume variance:

\[ \text{Volume Variance} = \left( \frac{\text{Fixed portion of Standard}}{\text{Denominator hours}} \right) - \text{Standard hours allowed} \]
\[ = $5 \text{ per hour} \times (60,000 \text{ hours} - 63,000 \text{ hours}) \]
\[ = $15,000 \text{ F} \]
Exercise 10A-3 (15 minutes)

1. The total overhead cost at the denominator level of activity must be determined before the predetermined overhead rate can be computed.

   Total fixed overhead cost per year ........................................... $250,000
   Total variable overhead cost
     ($2 per DLH × 40,000 DLHs) ................................................. 80,000
   Total overhead cost at the denominator level of activity .. $330,000

   \[
   \text{Predetermined overhead rate} = \frac{\text{Overhead at the denominator level of activity}}{\text{Denominator level of activity}} \\
   = \frac{\$330,000}{40,000 \text{ DLHs}} = \$8.25 \text{ per DLH}
   \]

2. Standard direct labor-hours allowed for the actual output (a) ......................... 38,000 DLHs

   Predetermined overhead rate (b) ............ $8.25 per DLH

   Overhead applied (a) × (b)......................... $313,500
Exercise 10A-4 (10 minutes)

Company A: This company has a favorable volume variance because the standard hours allowed for the actual production are greater than the denominator hours.

Company B: This company has an unfavorable volume variance because the standard hours allowed for the actual production are less than the denominator hours.

Company C: This company has no volume variance because the standard hours allowed for the actual production and the denominator hours are the same.
**Exercise 10A-5** (15 minutes)

1. 9,500 units × 4 hours per unit = 38,000 hours.

2. and 3.

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$198,700*</td>
<td>$200,000</td>
<td>38,000 hours × $5 per hour* = $190,000</td>
</tr>
</tbody>
</table>

↑ Budget variance, $1,300 F

↑ Volume variance, $10,000 U*

*Given

4. Fixed element of the predetermined overhead rate = \( \frac{\text{Budgeted fixed overhead}}{\text{Denominator activity}} \)

\[ \frac{\$200,000}{\text{Denominator activity}} = $5 \text{ per hour} \]

Therefore, the denominator activity is: $200,000 ÷ $5 per hour = 40,000 hours.
Exercise 10A-6 (15 minutes)

1. Predetermined overhead rate = Total overhead at the denominator activity / Denominator activity

   = $1.90 per DLH × 30,000 DLHs + $168,000 / 30,000 DLHs

   = $225,000 / 30,000 DLHs

   = $7.50 per DLH

   Fixed element: $168,000 ÷ 30,000 DLHs = $5.60 per DLH

2. 

<table>
<thead>
<tr>
<th>Standard Quantity or Hours</th>
<th>Standard Price or Rate</th>
<th>Standard Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct materials ..........</td>
<td>2.5 yards</td>
<td>$8.60 per yard</td>
</tr>
<tr>
<td>Direct labor ...............</td>
<td>3.0 hours*</td>
<td>$12.00 per hour</td>
</tr>
<tr>
<td>Variable manufacturing overhead ...............</td>
<td>3.0 hours</td>
<td>$1.90 per hour</td>
</tr>
<tr>
<td>Fixed manufacturing overhead ...............</td>
<td>3.0 hours</td>
<td>$5.60 per hour</td>
</tr>
<tr>
<td>Total standard cost ........</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*30,000 DLHs ÷ 10,000 units = 3 DLHs per unit
Exercise 10A-7 (15 minutes)

1. 14,000 units produced × 3 MHs per unit = 42,000 MHs

2. Actual fixed overhead incurred .................. $267,000
   Add: Favorable budget variance .............. 3,000
   Budgeted fixed overhead cost ................ $270,000

3. 
   \[
   \text{Fixed element of the predetermined overhead rate} = \frac{\text{Budgeted fixed overhead}}{\text{Denominator activity}}
   \]
   \[
   = \frac{270,000}{45,000 \text{ MHs}}
   \]
   \[
   = 6 \text{ per MH}
   \]

4. Volume \[\text{Variance} = \text{Fixed portion of the predetermined overhead rate} \times \frac{\text{Denominator hours}}{\text{Standard hours allowed}}\]
   \[
   = 6 \text{ per MH} (45,000 \text{ MHs} - 42,000 \text{ MHs})
   \]
   \[
   = 18,000 \text{ U}
   \]

Alternative solution to parts 1-3:

\[
\begin{array}{ccc}
\text{Actual Fixed Overhead} & \text{Budgeted Fixed Overhead} & \text{Fixed Overhead Applied to Work in Process} \\
$267,000^* & $270,000^1 & 42,000 \text{ MHs}^2 \times 6 \text{ per MH}^3 \\
\end{array}
\]

\[
\begin{array}{ccc}
\uparrow & \uparrow & \uparrow \\
\text{Budget variance,} & \text{Volume variance,} & \\
$3,000 \text{ F}^* & $18,000 \text{ U} & \\
\end{array}
\]

\[
1^* 267,000 + 3,000 = 270,000.
\]

\[
2^* 14,000 \text{ units} \times 3 \text{ MHs per unit} = 42,000 \text{ MHs}
\]

\[
3^* 270,000 \div 45,000 \text{ denominator MHs} = 6 \text{ per MH}
\]
*Given
Problem 10A-8 (45 minutes)

