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 either 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 or her work. In addition, recognizing the price variance when materials are purchased allows the company to carry its raw materials in the inventory accounts at standard cost, which greatly 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 on the basis of 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 and standards are tight, then the only way to generate favorable labor efficiency variances is for every workstation to produce at capacity. However, the output of the entire system is limited by the capacity of the bottleneck. If workstations before the bottleneck in the production process produce at capacity, the bottleneck will be unable to process all of the work in process. In general, if every workstation is attempting to produce at capacity, then work in process...
inventory will build up in front of the workstations with the least capacity.
The Foundational 15

1. The raw materials cost included in the planning budget is $1,000,000 (= 125,000 pounds × $8.00 per pound = $1,000,000).

2, 3, and 4.

The raw materials cost included in the flexible budget (SQ × 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 (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>160,000 pounds × $7.50 per pound = $1,200,000</td>
<td>160,000 pounds × $8.00 per pound = $1,280,000</td>
<td>150,000 pounds* × $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 × 5 pounds per unit = 150,000 pounds

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
= 160,000 pounds ($7.50 per pound – $8.00 per pound)
= $80,000 F

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

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 = $1,275,000</td>
<td>$170,000 pounds × $8.00 per pound = $1,360,000</td>
<td>$150,000 pounds* × $8.00 per pound = $1,200,000</td>
</tr>
</tbody>
</table>

Materials price variance = $85,000 F

$160,000 pounds × $8.00 per pound = $1,280,000

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 (= 50,000 hours × $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 (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 × $15 per hour = $825,000</td>
<td>55,000 hours × $14.00 per hour = $770,000</td>
<td>60,000 hours* × $14.00 per hour = $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 ($55,000 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** = $280,500</td>
<td>55,000 hours × $5.00 per hour = $275,000</td>
<td>60,000 hours* × $5.00 per hour = $300,000</td>
</tr>
<tr>
<td>Variable overhead rate variance = $5,500 U</td>
<td>Variable overhead efficiency variance = $25,000 F</td>
<td></td>
</tr>
</tbody>
</table>

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** ................................. 35,000  
   Standard kilograms of plastic per helmet .......... \( \times 0.6 \)  
   Total standard kilograms allowed .................. 21,000  
   Standard cost per kilogram .......................... \( \times \$8 \)  
   Total standard cost ................................ 168,000  
   Actual cost incurred (given) ......................... 171,000  
   Total standard cost (above) ......................... 168,000  
   Total material variance—unfavorable .......... \( \$3,000 \)

2. **Actual Quantity of Input, at Actual Price** (\( \text{AQ} \times \text{AP} \))  
   **Actual Quantity of Input, at Standard Price** (\( \text{AQ} \times \text{SP} \))  
   **Standard Quantity Allowed for Output, at Standard Price** (\( \text{SQ} \times \text{SP} \))  
   \[
   \begin{array}{ccc}
   \text{AQ} \times \text{AP} & \text{AQ} \times \text{SP} & \text{SQ} \times \text{SP} \\
   22,500 \text{ kilograms} \times \$8 \text{ per kilogram} & \$180,000 & \text{21,000 kilograms} \times \$8 \text{ per kilogram} \\
   $171,000 & \text{Price Variance,} \$9,000 \text{ F} & \text{Quantity Variance,} \$12,000 \text{ U} \\
   \end{array}
   \]

   Spending Variance, \$3,000 \text{ U}

   \*35,000 helmets \( \times \) 0.6 kilograms per helmet = 21,000 kilograms

   Alternatively, the variances can be computed using the formulas:
   Materials price variance = \( \text{AQ} \) (\( \text{AP} \) – \( \text{SP} \))
   22,500 kilograms ($7.60 per kilogram* – $8.00 per kilogram)
   = \$9,000 \text{ F}
   \* 171,000 ÷ 22,500 kilograms = $7.60 per kilogram

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

1. Number of meals prepared .................. 4,000
   Standard direct labor-hours per meal .... \times 0.25
   Total direct labor-hours allowed ............ 1,000
   Standard direct labor cost per hour ....... \times $9.75
   Total standard direct labor cost .......... $9,750

   Actual cost incurred ......................... $9,600
   Total standard direct labor cost (above) 9,750
   Total direct labor variance ................. $ 150 Favorable

2. Actual Hours of Input, at the Actual Rate
   \[ \text{Actual Hours of Input, at the Standard Rate} \]

   \[ \begin{array}{c|c|c}
   \hline
   \text{Actual Hours of Input,} & \text{Standard Hours} \\
   \text{Actual Rate} & \text{Allowed for Output, at} & \\
   (AH \times AR) & \text{the Standard Rate} & (SH \times SR) \\
   \hline
   960 \text{ hours} \times & 1,000 \text{ hours} \times & \\
   $10.00 \text{ per hour} & $9.75 \text{ per hour} & \\
   = $9,600 & = $9,750 & \\
   \uparrow & \uparrow & \\
   \text{Rate Variance,} & \text{Efficiency Variance,} & \\
   $240 \text{ U} & $390 \text{ F} & \\
   \hline
   \text{Spending Variance,} & \\
   $150 \text{ F} & \\
   \end{array} \]

   Alternatively, the variances can be computed using the formulas:

   \[
   \text{Labor rate variance} = \text{AH(AR} - \text{SR)}
   \]
   \[
   = 960 \text{ hours} (\$10.00 \text{ per hour} - \$9.75 \text{ per hour})
   \]
   \[
   = \$240 \text{ U}
   \]

   \[
   \text{Labor efficiency variance} = \text{SR(AH} - \text{SH)}
   \]
   \[
   = \$9.75 \text{ per hour} (960 \text{ hours} - 1,000 \text{ hours})
   \]
   \[
   = \$390 \text{ F}
   \]
Exercise 10-3 (20 minutes)

1. Number of items shipped ........................................ 120,000
   Standard direct labor-hours per item .................. $ \times 0.02
   Total direct labor-hours allowed .................. 2,400
   Standard variable overhead cost per hour ........ $ \times 3.25
   Total standard variable overhead cost .......... $ 7,800

   Actual variable overhead cost incurred .......... $ 7,360
   Total standard variable overhead cost (above) .. $ 7,800
   Total variable overhead variance ................... $ 440 Favorable

2. 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
   \( (SH \times SR) \)

   \[
   \begin{array}{c|c|c}
   \hline
   & \text{Actual Rate} & \text{Standard Rate} \\
   \hline
   AH \times AR & 2,300 \text{ hours} \times \$3.20 \text{ per hour} & 2,300 \text{ hours} \times \$3.25 \text{ per hour} \\
   & = \$7,360 & = \$7,475 \\
   \hline
   \text{Variable Overhead Rate} & \text{Variable Overhead Efficiency} & \\
   \text{Variance, $115 F} & \text{Variance, $325 F} & \\
   \text{Spending Variance,} & $440 F & \\
   \text{$440 F} & & \\
   \hline
   \end{array}
   \]

*\$7,360 \div 2,300 \text{ hours} = \$3.20 \text{ per hour}

Alternatively, the variances can be computed using the formulas:

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

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

1. Number of units manufactured ........................................ 20,000
   Standard labor time per unit
   (18 minutes ÷ 60 minutes per hour) ......................... × 0.3
   Total standard hours of labor time allowed ............ 6,000
   Standard direct labor rate per hour ...................... × $12
   Total standard direct labor cost ......................... $72,000
   Actual direct labor cost ........................................ $73,600
   Standard direct labor cost .................................. 72,000
   Total variance—unfavorable ................................ $1,600

2. 

