Quetiapine Extended-Release Tablets

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</table>

In accordance with the Rules and Procedures of the Council of Experts, the Small Molecules 4 Expert Committee has revised the Quetiapine Extended-Release Tablets monograph. The purpose of the revision is to add *Dissolution Test 11* to accommodate FDA-approved drug products with different dissolution conditions and/or tolerances than the existing dissolution test(s). The revision also necessitates a change in the table numbering in the test(s) for *Organic Impurities*.

The Quetiapine Extended-Release Tablets Revision Bulletin supersedes the currently official monograph.

Should you have any questions, please contact Claire Chisolm, Senior Scientist II (301-230-3215 or cnc@usp.org).
Quetiapine Extended-Release Tablets

**DEFINITION**
Quetiapine Extended-Release Tablets contain quetiapine fumarate \((C_{21}H_{26}N_3O_2S) \cdot C_4H_4O_4\) equivalent to NLT 90.0% and NMT 110.0% of the labeled amount of quetiapine \((C_{21}H_{26}N_3O_2S)\).

**IDENTIFICATION**

- **A.** Spectroscopic Identification Tests (197), Infrared Spectroscopy: 197F
  
  **Standard solution:** Transfer 10 mg of USP Quetiapine Fumarate RS to a suitable vial. Add 10 mL of acetone and cap the vial. Sonicate for about 10 min. Allow the solution to equilibrate to room temperature. Evaporate the acetone completely. Add 2 mL of chloroform. Gently swirl for several minutes. Pass through a suitable filter of 0.45-μm pore size. Use the filtrate.

  **Sample solution:** Grind NLT 10 Tablets. Transfer an amount of powder equivalent to NLT 10 mg of quetiapine fumarate to a suitable vial. Add 10 mL of acetone and cap the vial. Sonicate for about 10 min. Allow the solution to equilibrate to room temperature. Evaporate the acetone completely. Add 2 mL of chloroform. Gently swirl for several minutes. Pass through a suitable filter of 0.45-μm pore size. Use the filtrate.

  **Acceptance criteria:** Meet the requirements

- **B.** The retention time of the major peak of the Sample solution corresponds to that of the Standard solution, as obtained in the Assay.

**ASSAY**

*Change to read:*

- **PROCEDURE**
  
  **Buffer:** Dissolve 2.6 g/L of dibasic ammonium phosphate in water.

  **Mobile phase:** Methanol, acetonitrile, and Buffer (54:7:39)

  **Diluent:** Acetonitrile and water (50:50)

  **System suitability stock solution:** 0.05 mg/mL of USP Quetiapine Related Compound H RS in Mobile phase

  **System suitability solution:** 0.005 mg/mL of USP Quetiapine Related Compound H RS and 0.5 mg/mL of USP Quetiapine System Suitability RS in Mobile phase prepared as follows. Transfer 5 mg of USP Quetiapine System Suitability RS to a 10-mL volumetric flask. Add 7 mL of Mobile phase and sonicate to dissolve. Transfer 1 mL of System suitability stock solution to the volumetric flask. Dilute with Mobile phase to volume.

  **Standard solution:** 0.2 mg/mL of USP Quetiapine Fumarate RS in Mobile phase

  **Sample stock solution:** Transfer NLT 5 Tablets to a homogenizer vessel. Add 50 mL of acetonitrile, swirl to wet, and allow to stand for approximately 10 min. Add an additional 160 mL of Diluent and extract for about 10 min. Transfer the contents of the homogenizer to a 500-mL volumetric flask. Dilute with Diluent to volume. Pass a portion of the solution through a suitable filter of 0.45-μm pore size and use the filtrate.

  **Sample solution:** Nominally 0.16–0.18 mg/mL of quetiapine from the Sample stock solution in Mobile phase

  **Chromatographic system**

  (See Chromatography (621), System Suitability.)