1. Total rate: \( \frac{600,000}{60,000 \text{ DLHs}} = $10 \text{ per DLH} \)
   
   Variable rate: \( \frac{120,000}{60,000 \text{ DLHs}} = $2 \text{ per DLH} \)
   
   Fixed rate: \( \frac{480,000}{60,000 \text{ DLHs}} = $8 \text{ per DLH} \)

2. Direct materials: 3 pounds at $7 per pound .......... $21
   Direct labor: 1.5 DLHs at $12 per DLH................. 18
   Variable overhead: 1.5 DLHs at $2 per DLH ............ 3
   Fixed overhead: 1.5 DLHs at $8 per DLH ............... 12
   Standard cost per unit....................................... $54

3. a. 42,000 units \( \times \) 1.5 DLHs per unit = 63,000 standard DLHs
   b. Manufacturing Overhead
      
      \[
      \begin{array}{c|c|c}
        \text{Actual costs} & 606,500 & \text{Applied costs} & 630,000 \times \\
        \hline
        \text{Overapplied overhead} & 23,500 & \\
      \end{array}
      \]
      
      *63,000 standard DLHs \( \times \) $10 per DLH = $630,000

4. Variable overhead variances:
   
   \[
   \begin{array}{c|c|c}
     \text{Actual Hours of} & \text{Actual Hours of} & \text{Standard Hours} \\
     \text{Input, at the} & \text{Input, at the Standard Rate} & \text{Allowed for Output, at} \\
     \text{Actual Rate} & (AH \times SR) & \text{the Standard Rate} \\
     (AH \times AR) & & (SH \times SR) \\
     \hline
     $123,500 & 65,000 \text{ DLHs} \times & 63,000 \text{ DLHs} \times \\
     & $2 \text{ per DLH} & $2 \text{ per DLH} \\
     & = $130,000 & = $126,000 \\
   \end{array}
   \]

   \[
   \begin{array}{c|c|c}
     \text{Variable overhead rate} & \text{Variable overhead} & \text{Variable overhead} \\
     \text{variance,} & \text{efficiency variance,} & \\
     $6,500 \text{ F} & $4,000 \text{ U} & \\
   \end{array}
   \]
Problem 10A-8 (continued)

Alternative solution:

Variable overhead rate variance = (AH × AR) – (AH × SR)
($123,500) – (65,000 DLHs × $2 per DLH) = $6,500 F

Variable overhead efficiency variance = SR (AH – SH)
$2 per DLH (65,000 DLHs – 63,000 DLHs) = $4,000 U

Fixed overhead variances:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$483,000</td>
<td>$480,000</td>
<td>63,000 DLHs × $8 per DLH = $504,000</td>
</tr>
</tbody>
</table>

↑ Budget variance,
$3,000 U

↑ Volume variance,
$24,000 F

*Can be expressed as: 60,000 denominator DLHs × $8 per DLH = $480,000

Alternative solution:

Budget variance:

\[
\text{Budget variance} = \text{Actual fixed overhead} - \text{Budgeted fixed overhead}
\]

\[
= $483,000 - $480,000
= $3,000 U
\]

Volume variance:

\[
\text{Volume Variance} = \text{Fixed portion of the predetermined overhead rate} \times \frac{\text{Denominator hours} - \text{Standard hours allowed}}{\text{Denominator hours}}
\]

\[
= $8 \text{ per DLH} \times (60,000 \text{ DLHs} - 63,000 \text{ DLHs})
= $24,000 F
\]
Problem 10A-8 (continued)

The company’s overhead variances can be summarized as follows:

Variable overhead:
- Rate variance........................................ $ 6,500 F
- Efficiency variance................................. 4,000 U

Fixed overhead:
- Budget variance..................................... 3,000 U
- Volume variance..................................... 24,000 F
- Overapplied overhead—see
  requirement 3........................................ $23,500 F

5. Only the volume variance would have changed. It would have been unfavorable because the standard DLHs allowed for the year’s production (63,000 DLHs) would have been less than the denominator DLHs (65,000 DLHs).
Problem 10A-9 (45 minutes)

1. Total rate: \[ \frac{297,500}{35,000 \text{ hours}} = 8.50 \text{ per hour} \]

   Variable rate: \[ \frac{87,500}{35,000 \text{ hours}} = 2.50 \text{ per hour} \]

   Fixed rate: \[ \frac{210,000}{35,000 \text{ hours}} = 6.00 \text{ per hour} \]

2. 32,000 standard hours \( \times \) $8.50 per hour = $272,000

3. Variable overhead variances:

   | Actual Hours of | Actual Hours of Input, at the Standard Rate | Standard Hours Allowed for Output, at the Standard Rate |
   | Input, at the Actual Rate (AH \times AR) | (AH \times SR) | (SH \times SR) |
   | $78,000 | 30,000 hours \times $2.50 per hour = $75,000 | 32,000 hours \times $2.50 per hour = $80,000 |