<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>5,750 hours × $12.00 per hour = $69,000</td>
<td>6,000 hours* × $12.00 per hour = $72,000</td>
<td></td>
</tr>
<tr>
<td>Rate Variance, $4,600 U</td>
<td>Efficiency Variance, $3,000 F</td>
<td></td>
</tr>
<tr>
<td>Spending Variance, $1,600 U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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 ($12.80 per hour* – $12.00 per hour) = $4,600 U
  *$73,600 ÷ 5,750 hours = $12.80 per hour
- Labor efficiency variance = SR (AH – SH)
  $12.00 per hour (5,750 hours – 6,000 hours) = $3,000 F
### Exercise 10-4 (continued)

3. **Actual Hours of Input, at the Actual Rate**
   \[ (AH \times AR) \]
   - 5,750 hours × $4.00 per hour = $21,850

   **Actual Hours of Input, at the Standard Rate**
   \[ (AH \times SR) \]
   - 6,000 hours × $4.00 per hour = $24,000

   **Standard Hours Allowed for Output, at the Standard Rate**
   \[ (SH \times SR) \]
   - 6,000 hours × $4.00 per hour = $24,000

   - **Rate Variance**, $1,150 F
   - **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) = $1,150 F
  - *$\frac{21,850}{5,750\text{ hours}} = $3.80\text{ 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 $93 unfavorable, and the rate variance is $87 favorable, then the efficiency variance must be $180 unfavorable, because the rate and efficiency variances taken together always equal the spending variance. Knowing that the efficiency variance is $180 unfavorable, one approach to the solution would be:

   Efficiency variance = SR (AH – SH)
   $9.00 per hour (AH – 125 hours*) = $180 U
   $9.00 per hour × AH – $1,125 = $180**
   $9.00 per hour × AH = $1,305
   AH = $1,305 ÷ $9.00 per hour
   AH = 145 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. Rate variance = AH (AR – SR)
   145 hours (AR – $9.00 per hour) = $87 F
   145 hours × AR – $1,305 = –$87*
   145 hours × AR = $1,218
   AR = $1,218 ÷ 145 hours
   AR = $8.40 per hour

   *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>145 hours × $8.40 per hour</td>
<td>145 hours × $9.00 per hour*</td>
<td>125 hours§ × $9.00 per hour*</td>
</tr>
<tr>
<td>= $1,218</td>
<td>= $1,305</td>
<td>= $1,125</td>
</tr>
</tbody>
</table>

Rate Variance, $87 F*

Efficiency Variance, $180 U

Spending Variance, $93 U*

§50 tune-ups* × 2.5 hours per tune-up* = 125 hours

*Given
**Exercise 10-6** (20 minutes)

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) |
   | 20,000 pounds × $2.35 per pound | 20,000 pounds × $2.50 per pound | 18,400 pounds* × $2.50 per pound |
   | = $47,000 | = $50,000 | = $46,000 |

   Price Variance, $3,000 F  
   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
**Exercise 10-6 (continued)**

2. **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>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>
</table>
| \[ 750 \text{ hours} \times 12.00 \text{ per hour} \] | \[ 800 \text{ hours}^* \times 12.00 \text{ per hour} \] | \[
| \[ = 9,000 \] | \[ = 9,600 \] | |

\[ \text{Rate Variance,} \quad \$1,425 \text{ U} \]
\[ \text{Efficiency Variance,} \quad \$600 \text{ F} \]

\[ \text{Spending Variance,} \quad \$825 \text{ U} \]

\[ ^*4,000 \text{ units} \times 0.2 \text{ hours per unit} = 800 \text{ hours} \]

Alternatively, the variances can be computed using the formulas:

- Labor rate variance = \[ AH (AR - SR) \]
  - 750 hours \[ (13.90 \text{ per hour}^* - 12.00 \text{ per hour}) = 1,425 \text{ U} \]
  - \[ *10,425 \div 750 \text{ hours} = 13.90 \text{ per hour} \]

- Labor efficiency variance = \[ SR (AH - SH) \]
  - \[ 12.00 \text{ per hour} (750 \text{ hours} - 800 \text{ hours}) = 600 \text{ F} \]
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 (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>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>

Price Variance, $3,000 F
14,750 pounds × $2.50 per pound = $36,875

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

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**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 × 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>25,000 microns × $0.48 per micron = $12,000</td>
<td>25,000 microns × $0.50 per micron = $12,500</td>
<td>18,000 microns* × $0.50 per micron = $9,000</td>
</tr>
</tbody>
</table>

\[ \text{Price Variance, $500 F} \]

\[ 20,000 \text{ microns} \times 0.50 \text{ per micron} = 10,000 \]

\[ \text{Quantity Variance, $1,000 U} \]

\*3,000 toys × 6 microns per toy = 18,000 microns

Alternatively, the variances can be computed using the formulas:

- Materials price variance = \( AQ (AP - SP) \)
  \[ 25,000 \text{ microns} (0.48 \text{ per micron} - 0.50 \text{ per micron}) = 500 \text{ F} \]

- Materials quantity variance = \( SP (AQ - SQ) \)
  \[ 0.50 \text{ per micron} (20,000 \text{ microns} - 18,000 \text{ microns}) = 1,000 \text{ U} \]
**Exercise 10-8 (continued)**

b. Direct labor variances:

<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>4,000 hours × $8.00 per hour</td>
<td>3,900 hours* × $8.00 per hour</td>
</tr>
<tr>
<td></td>
<td>= $32,000</td>
<td>= $31,200</td>
</tr>
<tr>
<td>$36,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate Variance, $4,000 U</td>
<td>Efficiency Variance, $800 U</td>
<td></td>
</tr>
<tr>
<td>Spending Variance, $4,800 U</td>
<td></td>
<td></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 (AR – SR)
  
  4,000 hours ($9.00 per hour* – $8.00 per hour) = $4,000 U
  
  *$36,000 ÷ 4,000 hours = $9.00 per hour

- Labor efficiency variance = SR (AH – SH)
  
  $8.00 per hour (4,000 hours – 3,900 hours) = $800 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 \times AP) | Actual Quantity of Input, at Standard Price (AQ \times SP) | Standard Quantity Allowed for Output, at Standard Price (SQ \times SP) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12,000 yards × $4.00 per yard*</td>
<td>11,200 yards** × $4.00 per yard*</td>
<td></td>
</tr>
<tr>
<td>$45,600</td>
<td>= $48,000</td>
<td>= $44,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price Variance, $2,400 F</th>
<th>Quantity Variance, $3,200 U</th>
<th>Spending Variance, $800 U</th>
</tr>
</thead>
</table>

* $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 \((12,000 \text{ yards} – 11,200 \text{ yards})\) = $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></td>
<td>2,800 hours × $6.00 per hour*</td>
<td>3,000 hours** × $6.00 per hour*</td>
</tr>
<tr>
<td></td>
<td>= $16,800</td>
<td>= $18,000</td>
</tr>
</tbody>
</table>

$18,200

\[\text{Rate Variance, } \$1,400 \text{ U} \]

\[\text{Efficiency Variance, } \$1,200 \text{ F} \]

\[\text{Spending Variance, } \$200 \text{ U} \]

* 2,850 standard hours ÷ 1,900 sets = 1.5 standard hours per set,
  $9.00 standard cost per set ÷ 1.5 standard hours per set =
  $6.00 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:

\[
\text{Labor rate variance} = \text{AH} \times (\text{AR} - \text{SR})
\]

2,800 hours ($6.50 per hour* – $6.00 per hour) = $1,400 U

\[\*\$18,200 \div 2,800 \text{ hours} = \$6.50 \text{ per hour} \]

\[
\text{Labor efficiency variance} = \text{SR} \times (\text{AH} - \text{SH})
\]

$6.00 per hour (2,800 hours – 3,000 hours) = $1,200 F

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Solutions Manual, Appendix 10A 21
### Problem 10-9 (continued)

3. **Actual Hours of Input, at the Actual Rate**
   \[ (AH \times AR) \]
   - 2,800 hours × $2.40 per hour$ \[ = $6,720 \]

   **Actual Hours of Input, at the Standard Rate**
   \[ (AH \times SR) \]
   - 2,800 hours × $2.40 per hour$ \[ = $6,720 \]

   **Standard Hours Allowed for Output, at the Standard Rate**
   \[ (SH \times SR) \]
   - 3,000 hours × $2.40 per hour$ \[ = $7,200 \]

   **Rate Variance,**
   $280 U

   **Efficiency Variance,**
   $480 F

   **Spending Variance,**
   $200 F

* $3.60 standard cost per set ÷ 1.5 standard hours per set
  = $2.40 standard rate per hour

Alternatively, the variances can be computed using the formulas:

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

  *$7,000 ÷ 2,800 \text{ hours} = $2.50 \text{ per hour}*

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

1. |                      | Standard Quantity or Hours | Standard Price or Rate | Standard Cost |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha6:</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>Direct materials—Y661</td>
<td>2.0 liters</td>
<td>$1.40 per liter</td>
<td>2.80</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>Total</td>
<td></td>
<td></td>
<td><strong>$28.42</strong></td>
</tr>
<tr>
<td>Zeta7:</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>Total</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.