  **Mode:** LC

  **Detector:** UV 230 nm

  **Column:** 4.6-mm × 25-cm; 5-μm packing L7

  **Flow rate:** 1.3 mL/min

  **Injection volume:** 30 μL

  **Run time:** NLT 2.5 times the retention time of quetiapine

  **System suitability**

  **Samples:** System suitability solution and Standard solution

  [Note—See Table 10 (RB 1-Dec-2021) for the relative retention times.]
Suitability requirements

**Resolution:** NLT 1.5 between quetiapine related compound G and quetiapine related compound H; NLT 2.0 between the quetiapine desethoxy and quetiapine peaks; *System suitability solution*

**Tailing factor:** NMT 1.5, *Standard solution*

**Relative standard deviation:** NMT 2.0%, *Standard solution*

Analysis

**Samples:** *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of quetiapine \((C_{21}H_{25}N_{3}O_{2}S)\) in the portion of Tablets taken:

\[
\text{Result} = \left( \frac{r_U}{r_S} \right) \times \left( \frac{C_U}{C_S} \right) \times \left( \frac{M_{r1}}{M_{r2}} \right) \times N \times 100
\]

- \(r_U\) = peak response from the *Sample solution*
- \(r_S\) = peak response from the *Standard solution*
- \(C_S\) = concentration of *USP Quetiapine Fumarate RS* in the *Standard solution* (mg/mL)
- \(C_U\) = nominal concentration of quetiapine in the *Sample solution* (mg/mL)
- \(M_{r1}\) = molecular weight of quetiapine free base, 383.51
- \(M_{r2}\) = molecular weight of quetiapine fumarate, 883.09
- \(N\) = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

**Acceptance criteria:** 90.0%–110.0%

PERFORMANCE TESTS

*Change to read:*

- **Dissolution** (711)

**Test 1**

**Medium 1:** Citrate buffer, pH 4.8. Dissolve 9.6 g of anhydrous citric acid in 600 mL of water. Add 90 mL of 1 N sodium hydroxide. Dilute with water to 1 L; 900 mL.

**Medium 2:** Dissolve 17.9 g of dibasic sodium phosphate dodecahydrate in 400 mL of water. Add 460 mL of 1 N sodium hydroxide VS and dilute with water to 1 L; 100 mL.

[Note—It is recommended to check the pH of the mixture of 90 mL of Medium 1 and 10 mL of Medium 2, which should be between 6.4 and 6.8. If the pH of the mixture is less than 6.4, 10 mL/L of 1 N sodium hydroxide VS may be added to Medium 2. If the pH of the mixture is greater than 6.8, 10 mL/L of 1 N hydrochloric acid VS may be added to Medium 2.]

Start the test with 900 mL of Medium 1. Add 100 mL of Medium 2 to the vessel after 5 h of the test and continue the test.

**Apparatus 1:** 200 rpm

**Times:** 1, 6, 12, and 20 h

**Diluent:** Medium 1 and Medium 2 (90:10)

**Standard solution:** \((L/400)\) mg/mL of *USP Quetiapine Fumarate RS* in *Diluent*, where \(L\) is the label claim in mg/Tablet

**Sample solution:** Pass a suitable portion of the solution under test through a suitable filter.

**Instrumental conditions**

- **Mode:** UV
- **Analytical wavelength:** About 290 nm
- **Blank:** Diluent

**Analysis**

**Samples:** *Standard solution* and *Sample solution*

Calculate the concentration, \(C_p\) of quetiapine \((C_{21}H_{25}N_{3}O_{2}S)\) in *Medium* (mg/mL) after time point \((i)\):

\[
C_i = \left( \frac{A_U}{A_S} \right) \times C_S \times \left( \frac{M_{r1}}{M_{r2}} \right) \times N
\]