   Variable overhead rate variance, $3,000 U

   Variable overhead efficiency variance, $5,000 F

Alternative solution:

   Variable overhead rate variance = (AH \times AR) - (AH \times SR)

   ($78,000) - (30,000 hours \times $2.50 per hour) = $3,000 U

   Variable overhead efficiency variance = SR (AH - SH)

   $2.50 per hour \times (30,000 hours - 32,000 hours) = $5,000 F
**Problem 10A-9** (continued)

Fixed overhead variances:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$209,400</td>
<td>$210,000</td>
<td>32,000 hours × $6 per hour = $192,000</td>
</tr>
</tbody>
</table>

\[
\begin{array}{c}
\text{Budget variance,} \\
\uparrow
\end{array} \quad \begin{array}{c}
\text{Volume variance,} \\
\uparrow
\end{array}
\]

\[\begin{array}{c}
\uparrow \quad \text{Budget variance,} \quad \$600 \text{ F} \\
\uparrow \quad \text{Volume variance,} \quad \$18,000 \text{ U}
\end{array}\]

Alternative solution:

Budget variance:

\[
\text{Budget variance} = \text{Actual fixed overhead} - \text{Budgeted fixed overhead} \\
= \$209,400 - \$210,000 \\
= \$600 \text{ F}
\]

Volume variance:

\[
\text{Volume variance} = \frac{\text{Fixed portion of the predetermined overhead rate} \times (\text{Denominator hours} - \text{Standard hours allowed})}{\text{Denominator hours}} \\
= \$6.00 \text{ per hour} (35,000 \text{ hours} - 32,000 \text{ hours}) \\
= \$18,000 \text{ U}
\]

Verification:

<table>
<thead>
<tr>
<th>Variance Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable overhead rate variance</td>
<td>$3,000 U</td>
</tr>
<tr>
<td>Variable overhead efficiency variance</td>
<td>5,000 F</td>
</tr>
<tr>
<td>Fixed overhead budget variance</td>
<td>600 F</td>
</tr>
<tr>
<td>Fixed overhead volume variance</td>
<td>18,000 U</td>
</tr>
<tr>
<td>Underapplied overhead</td>
<td>$15,400 U</td>
</tr>
</tbody>
</table>
Problem 10A-9 (continued)

4. Variable overhead

*Rate variance:* This variance reflects differences between actual and standard prices for variable overhead items. Because the variable overhead rate variance is unfavorable, too much was paid for variable overhead items.

*Efficiency variance:* The term “variable overhead efficiency variance” is a misnomer, because the variance does not measure efficiency in the use of overhead items. It measures the indirect effect on variable overhead of the efficiency or inefficiency with which the activity base is utilized. In this company, the activity base is labor-hours. If variable overhead is really proportional to labor-hours, then more effective use of labor-hours has the indirect effect of reducing variable overhead. Because 2,000 fewer labor-hours were required than indicated by the labor standards, the indirect effect was presumably to reduce variable overhead spending by about $5,000 ($2.50 per hour × 2,000 hours).

Fixed overhead

*Budget variance:* This variance is simply the difference between the budgeted fixed cost and the actual fixed cost. In this case, the variance is favorable which indicates that actual fixed costs were lower than anticipated in the budget.

*Volume variance:* This variance occurs as a result of actual activity being different from the denominator activity in the predetermined overhead rate. In this case, the variance is unfavorable, so actual activity was less than the denominator activity. It is difficult to place much of a meaningful economic interpretation on this variance. It tends to be large, so it often swamps the other, more meaningful variances if they are simply netted against each other.
**Problem 10A-10** (45 minutes)

1. Direct materials price and quantity variances:
   - Materials price variance = \( AQ \times (AP - SP) \)
     - 64,000 feet ($8.55 per foot – $8.45 per foot) = $6,400 U
   - Materials quantity variance = \( SP \times (AQ - SQ) \)
     - $8.45 per foot (64,000 feet – 60,000 feet*) = $33,800 U
     *30,000 units \( \times \) 2 feet per unit = 60,000 feet

2. Direct labor rate and efficiency variances:
   - Labor rate variance = \( AH \times (AR - SR) \)
     - 43,500 DLHs ($15.80 per DLH – $16.00 per DLH) = $8,700 F
   - Labor efficiency variance = \( SR \times (AH - SH) \)
     - $16.00 per DLH (43,500 DLHs – 42,000 DLHs*) = $24,000 U
     *30,000 units \( \times \) 1.4 DLHs per unit = 42,000 DLHs

3. a. Variable overhead spending and efficiency variances:

<table>
<thead>
<tr>
<th>Actual Hours of Input, at the Actual Rate (AH ( \times ) AR)</th>
<th>Actual Hours of Input, at the Standard Rate (AH ( \times ) SR)</th>
<th>Standard Hours Allowed for Output, at the Standard Rate (SH ( \times ) SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$108,000</td>
<td>43,500 DLHs ( \times ) $2.50 per DLH = $108,750</td>
<td>42,000 DLHs ( \times ) $2.50 per DLH = $105,000</td>
</tr>
</tbody>
</table>