<table>
<thead>
<tr>
<th>Standard Quantity Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material X442:</td>
</tr>
<tr>
<td>Production of Alpha (1.8 kilos per unit × 1,500 units)</td>
</tr>
<tr>
<td>Production of Zeta (3.0 kilos per unit × 2,000 units)</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Material Y661:</td>
</tr>
<tr>
<td>Production of Alpha (2.0 liters per unit × 1,500 units)</td>
</tr>
<tr>
<td>Production of Zeta (4.5 liters per unit × 2,000 units)</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Direct Materials Variances—Material X442:

- Materials quantity variance = SP (AQ – SQ)
  = $3.50 per kilo (8,500 kilos – 8,700 kilos)
  = $700 F

- Materials price variance = AQ (AP – SP)
  = $52,200 ÷ 14,500 kilos = $3.60 per kilo

Direct Materials Variances—Material Y661:

- Materials quantity variance = SP (AQ – SQ)
  = $1.40 per liter (13,000 liters – 12,000 liters)
  = $1,400 U

- Materials price variance = AQ (AP – SP)
  = $20,925 ÷ 15,500 liters = $1.35 per liter
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 ................................................................. 1,000 hours

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 ................................................................. 3,000 hours

Direct Labor Variances—Sintering:
Labor efficiency variance = SR (AH – SH)
= $19.80 per hour (1,200 hours – 1,000 hours)
= $3,960 U

Labor rate variance = AH (AR – SR)
= 1,200 hours ($22.50 per hour* – $19.80 per hour)
= $3,240 U
* $27,000 ÷ 1,200 hours = $22.50 per hour

Direct Labor Variances—Finishing:
Labor efficiency variance = SR (AH – SH)
= $19.20 per hour (2,850 hours – 3,000 hours)
= $2,880 F

Labor rate variance = AH (AR – SR)
= 2,850 hours ($21.00 per hour* – $19.20 per hour)
= $5,130 U
* $59,850 ÷ 2,850 hours = $21.00 per hour
**Problem 10-11** (45 minutes)

1. a. Materials quantity variance = \( SP \times (AQ - SQ) \)
   
   $5.00 \text{ per foot} (AQ - 9,600 \text{ feet}*) = $4,500 \text{ U}
   
   $5.00 \text{ per foot} \times AQ - $48,000 = $4,500**
   
   $5.00 \text{ per foot} \times AQ = $52,500
   
   \( AQ = 10,500 \text{ feet} \)
   
   * $3,200 units \times 3 \text{ foot per unit}
   ** When used with the formula, unfavorable variances are positive and favorable variances are negative.

   Therefore, $55,650 \div 10,500 \text{ feet} = $5.30 \text{ per foot}
   
   b. Materials price variance = \( AQ \times (AP - SP) \)
   
   10,500 feet ($5.30 \text{ per foot} - $5.00 \text{ per foot}) = $3,150 \text{ U}
   
   The total variance for materials is:
   
   Materials quantity variance ............... $4,500 \text{ U}
   Materials price variance ...................... $3,150 \text{ U}
   Total variance ................................ $7,650 \text{ 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>10,500 feet × $5.30 per foot = $55,650*</td>
<td>10,500 feet × $5.00 per foot* = $52,500</td>
<td>9,600 feet** × $5.00 per foot* = $48,000</td>
</tr>
<tr>
<td>** Price Variance, $3,150 U**</td>
<td>** Quantity Variance, $4,500 U**</td>
<td>** Spending Variance, $7,650 U**</td>
</tr>
</tbody>
</table>

   * Given
   ** 3,200 units \times 3 \text{ foot per unit} = 9,600 \text{ feet}
Problem 10-11 (continued)

2. a. Labor rate variance = AH (AR – SR)
   4,900 hours ($7.50 per hour* – SR) = $2,450 F**
   $36,750 – 4,900 hours × SR = −$2,450***
   4,900 hours × SR = $39,200
   SR = $8.00

   * $36,750 ÷ 4,900 hours
   ** $1,650 F + $800 U.
   *** When used with the formula, unfavorable variances are positive and favorable variances are negative.

b. Labor efficiency variance = SR (AH – SH)
   $8 per hour (4,900 hours – SH) = $800 U
   $39,200 – $8 per hour × SH = $800*
   $8 per hour × SH = $38,400
   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>$36,750*</td>
<td>4,900 hours* × $8.00 per hour = $39,200</td>
<td>4,800 hours × $8.00 per hour = $38,400</td>
</tr>
</tbody>
</table>

Rate Variance, $2,450 F
Efficiency Variance, $800 U*
Spending Variance, $1,650 F*

*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>Standard Quantity Allowed</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 allowed</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 × $2.50 per plate = $28,200</td>
<td>$10,500 plates × $2.50 per plate = $26,250</td>
<td>$8,400 plates × $2.50 per plate = $21,000</td>
</tr>
<tr>
<td><strong>Price Variance, $1,800 F</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantity Variance, $5,250 U</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Alternatively, the variances can be computed using the formulas:

- Materials price variance = AQ (AP – SP)
  \[12,000 \text{ plates} \times (\$2.35 \text{ per plate} – \$2.50 \text{ per plate}) = \$1,800 \text{ F}\]
  \*\$28,200 ÷ 12,000 plates = $2.35 per plate.

- Materials quantity variance = SP (AQ – SQ)
  \[\$2.50 \text{ per plate} \times (10,500 \text{ plates} – 8,400 \text{ plates}) = \$5,250 \text{ U}\]
Problem 10-12 (continued)

Note that all of the price variance is due to the hospital’s 6% quantity discount. Also note that the $5,250 quantity variance for the month is equal to 25% of the standard cost allowed for plates.

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

Blood tests: 0.3 hour per test $\times$ 1,800 tests $\quad$ 540 hours
Smears: 0.15 hour per test $\times$ 2,400 tests $\quad$ 360 hours
Total standard hours allowed $\quad$ 900 hours

The variance analysis would be:

<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>1,150 hours $\times$ $$14.00$ per hour $\quad$ $$13,800$</td>
<td>$\quad$ $$16,100$</td>
<td>$\quad$ $$12,600$</td>
</tr>
<tr>
<td>Rate Variance, $$2,300$ F</td>
<td>Efficiency Variance, $$3,500$ U</td>
<td>Spending Variance, $$1,200$ U</td>
</tr>
</tbody>
</table>

Alternatively, the variances can be computed using the formulas:

Labor rate variance $=$ AH (AR $-$ SR)
1,150 hours ($\$12.00$ per hour* $-$ $\$14.00$ per hour) $=$ $\$2,300$ F
*$\$13,800$ $\div$ 1,150 hours $=$ $\$12.00$ per hour

Labor efficiency variance $=$ SR (AH $-$ SH)
$\$14.00$ per hour (1,150 hours $-$ 900 hours) $=$ $\$3,500$ U
Problem 10-12 (continued)

b. The policy probably should not be continued. Although the hospital is saving $2 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>1,150 hours × $6.00 per hour = $6,900</td>
<td>900 hours × $6.00 per hour = $5,400</td>
<td></td>
</tr>
<tr>
<td>$7,820</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate Variance, $920 U</td>
<td>Efficiency Variance, $1,500 U</td>
<td></td>
</tr>
<tr>
<td>Spending Variance, $2,420 U</td>
<td></td>
<td></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 \times AP) )</th>
<th>Actual Quantity of Input, at Standard Price ( (AQ \times SP) )</th>
<th>Standard Quantity Allowed for Actual Output, at Standard Price ( (SQ \times SP) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>21,600 feet** × $3.30 per foot</td>
<td>21,600 feet** × $3.00 per foot</td>
<td>21,600 feet* × $3.00 per foot</td>
</tr>
<tr>
<td>= $71,280</td>
<td>= $64,800</td>
<td>= $64,800</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 = \( AQ \times (AP - SP) \)
= 21,600 feet ($3.30 per foot − $3.00 per foot)
= $6,480 U

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

**Labor rate variance** = $5,520 F  
**Labor efficiency variance** = $4,320 U  
**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>

<table>
<thead>
<tr>
<th>Variable overhead rate variance = $5,520 F</th>
<th>Variable overhead efficiency variance = $1,200 U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spending variance = $4,320 F</td>
<td></td>
</tr>
</tbody>
</table>

* 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:

<table>
<thead>
<tr>
<th>Price variance ($6,480 ÷ 12,000 units)</th>
<th>$0.54 U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity variance ($0 ÷ 12,000 units)</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Labor:

<table>
<thead>
<tr>
<th>Rate variance ($5,520 ÷ 12,000 units)</th>
<th>0.46 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency variance ($4,320 ÷ 12,000 units)</td>
<td>0.36 U</td>
</tr>
</tbody>
</table>

Variable overhead:

<table>
<thead>
<tr>
<th>Rate variance ($5,520 ÷ 12,000 units)</th>
<th>0.46 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency variance ($1,200 ÷ 12,000 units)</td>
<td>0.36 F</td>
</tr>
</tbody>
</table>

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.