- \(A_U\) = absorbance of the *Sample solution*
- \(A_S\) = absorbance of the *Standard solution*
- \(C_S\) = concentration of quetiapine fumarate in the *Standard solution* (mg/mL)
Calculate the percentage of the labeled amount of quetiapine (\(\text{C}_{21}\text{H}_{25}\text{N}_{3}\text{O}_{2}\text{S}\)) dissolved at each time point (\(i\)):

\[
\text{Result}_1 = C_i \times V \times (1/L) \times 100
\]

\[
\text{Result}_2 = [(C_2 \times V) + (C_1 \times V_S)] \times (1/L) \times 100
\]

\[
\text{Result}_3 = \{(C_3 \times V) + [(C_2 + C_1) \times V_S]\} \times (1/L) \times 100
\]

\[
\text{Result}_4 = \{(C_4 \times V) + [(C_3 + C_2 + C_1) \times V_S]\} \times (1/L) \times 100
\]

- \(C_i\) = concentration of quetiapine in Medium in the portion of sample withdrawn at each time point (mg/mL)
- \(V\) = volume of Medium, 900 mL for 1 h; 1000 mL for 6-, 12-, and 20-h time points
- \(L\) = label claim (mg/Tablet)
- \(V_S\) = volume of the Sample solution withdrawn from the vessel and replaced with Medium (mL)

**Tolerances:** See Table 1.

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((h))</th>
<th>Amount Dissolved ((%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 20</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>47–69</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>65–95</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>NLT 85</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine (\(\text{C}_{21}\text{H}_{25}\text{N}_{3}\text{O}_{2}\text{S}\)) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.

**Test 2:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 2.

- **Medium:** Water; 900 mL
- **Apparatus 1:** 100 rpm
- **Times:** 2, 4, 8, and 24 h
- **Standard solution:** 0.03 mg/mL of USP Quetiapine Fumarate RS in water

**Sample solution:** Pass a suitable portion of the solution under test through a suitable filter of 0.45-μm pore size.

Discard the first few milliliters of filtrate. Replace the volume withdrawn with an equal volume of Medium. Dilute with Medium to a concentration that is similar to that of the Standard solution.

**Instrumental conditions**

- **Mode:** UV
- **Analytical wavelength:** 290 nm
- **Blank:** Water

**Analysis**

- **Samples:** Standard solution and Sample solution

Calculate the concentration, \(C_i\), of quetiapine (\(\text{C}_{21}\text{H}_{25}\text{N}_{3}\text{O}_{2}\text{S}\)) in Medium (mg/mL) after each time point (\(i\)):

\[
C_i = (A_U/A_S) \times C_S \times D \times (M_{r1}/M_{r2}) \times N
\]

- \(A_U\) = absorbance of the Sample solution
- \(A_S\) = absorbance of the Standard solution
\[ C_S = \text{concentration of quetiapine fumarate in the Standard solution (mg/mL)} \]

\[ D = \text{dilution factor for the Sample solution, if needed} \]

\[ M_{r1} = \text{molecular weight of quetiapine free base, 383.51} \]

\[ M_{r2} = \text{molecular weight of quetiapine fumarate, 883.09} \]

\[ N = \text{number of moles of quetiapine free base per mole of quetiapine fumarate, 2} \]

Calculate the percentage of the labeled amount of quetiapine \((C_{21}H_{25}N_3O_2S)\) dissolved at each time point \((i)\):

\[
\text{Result}_1 = C_1 \times V \times (1/L) \times 100
\]

\[
\text{Result}_2 = [(C_2 \times V) + (C_1 \times V_S)] \times (1/L) \times 100
\]

\[
\text{Result}_3 = [(C_3 \times V) + [(C_2 + C_1) \times V_S]] \times (1/L) \times 100
\]

\[
\text{Result}_4 = [(C_4 \times V) + [(C_3 + C_2 + C_1) \times V_S]] \times (1/L) \times 100
\]

\[ C_i = \text{concentration of quetiapine in Medium in the portion of sample withdrawn at each time point (mg/mL)} \]

\[ V = \text{volume of Medium, 900 mL} \]

\[ L = \text{label claim (mg/Tablet)} \]

\[ V_S = \text{volume of the Sample solution withdrawn from the vessel and replaced with Medium (mL)} \]

**Tolerances:** See Table 2.

### Table 2

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((h))</th>
<th>Amount Dissolved ((%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>5–25</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>20–45</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>45–75</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>NLT 85</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine \((C_{21}H_{25}N_3O_2S)\) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.