↑ Variable overhead rate variance, $750 F
↑ Variable overhead efficiency variance, $3,750 U

Alternative solution:
- Variable overhead rate variance = \((AH \times AR) - (AH \times SR)\)
  - ($108,000) – (43,500 DLHs \( \times \) $2.50 per DLH) = $750 F
- Variable overhead efficiency variance = \(SR \times (AH - SH)\)
  - $2.50 per DLH (43,500 DLHs – 42,000 DLHs) = $3,750 U
Problem 10A-10 (continued)

b. Fixed overhead budget and volume variances:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$211,800</td>
<td>$210,000*</td>
<td>$252,000</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
\text{Fixed Overhead Applied to Work in Process} &= 42,000 \text{ DLHs} \times \$6 \text{ per DLH} \\
&= $252,000
\end{align*}
\]

\[
\begin{align*}
\text{Budget variance} &= \text{Actual fixed overhead} - \text{Budgeted fixed overhead} \\
&= $211,800 - $210,000 \\
&= $1,800 \text{ U}
\end{align*}
\]

\[
\begin{align*}
\text{Volume variance} &= \text{Fixed portion of Standard Volume Denominator} \\
&= \text{Predetermined overhead rate} \times (\text{Denominator hours} - \text{Actual hours}) \\
&= $6.00 \text{ per DLH} \times (35,000 \text{ DLHs} - 42,000 \text{ DLHs}) \\
&= $42,000 \text{ F}
\end{align*}
\]

*As originally budgeted. This figure can also be expressed as: 35,000 denominator DLHs × $6 per DLH = $210,000.

Alternative solution:

Budget variance:

\[
\begin{align*}
\text{Budget variance} &= \text{Actual fixed overhead} - \text{Budgeted fixed overhead} \\
&= $211,800 - $210,000 \\
&= $1,800 \text{ U}
\end{align*}
\]

Volume variance:

\[
\begin{align*}
\text{Volume variance} &= \text{Fixed portion of Standard Volume Denominator} \\
&= \text{Predetermined overhead rate} \times (\text{Denominator hours} - \text{Actual hours}) \\
&= $6.00 \text{ per DLH} \times (35,000 \text{ DLHs} - 42,000 \text{ DLHs}) \\
&= $42,000 \text{ F}
\end{align*}
\]
**Problem 10A-10 (continued)**

4. The total of the variances would be:

<table>
<thead>
<tr>
<th>Variance</th>
<th>Amount (U)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct materials variances:</strong></td>
<td></td>
</tr>
<tr>
<td>Price variance</td>
<td>$6,400 U</td>
</tr>
<tr>
<td>Quantity variance</td>
<td>33,800 U</td>
</tr>
<tr>
<td><strong>Direct labor variances:</strong></td>
<td></td>
</tr>
<tr>
<td>Rate variance</td>
<td>8,700 F</td>
</tr>
<tr>
<td>Efficiency variance</td>
<td>24,000 U</td>
</tr>
<tr>
<td><strong>Variable manufacturing overhead variances:</strong></td>
<td></td>
</tr>
<tr>
<td>Rate variance</td>
<td>750 F</td>
</tr>
<tr>
<td>Efficiency variance</td>
<td>3,750 U</td>
</tr>
<tr>
<td><strong>Fixed manufacturing overhead variances:</strong></td>
<td></td>
</tr>
<tr>
<td>Budget variance</td>
<td>1,800 U</td>
</tr>
<tr>
<td>Volume variance</td>
<td>42,000 F</td>
</tr>
<tr>
<td><strong>Total of variances</strong></td>
<td>$18,300 U</td>
</tr>
</tbody>
</table>

Note that the total of the variances agrees with the $18,300 variance mentioned by the president.

It appears that not everyone should be given a bonus for good cost control. The materials quantity variance and the labor efficiency variance are 6.7% and 3.6%, respectively, of the standard cost allowed and thus would warrant investigation.

The company’s large unfavorable variances (for materials quantity and labor efficiency) do not show up more clearly because they are offset by the favorable volume variance. This favorable volume variance is a result of the company operating at an activity level that is well above the denominator activity level used to set predetermined overhead rates. (The company operated at an activity level of 42,000 standard hours; the denominator activity level set at the beginning of the year was 35,000 hours.) As a result of the large favorable volume variance, the unfavorable quantity and efficiency variances have been concealed in a small “net” figure. The large favorable volume variance may have been achieved by building up inventories.
Problem 10A-11 (30 minutes)

1. Direct materials, 3 yards × $4.40 per yard............................... $13.20
   Direct labor, 1 DLH × $12.00 per DLH ................................ 12.00
   Variable manufacturing overhead, 1 DLH × $5.00 per DLH* .... 5.00
   Fixed manufacturing overhead, 1 DLH × $11.80 per DLH** ..... 11.80
   Standard cost per unit......................................................... $42.00