   Excess of actual over standard cost per unit ...... $0.08 U
   Less portion attributable to labor inefficiency:
   Labor efficiency variance ................................ 0.36 U
   Variable overhead efficiency variance ............. 0.10 U 0.46 U
   Portion due to other variances ......................... $0.38 F

   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 (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>Actual Quantity of Input, at Standard Price (AQ × SP)</td>
<td>12,000 ounces × $20.00 per ounce = $240,000</td>
<td>9,375 ounces* × $20.00 per ounce = $187,500</td>
</tr>
<tr>
<td>$225,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price Variance, $15,000 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9,500 ounces × $20.00 per ounce = $190,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity Variance, $2,500 U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*3,750 units × 2.5 ounces per unit = 9,375 ounces

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
12,000 ounces ($18.75 per ounce* – $20.00 per ounce) = $15,000 F

*$225,000 ÷ 12,000 ounces = $18.75 per ounce

Materials quantity variance = SP (AQ – SQ)
$20.00 per ounce (9,500 ounces – 9,375 ounces) = $2,500 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* × $12.00 per hour = $67,200</td>
<td>5,600 hours × $12.50 per hour = $70,000</td>
<td>5,250 hours** × $12.50 per hour = $65,625</td>
</tr>
<tr>
<td>Rate Variance, $2,800 F</td>
<td>Efficiency Variance, $4,375 U</td>
<td></td>
</tr>
<tr>
<td>Spending Variance, $1,575 U</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 hrs

Alternatively, the variances can be computed using the formulas:

- Labor rate variance = AH (AR – SR)  
  5,600 hours ($12.00 per hour – $12.50 per hour) = $2,800 F  
- Labor efficiency variance = SR (AH – SH)  
  $12.50 per hour (5,600 hours – 5,250 hours) = $4,375 U

b. No, the new labor mix probably should not be continued. Although it decreases the average hourly labor cost from $12.50 to $12.00, 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**  
   \( (AH \times AR) \)  

<table>
<thead>
<tr>
<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>5,600 hours** × $3.50 per hour</td>
<td>5,250 hours** × $3.50 per hour</td>
<td></td>
</tr>
<tr>
<td>= $19,600</td>
<td>= $18,375</td>
<td></td>
</tr>
</tbody>
</table>

\[
\begin{array}{ccc}
\text{Rate Variance,} & \text{Efficiency Variance,} & \text{Spending Variance,} \\
\text{$1,400 \, F$} & \text{$1,225 \, U$} & \text{$175 \, F$}
\end{array}
\]

* 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 hours \((3.25 \text{ per hour}^* – 3.50 \text{ per hour}) = 1,400 \, F\)  
  
  \(*\$18,200 \div 5,600 \text{ hours} = 3.25 \text{ per hour}\)

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

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 × $1.95 per pound</td>
<td>60,000 pounds × $2.00 per pound</td>
<td>45,000 pounds* × $2.00 per pound</td>
</tr>
<tr>
<td>= $117,000</td>
<td>= $120,000</td>
<td>= $90,000</td>
</tr>
</tbody>
</table>

Price Variance, $3,000 F
49,200 pounds × $2.00 per pound = $98,400

Quantity Variance, $8,400 U

*15,000 pools × 3.0 pounds per pool = 45,000 pounds

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
60,000 pounds ($1.95 per pound – $2.00 per pound) = $3,000 F

Materials quantity variance = SP (AQ – SQ)
$2.00 per pound (49,200 pounds – 45,000 pounds) = $8,400 U
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 × $7.00 per hour = $82,600</td>
<td>11,800 hours × $6.00 per hour = $70,800</td>
<td>12,000 hours* × $6.00 per hour = $72,000</td>
</tr>
</tbody>
</table>

| Rate Variance, $11,800 U | Efficiency Variance, $1,200 F | Spending Variance, $10,600 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 ($7.00 per hour – $6.00 per hour) = $11,800 U

Labor efficiency variance = SR (AH – SH)
$6.00 per hour (11,800 hours – 12,000 hours) = $1,200 F
**Problem 10-15** (continued)

**c.**

<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>$18,290</td>
<td>5,900 hours ( \times ) $3.00 per hour = $17,700</td>
<td>6,000 hours* ( \times ) $3.00 per hour = $18,000</td>
</tr>
</tbody>
</table>

Rate Variance, $590 U
Efficiency Variance, $300 F
Spending Variance, $290 U

*15,000 pools \( \times \) 0.4 hours per pool = 6,000 hours

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH \( (\text{AR} – \text{SR}) \)
5,900 hours \( ($3.10 \text{ per hour}* – $3.00 \text{ per hour}) \) = $590 U

*\$18,290 \( \div \) 5,900 hours = $3.10 per hour

Variable overhead efficiency variance = SR \( (\text{AH} – \text{SH}) \)
$3.00 per hour \( (5,900 \text{ hours} – 6,000 \text{ hours}) \) = $300 F
Problem 10-15 (continued)

2. Summary of variances:

<table>
<thead>
<tr>
<th>Variance</th>
<th>Amount</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material price variance</td>
<td>$3,000</td>
<td>F</td>
</tr>
<tr>
<td>Material quantity variance</td>
<td>8,400</td>
<td>U</td>
</tr>
<tr>
<td>Labor rate variance</td>
<td>11,800</td>
<td>U</td>
</tr>
<tr>
<td>Labor efficiency variance</td>
<td>1,200</td>
<td>F</td>
</tr>
<tr>
<td>Variable overhead rate variance</td>
<td>590</td>
<td>U</td>
</tr>
<tr>
<td>Variable overhead efficiency variance</td>
<td>300</td>
<td>F</td>
</tr>
<tr>
<td>Net variance</td>
<td>$16,290</td>
<td>U</td>
</tr>
</tbody>
</table>

The net unfavorable variance of $16,290 for the month caused the plant’s variable cost of goods sold to increase from the budgeted level of $180,000 to $196,290:

- Budgeted cost of goods sold at $12 per pool ....... $180,000
- Add the net unfavorable variance, as above ........ 16,290
- Actual cost of goods sold ........................... $196,290

This $16,290 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 ....................... $36,000
- Deduct the net unfavorable variance added to cost of goods sold for the month ....................... 16,290
- Net operating income ................................. $19,710

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 ............................................................... 10,500
   - Variable manufacturing overhead ................................ 4,200
   - Total standard cost (a) .............................................. $31,500
   - Number of backpacks produced (b) ............................ 1,000
   - Standard cost of a single backpack (a) ÷ (b) .................. $31.50

2. Standard cost of a single backpack (above) ........................ $31.50
   - Deduct difference between standard and actual cost .......... 0.15
   - Actual cost per backpack ............................................ $31.35

3. Total standard cost of materials allowed 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 backpack = $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
   - Total variance .................................................. $ 1,800 F

   The price and quantity variances together equal the total variance. If
   the quantity variance is $1,200 U, then the price variance must be
   $3,000 F:
   - Price variance .............................................. $ 3,000 F
   - Quantity variance ........................................... 1,200 U
   - Total variance .................................................. $ 1,800 F
Alternative Solution:

<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>3,000 yards ( \times ) $5.00 per yard = $15,000*</td>
<td>3,000 yards ( \times ) $6.00 per yard* = $18,000</td>
<td>2,800 yards** ( \times ) $6.00 per yard* = $16,800*</td>
</tr>
</tbody>
</table>

\[ \begin{align*}
\text{Price Variance,} & \quad $3,000 \ F \\
\text{Quantity Variance,} & \quad $1,200 \ U^* \\
\text{Spending Variance,} & \quad $1,800 \ F
\end{align*} \]

* Given.
** 1,000 units \( \times \) 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) \( \div \) (b) \( = 1,400 \)

\[
\begin{align*}
\text{Total standard direct labor cost for March} & \quad = \frac{\$10,500}{1,400 \text{ DLHs}} \\
& \quad = \$7.50 \text{ per DLH}
\end{align*}
\]
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 (part 2)</td>
<td>$ 31.35</td>
</tr>
<tr>
<td>Number of backpacks produced</td>
<td>× 1,000</td>
</tr>
<tr>
<td>Total actual cost of production</td>
<td>$31,350</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>$12,750</td>
</tr>
</tbody>
</table>

With this information, the variances can be computed:

<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>$12,750</td>
<td>$12,750</td>
<td>$10,500*</td>
</tr>
<tr>
<td>$12,750</td>
<td>$11,250</td>
<td></td>
</tr>
</tbody>
</table>

- Rate Variance, $1,500 U
- Efficiency Variance, $750 U
- Spending Variance, $2,250 U

*Given.
Problem 10-16 (continued)

7. 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

   \[
   \begin{array}{ccc}
   \text{AH} & \times & \text{AR} \\
   \text{AH} & \times & \text{SR} \\
   \text{SH} & \times & \text{SR} \\
   \end{array}
   \]

   \[
   \begin{array}{c}
   1,500 \text{ hours} \times \\
   \$3.00 \text{ per hour} \\
   \$4,500 \\
   \end{array}
   \]

   Rate Variance, $900 F

   Efficiency Variance, $300 U

   Spending Variance, $600 F

   *Given.

8. 

   \[
   \begin{array}{ccc}
   \text{Standard Quantity or Hours} & \text{Standard Price or Rate} & \text{Standard Cost} \\
   \text{Direct materials} & 2.8 \text{ yards} & \$6 \text{ per yard} & \$16.80 \\
   \text{Direct labor} & 1.4 \text{ hours} & \$7.50 \text{ per hour} & 10.50 \\
   \text{Variable manufacturing overhead} & 1.4 \text{ hours} & \$3 \text{ per hour} & 4.20 \\
   \end{array}
   \]

   Total standard cost ........... $31.50

   \[
   \begin{array}{c}
   = \$305,550 \\
   = \$291,000 \\
   = \$270,000 \\
   \end{array}
   \]

   Rate Variance, $14,550 U

   Efficiency Variance, $21,000 U

   Spending Variance, $35,550 U

   * 22,500 units \times 0.8 \text{ DLHs per unit} = 18,000 \text{ DLHs}

   ** $291,000 \div \$15 \text{ per DLH} = 19,400 \text{ DLHs}

   *** $305,550 \div 19,400 \text{ DLHs} = \$15.75 \text{ per DLH}
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 = Actual fixed overhead - Budgeted fixed overhead
   = $254,000 - $250,000
   = $4,000 U

Volume variance = Fixed portion of the predetermined overhead rate \times \frac{\text{Denominator hours} - \text{Standard hours allowed}}{\text{Denominator level of activity}}
   = $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 = \[
\frac{$3 \text{ per MH} \times 60,000 \text{ MHs} + $300,000}{60,000 \text{ MHs}}
\]
   = $480,000
   = $8 per MH

   Variable portion of the predetermined overhead rate = \[
\frac{$3 \text{ per MH} \times 60,000 \text{ MHs}}{60,000 \text{ MHs}}
\]
   = $180,000
   = $3 per MH

   Fixed portion of the predetermined overhead rate = \[
\frac{$300,000}{60,000 \text{ MHs}}
\]
   = $5 per MH

2. The standard hours per unit of product are:
   60,000 hours ÷ 40,000 units = 1.5 hours per unit
   Given this figure, the standard hours allowed for the actual production would be:
   42,000 units × 1.5 hours per unit = 63,000 standard hours allowed.
Exercise 10A-2 (continued)

3. Variable overhead rate variance:
   Variable overhead rate variance = (AH × AR) – (AH × SR)
   ($185,600) – (64,000 hours × $3 per hour) = $6,400 F

Variable overhead efficiency variance:
   Variable overhead efficiency variance = SR (AH − SH)
   $3 per hour (64,000 hours – 63,000 hours) = $3,000 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 hours × $5 per hour = $315,000</td>
</tr>
</tbody>
</table>

↑ Budget Variance, $2,400 U
↑ Volume Variance, $15,000 F

*As originally budgeted.

Alternative approach to the budget variance:

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

\[
= $302,400 - $300,000
\]

\[
= $2,400 U
\]

Alternative approach to the volume variance:

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

\[
= $5 \text{ per hour} \times (60,000 \text{ hours} - 63,000 \text{ hours})
\]

\[
= $15,000 F
\]
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 \times 40,000 DLHs) ........................................ 80,000
   Total overhead cost at the denominator level of activity .. $330,000

   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 \text{ per DLH}
   Overhead applied (a) \times (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. \(9,500 \text{ units} \times 4 \text{ hours per unit} = 38,000 \text{ hours.}\)

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 \text{ hours} \times $5 \text{ per hour}^*)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= $190,000</td>
</tr>
</tbody>
</table>

\[\text{Budget Variance, } \$1,300 \text{ F} \]
\[\text{Volume Variance, } \$10,000 \text{ U}^*\]

*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: \(\$200,000 \div \$5 \text{ per hour} = 40,000 \text{ hours.}\)
**Exercise 10A-6** (15 minutes)

1. **Predetermined overhead rate**
   
   \[
   \text{Predetermined overhead rate} = \frac{\text{Total overhead at the denominator activity}}{\text{Denominator activity}}
   \]
   
   $1.90 \text{ per DLH} \times 30,000 \text{ per DLH} + $168,000
   
   \[
   = \frac{\$225,000}{30,000 \text{ DLHs}}
   \]
   
   $7.50 \text{ per DLH}

   **Variable element:**
   
   \[
   \frac{(1.90 \text{ per DLH} \times 30,000 \text{ DLHs})}{30,000 \text{ DLHs}} = $57,000
   \]

   **Fixed element:**
   
   \[
   \frac{168,000}{30,000 \text{ DLHs}} = $5.60 \text{ per DLH}
   \]

2. **Direct materials, 2.5 yards × $8.60 per yard**
   
   $21.50

   **Direct labor, 3 DLHs × $12.00 per DLH**
   
   $36.00

   **Variable manufacturing overhead, 3 DLHs × $1.90 per DLH**
   
   $5.70

   **Fixed manufacturing overhead, 3 DLHs × $5.60 per DLH**
   
   $16.80

   **Total standard cost per unit**
   
   $80.00

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

1. 14,000 units produced \(\times\) 3 MHs per unit = 42,000 MHs

2. Actual fixed overhead incurred \(\ldots\) $267,000
   
   Add: Favorable budget variance \(\ldots\) 3,000
   
   Budgeted fixed overhead cost \(\ldots\) $270,000
   
   Fixed element of the predetermined overhead rate = \(\frac{\text{Budgeted fixed overhead cost}}{\text{Denominator activity}}\)
   
   \[= \frac{270,000}{45,000 \text{ MHs}}\]
   
   = $6 per MH

3. Volume Variance = \(\frac{\text{Fixed portion of the predetermined overhead rate}}{\text{Denominator hours} - \text{Standard hours allowed}}\)

   \[= \frac{6 \text{ per MH}}{45,000 \text{ MHs} - 42,000 \text{ MHs}}\]
   
   = $18,000 U

Alternative solution to parts 1-3:

\[
\begin{array}{ccc}
\text{Actual Fixed Overhead} & \text{Budgeted Fixed Overhead} & \text{Fixed Overhead Applied to Work in Process} \\
$267,000^* & $270,000^1 & 42,000 \text{ MHs}^2 \times \frac{6 \text{ per MH}^3}{45,000 \text{ MHs}} = $252,000 \\
\end{array}
\]

\[\uparrow \quad \text{Budget Variance, }$3,000 F^*\]

\[\uparrow \quad \text{Volume Variance,}$18,000 U\]

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

\[^214,000 \text{ units} \times 3 \text{ MHs per unit} = 42,000 \text{ MHs}\]

\[^3$270,000 \div 45,000 \text{ denominator MHs} = $6 \text{ per MH}\]

\[^*\text{Given.}\]
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 |
      | Actual costs 606,500 | Applied costs 630,000 * |
      | Overapplied overhead 23,500 |

   *63,000 standard DLHs \( \times \) $10 per DLH = $630,000.