**Test 3:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 3.

**Medium:** 0.1 N hydrochloric acid VS; 900 mL

**Apparatus 2:** 50 rpm

**Times:** 1, 4, and 8 h

**Standard solution:** USP Quetiapine Fumarate RS, equivalent to \((L/900)\) mg/mL of quetiapine in Medium, where \(L\) is the label claim in mg/Tablet

**Sample solution:** Pass a suitable portion of the solution under test through a suitable full flow filter of 10-μm pore size.

**Instrumental conditions**

- **Mode:** UV
- **Analytical wavelength:** 295 nm
- **Cell**
  - For 50-mg Tablets: 10 mm
  - For 150-, 200-, 300-, and 400-mg Tablets: 1 mm
- **Blank:** Medium

**Analysis**

**Samples:** Standard solution and Sample solution
Calculate the percentage of the labeled amount of quetiapine \((C_{21}H_{25}N_3O_2S)\) dissolved at each time point \(i\):

\[
\text{Result} = \left(\frac{A_U}{A_S}\right) \times C_s \times V \times \left(\frac{1}{L}\right) \times \left(\frac{M_{r1}}{M_{r2}}\right) \times N \times 100
\]

- \(A_U\) = absorbance of the Sample solution
- \(A_S\) = absorbance of the Standard solution
- \(C_s\) = concentration of quetiapine fumarate in the Standard solution (mg/mL)
- \(V\) = volume of Medium, 900 mL
- \(L\) = label claim (mg/Tablet)
- \(M_{r1}\) = molecular weight of quetiapine free base, 383.51
- \(M_{r2}\) = molecular weight of quetiapine fumarate, 883.09
- \(N\) = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

**Tolerances:** See Table 3.

### Table 3

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((h))</th>
<th>Amount Dissolved (for 50-, 150-, and 200-mg Tablets) ((%)</th>
<th>Amount Dissolved (for 300- and 400-mg Tablets) ((%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 40</td>
<td>NMT 35</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>55–75</td>
<td>45–65</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>NLT 85</td>
<td>NLT 80</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine \((C_{21}H_{25}N_3O_2S)\) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.

**Test 4:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 4.

- **Medium:** Water; 900 mL
- **Apparatus 2:** 100 rpm
- **Times:** 1, 4, 8, and 16 h

**Standard solution:** USP Quetiapine Fumarate RS, equivalent to \((L/900)\) mg/mL of quetiapine in Medium, where \(L\) is the label claim in mg/Tablet

**Sample solution:** Pass a suitable portion of the solution under test through a suitable filter.

**Instrumental conditions**

- **Mode:** UV
- **Analytical wavelength:** 250 nm
- **Blank:** Medium

**Analysis**

**Samples:** Standard solution and Sample solution

Calculate the percentage of the labeled amount of quetiapine \((C_{21}H_{25}N_3O_2S)\) dissolved at each time point \(i\):

\[
\text{Result} = \left(\frac{A_U}{A_S}\right) \times C_s \times V \times \left(\frac{1}{L}\right) \times \left(\frac{M_{r1}}{M_{r2}}\right) \times N \times 100
\]

- \(A_U\) = absorbance of the Sample solution
- \(A_S\) = absorbance of the Standard solution
- \(C_s\) = concentration of quetiapine fumarate in the Standard solution (mg/mL)
- \(V\) = volume of Medium, 900 mL
- \(L\) = label claim (mg/Tablet)
- \(M_{r1}\) = molecular weight of quetiapine free base, 383.51
- \(M_{r2}\) = molecular weight of quetiapine fumarate, 883.09
\[ N = \text{number of moles of quetiapine free base per mole of quetiapine fumarate}, \ 2 \]

**Tolerances:** See Table 4. The percentages of the labeled amount of quetiapine \((\text{C}_{21}\text{H}_{25}\text{N}_{3}\text{O}_{2}\text{S})\) dissolved at the times specified conform to Dissolution \((711)\), Acceptance Table 2.