   * $25,000 ÷ 5,000 DLHs = $5.00 per DLH
   ** $59,000 ÷ 5,000 DLHs = $11.80 per DLH

2. Materials variances:
   Materials price variance = AQ (AP – SP)
   24,000 yards ($4.80 per yard – $4.40 per yard) = $9,600 U
   Materials quantity variance = SP (AQ – SQ)
   $4.40 per yard (18,500 yards – 18,000 yards*) = $2,200 U
   *6,000 units × 3 yards per unit = 18,000 yards

   Labor variances:
   Labor rate variance = AH (AR – SR)
   5,800 DLHs ($13.00 per DLH – $12.00 per DLH) = $5,800 U
   Labor efficiency variance = SR (AH – SH)
   $12.00 per DLH (5,800 DLHs – 6,000 DLHs*) = $2,400 F
   *6,000 units × 1 DLH per unit = 6,000 DLHs
Problem 10A-11 (continued)

3. Variable overhead variances:

<table>
<thead>
<tr>
<th>Actual DLHs of Input, at the Actual Rate (AH × AR)</th>
<th>Actual DLHs of Input, at the Standard Rate (AH × SR)</th>
<th>Standard DLHs Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$29,580</td>
<td>5,800 DLHs × $5.00 per DLH = $29,000</td>
<td>6,000 DLHs × $5.00 per DLH = $30,000</td>
</tr>
</tbody>
</table>

Variable overhead rate variance, $580 U

Variable overhead efficiency variance, $1,000 F

Spending variance, $420 F

Alternative solution for the variable overhead variances:

Variable overhead rate variance = (AH × AR) – (AH × SR)  
($29,580) – (5,800 DLHs × $5.00 per DLH) = $580 U

Variable overhead efficiency variance = SR (AH – SH) $5.00 per DLH (5,800 DLHs – 6,000 DLHs) = $1,000 F

Fixed overhead variances:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
<th>Budgeted Fixed Overhead</th>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>$60,400</td>
<td>$59,000</td>
<td>6,000 DLHs × $11.80 per DLH = $70,800</td>
</tr>
</tbody>
</table>

Budget variance, $1,400 U

Volume variance, $11,800 F
Problem 10A-11 (continued)

Alternative approach to the budget variance:

\[
\text{Budget variance} = \text{Actual fixed overhead} - \text{Budgeted fixed overhead}
\]

\[
= \$60,400 - \$59,000
\]

\[
= \$1,400 \text{ U}
\]

Alternative approach to the volume variance:

\[
\text{Volume Variance} = \left( \frac{\text{Fixed portion of overhead rate}}{\text{Denominator hours}} \right) \times (\text{Actual hours} - \text{Allowed hours})
\]

\[
= \$11.80 \text{ per DLH} \times (5,000 \text{ DLHs} - 6,000 \text{ DLHs})
\]

\[
= \$11,800 \text{ F}
\]

4. The choice of a denominator activity level affects standard unit costs in that the higher the denominator activity level chosen, the lower standard unit costs will be. The reason is that the fixed portion of overhead costs is spread over more units as the denominator activity rises.

The volume variance cannot be controlled by controlling spending. The volume variance simply reflects whether actual activity was greater than or less than the denominator activity. Thus, the volume variance is controllable only through activity.
Problem 10A-12 (45 minutes)

1. and 2.  

<table>
<thead>
<tr>
<th></th>
<th>Variable</th>
<th>Fixed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denominator of 30,000 DLHs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$135,000 ÷ 30,000 DLHs</td>
<td>$4.50</td>
<td></td>
<td>$4.50</td>
</tr>
<tr>
<td>$270,000 ÷ 30,000 DLHs</td>
<td></td>
<td>$9.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Total predetermined rate</td>
<td></td>
<td></td>
<td>$13.50</td>
</tr>
<tr>
<td>Denominator of 40,000 DLHs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$180,000 ÷ 40,000 DLHs</td>
<td>$4.50</td>
<td></td>
<td>$4.50</td>
</tr>
<tr>
<td>$270,000 ÷ 40,000 DLHs</td>
<td></td>
<td>$6.75</td>
<td>6.75</td>
</tr>
<tr>
<td>Total predetermined rate</td>
<td></td>
<td></td>
<td>$11.25</td>
</tr>
</tbody>
</table>

3.  

<table>
<thead>
<tr>
<th>Denominator Activity: 30,000 DLHs</th>
<th>Denominator Activity: 40,000 DLHs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct materials, 4 feet × $8.75 per foot</td>
<td>$35.00 Same........................ $35.00</td>
</tr>
<tr>
<td>Direct labor, 2 DLHs × $15 per DLH</td>
<td>30.00 Same........................ 30.00</td>
</tr>
<tr>
<td>Variable overhead, 2 DLHs × $4.50 per DLH</td>
<td>9.00 Same........................ 9.00</td>
</tr>
<tr>
<td>Fixed overhead, 2 DLHs × $9.00 per DLH</td>
<td>18.00 × $6.75 per DLH........ 13.50</td>
</tr>
<tr>
<td>Standard cost per unit</td>
<td>$92.00 Standard cost per unit</td>
</tr>
</tbody>
</table>