4. Variable overhead variances:

   \[
   \begin{align*}
   \text{Actual Hours of Input, at the Actual Rate} & = 65,000 \text{ DLHs} \\
   & \times \$2 \text{ per DLH} \\
   & = \$130,000 \\
   \text{Actual Hours of Input, at the Standard Rate} & = \text{Standard Hours Allowed for Output, at the Standard Rate} \\
   & = 63,000 \text{ DLHs} \\
   & \times \$2 \text{ per DLH} \\
   & = \$126,000 \\
   \text{Rate Variance} & = \$6,500 \text{ F} \\
   \text{Efficiency Variance} & = \$4,000 \text{ U}
   \end{align*}
   \]
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:

$$
\begin{array}{|c|c|c|}
\hline
\text{Actual Fixed Overhead} & \text{Budgeted Fixed Overhead} & \text{Fixed Overhead Applied to Work in Process} \\
\hline
$483,000 & $480,000* & 63,000 DLHs × $8 per DLH \\
\hline
\hline
\text{Budget Variance}, \$3,000 U & \text{Volume Variance}, \$24,000 F & \\
\hline
\end{array}
$$

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

Alternative solution:

Budget variance:

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

$$
= $483,000 - $480,000
$$

= $3,000 U

Volume variance:

$$
\text{Volume Variance} = \text{Fixed portion of the predetermined overhead rate} \left( \text{Denominator hours} - \text{Standard hours allowed} \right)
$$

$$
= $8 per DLH × (60,000 DLHs - 63,000 DLHs)
$$

= $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 part 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:

<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>$78,000</td>
<td>30,000 hours ( \times ) $2.50 per hour = $75,000</td>
<td>32,000 hours ( \times ) $2.50 per hour = $80,000</td>
</tr>
</tbody>
</table>

\[ \uparrow \text{Rate Variance, } $3,000 \text{ U} \]

\[ \uparrow \text{Efficiency Variance, } $5,000 \text{ F} \]

Alternative solution:

Variable overhead rate variance = \((AH \times AR) – (AH \times SR)\)
\($78,000) – (30,000 \text{ hours} \times $2.50 \text{ per hour}) = $3,000 \text{ U} \)

Variable overhead efficiency variance = \(SR (AH – SH)\)
$2.50 \text{ per hour} (30,000 \text{ hours} – 32,000 \text{ hours}) = $5,000 \text{ 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>$209,400</td>
<td>$210,000</td>
<td>32,000 hours × $6 per hour = $192,000</td>
</tr>
</tbody>
</table>

$209,400 - $210,000 = $600 F

Volume Variance:

Volume Variance = \( \frac{\text{Fixed portion of the predetermined overhead rate}}{\text{Denominator hours - Standard hours allowed}} \times \) $6 per hour (35,000 hours - 32,000 hours)

= $18,000 U

Verification:

Variable overhead rate variance ........ $ 3,000 U
Variable overhead efficiency variance 5,000 F
Fixed overhead budget variance ......... $ 600 F
Fixed overhead volume variance ........ $18,000 U
Underapplied overhead .................. $15,400 U
Problem 10A-9 (continued)

4. Variable overhead

Rate variance: This variance includes both price and quantity elements. The overhead spending variance reflects differences between actual and standard prices for variable overhead items. It also reflects differences between the amounts of variable overhead inputs that were actually used and the amounts that should have been used for the actual output of the period. Because the variable overhead spending variance is unfavorable, either too much was paid for variable overhead items or too many of them were used.

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

2. Direct labor rate and efficiency variances:
   - Labor rate variance = AH (AR – SR)
     43,500 DLHs ($15.80 per DLH – $16.00 per DLH) = $8,700 F
   - Labor efficiency variance = SR (AH – SH)
     $16.00 per DLH (43,500 DLHs – 42,000 DLHs*) = $24,000 U
     *30,000 units × 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 × 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>$108,000</td>
<td>43,500 DLHs × $2.50 per DLH = $108,750</td>
<td>42,000 DLHs × $2.50 per DLH = $105,000</td>
</tr>
</tbody>
</table>

   Rate Variance, $750 F  
   Efficiency Variance, $3,750 U

   Alternative solution:
   - Variable overhead rate variance = (AH × AR) – (AH × SR)
     ($108,000) – (43,500 DLHs × $2.50 per DLH) = $750 F
   - Variable overhead efficiency variance = SR (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>42,000 DLHs × $6 per DLH = $252,000</td>
</tr>
</tbody>
</table>

Budget Variance, $1,800 U

Volume Variance, $42,000 F

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

Alternative solution:

**Budget variance:**

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

\[
= $211,800 - $210,000
\]

\[
= $1,800 \text{ U}
\]

**Volume variance:**

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

\[
= $6.00 \text{ per DLH} \times (35,000 \text{ DLHs} - 42,000 \text{ DLHs})
\]

\[
= $42,000 \text{ F}
\]
Problem 10A-10 (continued)

4. The total of the variances would be:

   Direct materials variances:
   
    | Price variance | $6,400 U |
    |-----------------|----------|
    | Quantity variance | 33,800 U |

   Direct labor variances:
   
    | Rate variance | 8,700 F |
    |-----------------|----------|
    | Efficiency variance | 24,000 U |

   Variable manufacturing overhead variances:
   
    | Rate variance | 750 F |
    |-----------------|----------|
    | Efficiency variance | 3,750 U |

   Fixed manufacturing overhead variances:

    | Budget variance | 1,800 U |
    |-----------------|----------|
    | Volume variance | 42,000 F |

   Total of variances | $18,300 U |

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
3. Variable overhead variances:

<table>
<thead>
<tr>
<th></th>
<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></td>
<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>
<tr>
<td>Rate Variance,</td>
<td>$580 U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency Variance,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spending Variance,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$580 U</td>
<td>$1,000 F</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative solution for the variable overhead variances:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable overhead rate variance = (AH × AR) – (AH × SR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($29,580) – (5,800 DLHs × $5.00 per DLH) = $580 U</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable overhead efficiency variance = SR (AH – SH)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$5.00 per DLH (5,800 DLHs – 6,000 DLHs) = $1,000 F</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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>
<tr>
<td>Budget Variance,</td>
<td>Volume Variance,</td>
<td></td>
</tr>
<tr>
<td>$1,400 U</td>
<td>$11,800 F</td>
<td></td>
</tr>
</tbody>
</table>
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:

\[
\text{Volume variance} = \left( \frac{\text{Fixed portion of the predetermined overhead rate}}{\text{Denominator hours}} - \frac{\text{Standard hours allowed}}{\text{Standard hours allowed}} \right) = \$11.80 \text{ per DLH} \times (5,000 \text{ DLHs} - 6,000 \text{ DLHs}) = \$11,800 \text{ F}
\]

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>Per Direct Labor-Hour</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>
</tbody>
</table>

Denominator of 40,000 DLHs:

<table>
<thead>
<tr>
<th></th>
<th>Variable</th>
<th>Fixed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<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</td>
</tr>
<tr>
<td>Direct labor, 2 DLHs × $15 per DLH</td>
<td>30.00 Same</td>
</tr>
<tr>
<td>Variable overhead, 2 DLHs × $4.50 per DLH</td>
<td>9.00 Same</td>
</tr>
<tr>
<td>Fixed overhead, 2 DLHs × $9.00 per DLH</td>
<td>18.00 × $6.75 per DLH</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>Applied costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>446,400</td>
<td>486,000 *</td>
</tr>
<tr>
<td>Overapplied overhead</td>
<td>39,600</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>

| Rate Variance, $3,800 U                           | Efficiency Variance, $9,000 U                         |