### Table 4

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((\text{h}))</th>
<th>Amount Dissolved (for 50-mg Tablets) (%)</th>
<th>Amount Dissolved (for 150-mg Tablets) (%)</th>
<th>Amount Dissolved (for 200-mg Tablets) (%)</th>
<th>Amount Dissolved (for 300-mg Tablets) (%)</th>
<th>Amount Dissolved (for 400-mg Tablets) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 20</td>
<td>NMT 20</td>
<td>NMT 20</td>
<td>NMT 15</td>
<td>NMT 15</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>60–85</td>
<td>65–90</td>
<td>60–85</td>
<td>52–76</td>
<td>50–75</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>NLT 85</td>
<td>NLT 85</td>
<td>NLT 85</td>
<td>NLT 85</td>
<td>NLT 85</td>
</tr>
</tbody>
</table>

**Test 5:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 5.

**Medium, Apparatus 1, Times, Standard solution, Sample solution, Instrumental conditions,** and **Analysis:** Proceed as directed in Dissolution Test 2.

**Tolerances:** See Table 5.

### Table 5

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((\text{h}))</th>
<th>Amount Dissolved (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>10–30</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>30–50</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>60–80</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>NLT 85</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine \((\text{C}_{21}\text{H}_{25}\text{N}_{3}\text{O}_{2}\text{S})\) dissolved at the times specified conform to Dissolution \((711)\), Acceptance Table 2.

**Test 6:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 6.

**Medium:** pH 6.8 phosphate buffer \((6.8 \text{ g/L of monobasic potassium phosphate} \text{ and 0.9 g/L of sodium hydroxide in water})\).

Adjust with 1 N sodium hydroxide VS or phosphoric acid to a pH of 6.8, and sonicate for NLT 10 min); 900 mL

**Apparatus 2:** 100 rpm, with sinker

**Times:** 1, 4, 8, and 16 h

**Mobile phase:** Methanol, trifluoroacetic acid, and water \((40: 0.1: 60)\)

**Standard solution:** 0.1 mg/mL of USP Quetiapine Fumarate RS prepared as follows. Transfer an appropriate amount of USP Quetiapine Fumarate RS to a suitable volumetric flask, and add 5% of the final flask volume of methanol. Sonicate to dissolve, then dilute with Medium to volume.

**Sample solution:** Pass a suitable portion of the solution under test through a suitable filter of 0.45-μm pore size. Discard the first few milliliters of filtrate.
Chromatographic system
(See Chromatography (621), System Suitability.)

Mode: LC
Detector: UV 280 nm
Column: 4.6-mm × 5.0-cm; 5-μm packing L1
Column temperature: 40°
Flow rate: 1.2 mL/min
Injection volume: 10 μL
Run time: NLT 2.0 times the retention time of quetiapine

System suitability
Sample: Standard solution

Suitability requirements
Tailing factor: NMT 2.0
Relative standard deviation: NMT 3.0%

Analysis
Samples: Standard solution and Sample solution

Calculate the concentration, \( C_i \), of quetiapine (C\(_{21}\)H\(_{25}\)N\(_3\)O\(_2\)S) in Medium (mg/mL) after each time point \((i)\):

\[
C_i = \frac{r_U}{r_S} \times C_S \times \frac{M_{r1}}{M_{r2}} \times N
\]