4. a. 18,000 units × 2 DLHs per unit = 36,000 standard DLHs

b. Manufacturing Overhead

<table>
<thead>
<tr>
<th>Actual costs</th>
<th>446,400</th>
<th>Applied costs</th>
<th>486,000 *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overapplied overhead</td>
<td>39,600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*36,000 standard DLHs × $13.50 predetermined rate per DLH = $486,000
Problem 10A-12 (continued)

c. Variable overhead variances:

<table>
<thead>
<tr>
<th>Actual DLHs of Input, at the Actual Rate (AH × AR)</th>
<th>Actual DLHs of Input, at the Standard Rate (AH × SR)</th>
<th>Standard DLHs Allowed for Output, at the Standard Rate (SH × SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$174,800</td>
<td>38,000 DLHs × $4.50 per DLH = $171,000</td>
<td>36,000 DLHs × $4.50 per DLH = $162,000</td>
</tr>
</tbody>
</table>

**Variable overhead rate variance,** $3,800 U

**Variable overhead efficiency variance,** $9,000 U

Alternative solution:

Variable overhead rate variance = (AH × AR) – (AH × SR) ($174,800) – (38,000 DLHs × $4.50 per DLH) = $3,800 U

Variable overhead efficiency variance = SR (AH – SH) $4.50 per DLH (38,000 DLHs – 36,000 DLHs) = $9,000 U

Fixed overhead variances:

<table>
<thead>
<tr>
<th>Actual Fixed Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>$271,600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Budgeted Fixed Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>$270,000*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixed Overhead Applied to Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>36,000 DLHs × $9 per DLH = $324,000</td>
</tr>
</tbody>
</table>

**Budget variance, $1,600 U**

**Volume variance, $54,000 F**

*Can be expressed as: 30,000 denominator DLHs × $9 per DLH = $270,000*
Problem 10A-12 (continued)

Alternative solution:

Budget variance:

\[
\text{Budget variance} = \text{Actual fixed overhead} - \text{Budgeted fixed overhead}
\]

\[
= $271,600 - $270,000
\]

\[
= $1,600 \text{ U}
\]

Volume variance:

\[
\text{Volume Variance} = \text{Fixed portion of the predetermined overhead rate} \times \frac{\text{Denominator hours}}{\text{Denominator hours allowed}} - \frac{\text{Denominator hours}}{\text{Denominator hours allowed}}
\]

\[
= $9.00 \text{ per DLH} \times (30,000 \text{ DLHs} - 36,000 \text{ DLHs})
\]

\[
= $54,000 \text{ F}
\]

Summary of variances:

- Variable overhead rate variance .................. $3,800 \text{ U}
- Variable overhead efficiency variance .......... 9,000 \text{ U}
- Fixed overhead budget variance .................. 1,600 \text{ U}
- Fixed overhead volume variance .................. 54,000 \text{ F}
- Overapplied overhead .............................. $39,600 \text{ F}
Problem 10A-12 (continued)

5. The major disadvantage of using normal activity is the large volume variance that ordinarily results. This occurs because the denominator activity used to compute the predetermined overhead rate is different from the activity level that is anticipated for the period. In the case at hand, the company has used a long-run normal activity figure of 30,000 DLHs to compute the predetermined overhead rate, whereas activity for the period was expected to be 40,000 DLHs. This has resulted in a large favorable volume variance that may be difficult for management to interpret. In addition, the large favorable volume variance in this case has masked the fact that the company did not achieve the budgeted level of activity for the period. The company had planned to work 40,000 DLHs, but managed to work only 36,000 DLHs (at standard). This unfavorable result is concealed due to using a denominator figure that is out of step with current activity.

On the other hand, using long-run normal activity as the denominator results in unit costs that are stable from year to year. Thus, management’s decisions are not clouded by unit costs that jump up and down as the activity level rises and falls.
Appendix 10B

Exercise 10B-1 (10 minutes)

1. The cost of goods sold will decrease by:

   - Materials price variance ................................ $ (6,500)
   - Materials quantity variance ........................... 10,200
   - Labor rate variance ...................................... 3,500
   - Labor efficiency variance ............................... (4,400)
   - Fixed overhead budget variance .................... (2,500)
   - Fixed overhead volume variance ................... (12,000)
   - Decrease in cost of goods sold ......................... $(11,700)

2. The income statement is as follows:

   - Sales (10,000 units × $135) .......................... $1,350,000
   - Cost of goods sold at standard (10,000 units × $105) .................................................. $1,050,000
   - Total variance adjustments ........................... (11,700)
   - Cost of goods sold ...................................... 1,038,300
   - Gross margin ............................................ 311,700
   - Selling and administrative expenses .............. 235,000
   - Net operating income ................................. $ 76,700
Exercise 10B-2 (15 minutes)

1. The cost of goods sold will increase by:

   Materials price variance ................................ $3,400
   Materials quantity variance ........................... (9,000)
   Labor rate variance ................................... 3,900
   Labor efficiency variance ............................. 6,600
   Fixed overhead budget variance ...................... 1,300
   Fixed overhead volume variance .................... (5,500)
   Increase in cost of goods sold ...................... $ 700