Alternative solution:
Variable overhead rate variance = \( (AH \times AR) - (AH \times SR) \)
\( ($174,800) - (38,000 \text{ DLHs} \times $4.50 \text{ per DLH}) = $3,800 \text{ U} \)

Variable overhead efficiency variance = \( SR \times (AH - SH) \)
\( $4.50 \text{ per DLH} \times (38,000 \text{ DLHs} - 36,000 \text{ DLHs}) = $9,000 \text{ U} \)

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>$271,600</td>
<td>$270,000*</td>
<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:

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

\[
= $9.00 \text{ per DLH} \times (30,000 \text{ DLHs} - 36,000 \text{ DLHs}) \\
= $54,000 \text{ F}
\]

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 11B
Journal Entries to Record Variances

Exercise 10B-1 (20 minutes)

1. The general ledger entry to record the purchase of materials for the month is:

   Raw Materials
   (12,000 meters at $3.25 per meter) 39,000
   Materials Price Variance
   (12,000 meters at $0.10 per meter F) 1,200
   Accounts Payable
   (12,000 meters at $3.15 per meter) 37,800

2. The general ledger entry to record the use of materials for the month is:

   Work in Process
   (10,000 meters at $3.25 per meter) 32,500
   Materials Quantity Variance
   (500 meters at $3.25 per meter U) 1,625
   Raw Materials
   (10,500 meters at $3.25 per meter) 34,125

3. The general ledger entry to record the incurrence of direct labor cost for the month is:

   Work in Process (2,000 hours at $12.00 per hour) 24,000
   Labor Rate Variance
   (1,975 hours at $0.20 per hour U) 395
   Labor Efficiency Variance
   (25 hours at $12.00 per hour F) 300
   Wages Payable
   (1,975 hours at $12.20 per hour) 24,095
### Exercise 10B-2 (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>10,000 yards × $13.80 per yard</td>
<td>10,000 yards × $14.00 per yard</td>
<td>7,500 yards* × $14.00 per yard</td>
</tr>
<tr>
<td>= $138,000</td>
<td>= $140,000</td>
<td>= $105,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*3,000 units × 2.5 yards per unit = 7,500 yards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Price Variance, $2,000 F

8,000 yards × $14.00 per yard

= $112,000

Quantity Variance, $7,000 U

*Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
10,000 yards ($13.80 per yard – $14.00 per yard) = $2,000 F

Materials quantity variance = SP (AQ – SQ)
$14.00 per yard (8,000 yards – 7,500 yards) = $7,000 U
Exercise 10B-2 (continued)

b. The journal entries would be:

Raw Materials
(10,000 yards × 14.00 per yard) ................. 140,000
Materials Price Variance
(10,000 yards × $0.20 per yard F) ...... 2,000
Accounts Payable
(10,000 yards × $13.80 per yard) ...... 138,000

Work in Process
(7,500 yards × $14.00 per yard) ................. 105,000
Materials Quantity Variance
(500 yards U × $14.00 per yard) ................. 7,000
Raw Materials
(8,000 yards × $14.00 per yard) .......... 112,000

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>5,000 hours × $8.00 per hour = $40,000</td>
<td>4,800 hours* × $8.00 per hour = $38,400</td>
<td></td>
</tr>
</tbody>
</table>

Rate Variance, $3,000 U
Efficiency Variance, $1,600 U
Spending Variance, $4,600 U

*3,000 units × 1.6 hours per unit = 4,800 hours
Exercise 10B-2 (continued)

Alternative Solution:

Labor rate variance = AH (AR – SR)
5,000 hours ($8.60 per hour* – $8.00 per hour) = $3,000 U
* $43,000 ÷ 5,000 hours = $8.60 per hour

Labor efficiency variance = SR (AH – SH)
$8.00 per hour (5,000 hours – 4,800 hours) = $1,600 U

b. The journal entry would be:

Work in Process
(4,800 hours × $8.00 per hour) .................. 38,400
Labor Rate Variance
(5,000 hours × $0.60 per hour U) ................ 3,000
Labor Efficiency Variance
(200 hours U × $8.00 per hour) ................... 1,600
Wages Payable
(5,000 hours × $8.60 per hour) ............. 43,000

3. The entries are: entry (a), purchase of materials; entry (b), issue of materials to production; and entry (c), incurrence of direct labor cost.

<table>
<thead>
<tr>
<th>Raw Materials</th>
<th>Work in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 140,000</td>
<td>(b) 112,000</td>
</tr>
<tr>
<td>Bal.* 28,000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accounts Payable</th>
<th>Wages Payable</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 138,000</td>
<td>(c) 43,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Materials Price Variance</th>
<th>Materials Quantity Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 2,000</td>
<td>(b) 7,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labor Rate Variance</th>
<th>Labor Efficiency Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c) 3,000</td>
<td>(c) 1,600</td>
</tr>
</tbody>
</table>

*2,000 yards of material at a standard cost of $14.00 per yard
**Problem 10B-3** (60 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>32,000 feet × $4.80 per foot = $153,600</td>
<td>32,000 feet × $5.00 per foot = $160,000</td>
<td>29,600 feet* × $5.00 per foot = $148,000</td>
</tr>
</tbody>
</table>

| Price Variance, $6,400 F | Quantity Variance, $12,000 U | Spending Variance, $5,600 U |

*8,000 footballs × 3.7 ft. per football = 29,600 feet

Alternatively, the variances can be computed using the formulas:

- **Materials price variance** = \( AQ \times (AP - SP) \)
  
  \[
  32,000 \text{ feet } (4.80 \text{ per foot } - 5.00 \text{ per foot}) = 6,400 \text{ F}
  \]

- **Materials quantity variance** = \( SP \times (AQ - SQ) \)
  
  \[
  5.00 \text{ per foot } (32,000 \text{ feet } - 29,600 \text{ feet}) = 12,000 \text{ U}
  \]

b. Raw Materials (32,000 feet × $5.00 per foot)...
   
   Materials Price Variance
   
   \( (32,000 \text{ feet } \times 0.20 \text{ per foot} \text{ F}) \)
   
   Accounts Payable
   
   \( (32,000 \text{ feet } \times 4.80 \text{ per foot}) \)

   Work in Process
   
   \( (29,600 \text{ feet } \times 5.00 \text{ per foot}) \)

<table>
<thead>
<tr>
<th>Accounts Payable</th>
<th>6,400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials</td>
<td>153,600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work in Process</th>
<th>148,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials</td>
<td>160,000</td>
</tr>
</tbody>
</table>

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Managerial Accounting, 15th Edition
**Problem 10B-3 (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>6,400 hours* × $8.00 per hour = $51,200</td>
<td>6,400 hours × $7.50 per hour = $48,000</td>
<td>7,200 hours** × $7.50 per hour = $54,000</td>
</tr>
<tr>
<td><strong>Rate Variance, $3,200 U</strong></td>
<td><strong>Efficiency Variance, $6,000 F</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Spending Variance, $2,800 F</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 8,000 footballs × 0.8 hours per football = 6,400 hours  
** 8,000 footballs × 0.9 hours per football = 7,200 hours

Alternatively, the variances can be computed using the formulas:

- **Labor rate variance** = AH (AR – SR)  
  6,400 hours ($8.00 per hour – $7.50 per hour) = $3,200 U

- **Labor efficiency variance** = SR (AH – SH)  
  $7.50 per hour (6,400 hours – 7,200 hours) = $6,000 F

b. Work in Process (7,200 hours × $7.50 per hour) .  54,000  
Labor Rate Variance  
(6,400 hours × $0.50 per hour U) .......................  3,200  
Labor Efficiency Variance  
(800 hours F × $7.50 per hour) ......................  6,000  
Wages Payable  
(6,400 hours × $8.00 per hour) ....................  51,200
### Problem 10B-3 (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></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6,400 hours \times $2.75 per hour</td>
<td>6,400 hours \times $2.50 per hour</td>
<td>7,200 hours \times $2.50 per hour</td>
</tr>
<tr>
<td>= $17,600</td>
<td>= $16,000</td>
<td>= $18,000</td>
</tr>
</tbody>
</table>

Rate Variance, $1,600 U

Efficiency Variance, $2,000 F

Spending Variance, $400 F

Alternatively, the variances can be computed using the formulas:

- Variable overhead rate variance = \(AH \times (AR - SR)\)
  - \(6,400 \text{ hours} \times ($2.75 \text{ per hour} - $2.50 \text{ per hour}) = $1,600 \text{ U}\)

- Variable overhead efficiency variance = \(SR \times (AH - SH)\)
  - \$2.50 \text{ per hour} \times (6,400 \text{ hours} - 7,200 \text{ hours}) = $2,000 \text{ F}\)

4. No. He is not correct in his statement. The company has a large, unfavorable materials quantity variance that should be investigated. Also, the overhead rate variance equals 10% of standard, which should also be investigated.

It appears that the company’s strategy to increase output by giving raises was effective. Although the raises resulted in an unfavorable rate variance, this variance was more than offset by a large, favorable efficiency variance.
Problem 10B-3 (continued)

5. The variances have many possible causes. Some of the more likely causes include the following:

*Materials variances:*

Favorable price variance: Good price, inferior quality materials, unusual discount due to quantity purchased, drop in market price, less costly method of freight, outdated or inaccurate standards.

Unfavorable quantity variance: Carelessness, poorly adjusted machines, unskilled workers, inferior quality materials, outdated or inaccurate standards.

*Labor variances:*

Unfavorable rate variance: Use of highly skilled workers, change in pay scale, overtime, outdated or inaccurate standards.

Favorable efficiency variance: Use of highly skilled workers, high-quality materials, new equipment, outdated or inaccurate standards.

*Variable overhead variances:*

Unfavorable rate variance: Increase in costs, waste, theft, spillage, purchases in uneconomical lots, outdated, or inaccurate standards.

Favorable efficiency variance: Same as for labor efficiency variance.
**Problem 10B-4** (75 minutes)

1. a. Before the variances can be computed, we must first compute the standard and actual quantities of material per hockey stick. The computations are:

   Direct materials added to work in process (a) $115,200
   Standard direct materials cost per foot (b) $3.00
   Standard quantity of direct materials (a) ÷ (b) 38,400 feet

   Number of sticks produced (b) 8,000
   Standard quantity per stick (a) ÷ (b) 4.8 feet

   Actual quantity of direct materials used per stick last year:
   4.8 feet + 0.2 feet = 5.0 feet.

With these figures, the variances 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 Output, at Standard Price (SQ × SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$174,000</td>
<td>60,000 feet × $3.00 per foot = $180,000</td>
<td>38,400 feet × $3.00 per foot = $115,200</td>
</tr>
</tbody>
</table>

  Price Variance, $6,000 F

  Quantity Variance, $4,800 U

  *8,000 units × 5.0 feet per unit = 40,000 feet
Problem 10B-4 (continued)

Alternatively, the variances can be computed using the formulas:

Materials price variance = AQ (AP – SP)
60,000 feet ($2.90 per foot* – $3.00 per foot) = $6,000 F

* $174,000 ÷ 60,000 feet = $2.90 per foot

Materials quantity variance = SP (AQ – SQ)
$3.00 per foot (40,000 feet – 38,400 feet) = $4,800 U

b. Raw Materials (60,000 feet × $3.00 per foot) ..... 180,000
   Materials Price Variance
   (60,000 feet × $0.10 per foot F) ............ 6,000
   Accounts Payable
   (60,000 feet × $2.90 per foot) ............... 174,000

Work in Process (38,400 feet × $3.00 per foot) .. 115,200
Materials Quantity Variance
   (1,600 feet U × $3.00 per foot) .................. 4,800
   Raw Materials (40,000 feet × $3.00 per foot) 120,000
**Problem 10B-4 (continued)**

2. a. Before the variances can be computed, we must first determine the actual direct labor hours worked for last year. This can be done through the variable overhead efficiency variance, as follows:

    Variable overhead efficiency variance = SR \( \times (AH - SH) \)
    
    $1.30 \text{ per hour} \times (AH - 16,000 \text{ hours}^*) = $650 U
    
    $1.30 \text{ per hour} \times AH - $20,800 = $650**
    
    $1.30 \text{ per hour} \times AH = $21,450
    
    \[ AH = \frac{$21,450 \text{ per hour}}{1.30 \text{ per hour}} = 16,500 \text{ hours} \]

    \* 8,000 units \( \times \) 2.0 hours per unit = 16,000 hours

    ** When used in the formula, an unfavorable variance is positive.

    We must also compute the standard rate per direct labor hour. The computation is:

    Labor rate variance = \( (AH \times AR) - (AH \times SR) \)
    
    $79,200 - (16,500 \text{ hours} \times SR) = $3,300 F
    
    $79,200 - 16,500 \text{ hours} \times SR = -$3,300*
    
    16,500 \text{ hours} \times SR = $82,500
    
    \[ SR = \frac{$82,500}{16,500 \text{ hours}} = $5.00 \text{ per hour} \]

    * When used in the formula, a favorable variance is negative.
**Problem 10B-4 (continued)**

Given these figures, the variances are:

<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>16,500 hours × $5.00 per hour = $82,500</td>
<td>16,000 hours × $5.00 per hour = $80,000</td>
</tr>
<tr>
<td>$79,200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rate Variance, $3,300 F

Efficiency Variance, $2,500 U

Spending Variance, $800 F

Alternatively, the variances can be computed using the formulas:

Labor rate variance = AH (AR – SR)
16,500 hours ($4.80 per hour* – $5.00 per hour) = $3,300 F

*79,200 ÷ 16,500 hours = $4.80 per hour

Labor efficiency variance = SR (AH – SH)
$5.00 per hour (16,500 hours – 16,000 hours) = $2,500 U

b. Work in Process
(16,000 hours × $5.00 per hour) ................. 80,000

Labor Efficiency Variance
(500 hours U × $5.00 per hour) ................... 2,500

Labor Rate Variance
(16,500 hours × $0.20 per hour F) ............ 3,300

Wages Payable
(16,500 hours × $4.80 per hour) ............... 79,200

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Problem 10B-4 (continued)

3. | 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) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16,500 hours × $1.30 per hour = $21,450</td>
<td>16,000 hours × $1.30 per hour = $20,800</td>
<td></td>
</tr>
<tr>
<td>$19,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate Variance, $1,650 F</td>
<td>Efficiency Variance, $650 U</td>
<td></td>
</tr>
<tr>
<td>Spending Variance, $1,000 F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Alternatively, the variances can be computed using the formulas:

Variable overhead rate variance = AH (AR – SR)
16,500 hours ($1.20 per hour* – $1.30 per hour) = $1,650 F

* $19,800 ÷ 16,500 hours = $1.20 per hour

Variable overhead efficiency variance = SR (AH – SH)
$1.30 per hour (16,500 hours – 16,000 hours) = $650 U
Problem 10B-4 (continued)

4. *For materials:*

Favorable price variance: Decrease in outside purchase price; fortunate buy; inferior quality materials; unusual discounts due to quantity purchased; less costly method of freight; inaccurate standards.

Unfavorable quantity variance: Inferior quality materials; carelessness; poorly adjusted machines; unskilled workers; inaccurate standards.

*For labor:*

Favorable rate variance: Unskilled workers (paid lower rates); piecework; inaccurate standards.

Unfavorable efficiency variance: Poorly trained workers; poor quality materials; faulty equipment; work interruptions; fixed labor and insufficient demand to fill capacity; inaccurate standards.

*For variable overhead:*

Favorable rate variance: Decrease in supplier prices; less usage of lubricants or indirect materials than planned; inaccurate standards.

Unfavorable efficiency variance: See comments under direct labor efficiency variance above.

5.

<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>Direct materials</td>
<td>4.8 feet</td>
<td>$3.00 per foot</td>
<td>$14.40</td>
</tr>
<tr>
<td>Direct labor</td>
<td>2.0 hours</td>
<td>$5.00 per hour</td>
<td>10.00</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>2.0 hours</td>
<td>$1.30 per hour</td>
<td>2.60</td>
</tr>
<tr>
<td>Total standard cost</td>
<td></td>
<td></td>
<td><strong>$27.00</strong></td>
</tr>
</tbody>
</table>