2. The first step is to compute the number of units sold as follows:

   Total sales (a)................................................. $577,500
   Selling price per unit (b).............................. $165
   Number of units sold (a) ÷ (b)....................... 3,500

   The income statement is as follows:

   Sales ......................................................... $577,500
   Cost of goods sold at standard (3,500 units × $143)........................................... $500,500
   Total variance adjustments ......................... 700
   Cost of goods sold..................................... 501,200
   Gross margin ............................................. 76,300
   Selling and administrative expenses .......... 54,000
   Net operating income ................................. $ 22,300

3. The ending balance in Retained Earnings is computed as follows:

   Beginning balance in retained earnings .......... $70,000
   Net operating income ................................. 22,300
   Ending balance in retained earnings ............ $92,300
Exercise 10B-3 (20 minutes)

1a. The Raw Materials will increase by $300,000 computed as follows:
   Actual quantity purchased (a) ......................... 30,000 yards
   Standard price per yard (b) ............................... $10.00
   Increase in Raw Materials (a) × (b) .................. $300,000

1b. The Cash will decrease by $294,000 computed as follows:
   Actual quantity purchased (a) ......................... 30,000 yards
   Actual price per yard (b) ................................. $9.80
   Decrease in Cash (a) × (b) ............................... $294,000

2a. The Raw Materials will decrease by $300,000 computed as follows:
   Actual quantity used (a) ................................. 30,000 yards
   Standard price per yard (b) ............................... $10.00
   Decrease in Raw Materials (a) × (b) .................. $300,000

2b. The Work in Process will increase by $243,000 computed as follows:
   Standard quantity allowed (8,100 units
      × 3 yards per unit) (a) ......................... 24,300 yards
   Standard price per yard (b) ............................... $10.00
   Increase in Work in Process (a) × (b) ............... $243,000

3a. The Work in Process will increase by $272,160 computed as follows:
   Standard hours allowed (8,100 units
      × 2.4 hours per unit) (a) ......................... 19,440 hours
   Standard rate per hour (b) ............................... $14.00
   Increase in Work in Process (a) × (b) ............... $272,160

3b. The Cash will decrease by $290,000—the amount of cash paid to direct laborers.
**Exercise 10B-3** (continued)

4. The Work in Process will increase by $388,800 computed as follows:
   
   Standard hours allowed (a)............................ 19,440 hours  
   Predetermined overhead rate per hour (b)...... $20.00  
   Increase in Work in Process (a) × (b)......... $388,800

5. The Finished Goods will increase by $903,960 computed as follows:
   
   Number of units completed (a) ....................... 8,100 units  
   Standard cost per unit (b) ........................... $111.60  
   Increase in Finished Goods (a) × (b)............. $903,960
**Exercise 10B-4 (30 minutes)**

1a. The Raw Materials will increase by $720,000 computed as follows:
   - Actual quantity purchased (a) .................. 60,000 yards
   - Standard price per yard (b) .................. $12.00
   - Increase in Raw Materials (a) × (b) .......... $720,000

1b. The Cash will decrease by $660,000 computed as follows:
   - Actual quantity purchased (a) .................. 60,000 yards
   - Actual price per yard (b) .................. $11.00
   - Decrease in Cash (a) × (b) .................. $660,000

1c. The materials price variance is computed as follows:
   - Materials price variance = AQ(AP – SP)
     - 60,000 yards ($11.00 per yard – $12.00 per yard) = $60,000 F

2a. The Raw Materials will decrease by $720,000 computed as follows:
   - Actual quantity used (a) .................. 60,000 yards
   - Standard price per yard (b) .................. $12.00
   - Decrease in Raw Materials (a) × (b) .......... $720,000

2b. The Work in Process will increase by $672,000 computed as follows:
   - Standard quantity allowed (28,000 units × 2 yards per unit) (a) ............... 56,000 yards
   - Standard price per yard (b) .................. $12.00
   - Increase in Work in Process (a) × (b) .......... $672,000

2c. The materials quantity variance is computed as follows:
   - Materials quantity variance = SP (AQ – SQ)
     - $12.00 per yard (60,000 yards – 56,000 yards) = $48,000 U

3a. The Work in Process will increase by $630,000 computed as follows:
   - Standard hours allowed (28,000 units × 1.5 hours per unit) (a) ............... 42,000 hours
   - Standard rate per hour (b) .................. $15.00
   - Increase in Work in Process (a) × (b) .......... $630,000

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Exercise 10B-4 (continued)

3b. The Cash decrease by $600,000 computed as follows:

- Actual hours \( \times \) Actual rate per hour = Decrease in Cash
  
  - Actual hours (a) = 40,000 hours
  - Actual rate per hour (b) = $15.00
  - Decrease in Cash = $600,000

3c. The labor rate variance is zero because the actual rate (see requirement 3b) and the standard rate are both $15.00 per hour. The labor efficiency variance is computed as follows:

- Labor efficiency variance = Standard rate \( \times \) (Actual hours - Standard hours)
  
  - Standard rate = $15.00 per hour
  - Actual hours = 40,000 hours
  - Standard hours = 42,000 hours
  - Labor efficiency variance = $30,000 favorable

4a. The Work in Process will increase by $1,680,000 computed as follows:

- Increase in Work in Process = Standard hours \( \times \) Predetermined overhead rate
  
  - Standard hours = 28,000 units \( \times \) 1.5 hours = 42,000 hours
  - Predetermined overhead rate = $40.00 per hour
  - Increase in Work in Process = $1,680,000

4b. The fixed overhead budget and volume variances are computed as follows:

- Budget variance = Actual fixed overhead - Budgeted fixed overhead
  
  - Budget variance = $1,780,000 - $1,760,000 = $20,000 unfavorable

- Volume variance = Budgeted fixed overhead - Fixed overhead applied
  
  - Volume variance = $1,760,000 - $1,680,000 = $80,000 unfavorable

5. The Finished Goods will increase by $2,982,000 computed as follows:

- Increase in Finished Goods = Number of units completed \( \times \) Standard cost per unit
  
  - Number of units completed = 28,000 units
  - Standard cost per unit = $106.50
  - Increase in Finished Goods = $2,982,000
Problem 10B-5 (60 minutes)

1. The manufacturing cost variances are computed as follows:

   **Materials price variance** = AQ(AP – SP)
   
   230,000 pounds ($29.50 per pound – $30.00 per pound) = $115,000 F

   **Materials quantity variance** = SP(AQ – SQ)
   
   $30.00 per pound (215,000 pounds – 190,000 pounds*) = $750,000 U

   *95,000 units × 2 pounds per unit = 190,000 pounds

   **Labor rate variance** = AH(AR – SR)
   
   245,000 hours ($16.00 per hour – $15.00 per hour) = $245,000 U

   **Labor efficiency variance** = SR(AH – SH)
   
   $15.00 per hour (245,000 hours – 285,000 hours*) = $600,000 F

   *95,000 units × 3 hours per unit = 285,000 hours

   **Budget variance** = Actual fixed overhead – Budgeted fixed overhead
   
   Budget variance = $2,740,000 – $2,880,000 = $140,000 F

   **Volume variance** = Budgeted fixed overhead – Fixed overhead applied
   
   Volume variance = $2,880,000 – $2,850,000* = $30,000 U

   * 95,000 units × 3 hours per unit × $10 per hour = $2,850,000
Problem 10B-5 (continued)

2 and 3: The transactions (including the ending balances) are recorded as follows:

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Problem 10B-5 (continued)

4. The income statement is computed as follows:

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<td>Net operating income</td>
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Problem 10B-6 (60 minutes)

1. The manufacturing cost variances are computed as follows:

   Materials price variance = AQ(AP – SP)
   460,000 pounds ($26.50 per pound – $25.00 per pound) = $690,000 U

   Materials quantity variance = SP(AQ – SQ)
   $25.00 per pound (430,000 pounds – 375,000 pounds) = $1,375,000 U

   Labor rate variance = AH(AR – SR)
   265,000 hours ($15.00 per hour – $16.00 per hour) = $265,000 F

   Labor efficiency variance = SR(AH – SH)
   $16.00 per hour (265,000 hours – 250,000 hours) = $240,000 U

   Variable overhead rate variance = AH(AR – SR)
   265,000 hours ($1.81 per hour – $2.00 per hour) = $50,000 F

   Note: The variable overhead rate variance of $50,000 F agrees with cell L11 in the Excel screen capture solution for requirements 2 and 3. An answer of $50,000 F is correct when the actual rate (AR) is not rounded.

   Variable overhead efficiency variance = SR(AH – SH)
   $2.00 per hour (265,000 hours – 250,000 hours) = $30,000 U

   Budget variance = Actual fixed overhead – Budgeted fixed overhead
   Budget variance = $2,450,000 – $2,400,000 = $50,000 U

   Volume variance = Budgeted fixed overhead – Fixed overhead applied
   Volume variance = $2,400,000 – $2,500,000 = $100,000 F

   Note: The budgeted fixed overhead of $2,400,000 is computed as follows:

   Total budgeted overhead (a) ............................................... $2,880,000
   Variable portion of the budget (240,000 DLH ×$2.00 per DLH) (b) ................................................................. $480,000
   Total budgeted fixed overhead (a) – (b).............................. $2,400,000

   Note: The fixed overhead applied of $2,500,000 is computed as follows:

   Standard labor-hours allowed (a)................................. 250,000
   Fixed portion of the predetermined overhead rate per DLH (b)................................................................. $10
   Fixed overhead applied (a) × (b) ................................. $2,500,000
**Problem 10B-6 (continued)**

2 and 3. The transactions (including the ending balances) are recorded as follows:

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**Problem 10B-6 (continued)**

4. The income statement is computed as follows:

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<th>A</th>
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<td>Income Statement</td>
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<td>Sales</td>
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<td>Net operating income</td>
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