\( r_U \) = peak response from the Sample solution
\( r_S \) = peak response from the Standard solution
\( C_S \) = concentration of USP Quetiapine Fumarate RS in the Standard solution (mg/mL)
\( M_{r1} \) = molecular weight of quetiapine free base, 383.51
\( M_{r2} \) = molecular weight of quetiapine fumarate, 883.09
\( N \) = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

Calculate the percentage of the labeled amount of quetiapine (C\(_{21}\)H\(_{25}\)N\(_3\)O\(_2\)S) dissolved at each time point \((i)\):

\[
\text{Result}_1 = C_i \times V \times \left(\frac{1}{L}\right) \times 100
\]

\[
\text{Result}_2 = \left(\left[C_2 \times (V - V_S)\right] + \left(C_1 \times V_S\right)\right) \times \left(\frac{1}{L}\right) \times 100
\]

\[
\text{Result}_3 = \left(\left[C_3 \times (V - (2 \times V_S))\right] + \left[(C_2 + C_1) \times V_S\right]\right) \times \left(\frac{1}{L}\right) \times 100
\]

\[
\text{Result}_4 = \left(\left[C_4 \times (V - (3 \times V_S))\right] + \left[C_2 + C_3 + C_1 \times V_S\right]\right) \times \left(\frac{1}{L}\right) \times 100
\]

\( C_i \) = concentration of quetiapine in Medium in the portion of sample withdrawn at each time point (mg/mL)
\( V \) = volume of Medium, 900 mL
\( L \) = label claim (mg/Tablet)
\( V_S \) = volume of the Sample solution withdrawn from the Medium (mL)

Tolerances: See Table 6.

### Table 6

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time (h)</th>
<th>Amount Dissolved (for 50- and 150-mg Tablets) (%)</th>
<th>Amount Dissolved (for 200-, 300-, and 400-mg Tablets) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 15</td>
<td>NMT 10</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>21–41</td>
<td>21–41</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>56–76</td>
<td>51–71</td>
</tr>
<tr>
<td>Time Point (i)</td>
<td>Time (h)</td>
<td>Amount Dissolved (for 50- and 150-mg Tablets) (%)</td>
<td>Amount Dissolved (for 200-, 300-, and 400-mg Tablets) (%)</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>NLT 80</td>
<td>NLT 80</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine ($C_{21}H_{25}N_{3}O_{S}$) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.

**Test 7:** If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 7.

**Acid stage medium:** Citrate buffer, pH 4.8 (9.6 g/L of anhydrous citric acid in water) prepared as follows. Transfer a suitable quantity of anhydrous citric acid to an appropriate volumetric flask. Dissolve in 60% of the flask volume of water, then add 9% of the flask volume of 1 N sodium hydroxide VS. Dilute with water to volume); 900 mL, deaerated

**0.05 M phosphate buffer solution:** 17.9 g/L of dibasic sodium phosphate dodecahydrate solution prepared as follows. Transfer a suitable amount of dibasic sodium phosphate dodecahydrate to an appropriate volumetric flask containing 40% of the flask volume of water. Add 46% of the flask volume of 1 N sodium hydroxide VS and dilute with water to volume.

**Buffer stage medium:** Phosphate buffer, pH 6.6 (add 100 mL of 0.05 M phosphate buffer solution to the Acid stage medium; adjust with 1 N sodium hydroxide VS or 1 N hydrochloric acid VS to obtain a pH of 6.6 ± 0.20, if necessary); 1000 mL

**Apparatus 1:** 20-mesh basket; 200 rpm

**Times:** 1 and 4 h in Acid stage medium; 6, 10, and 16 h in Buffer stage medium. The time in the Buffer stage medium includes the time in the Acid stage medium.

**Procedure:** Run the test in the Acid stage medium for the times specified. After 5 h, add 100 mL of 0.05 M phosphate buffer solution and continue running the test in Buffer stage medium for the times specified.

**Standard stock solution:** 1.2 mg/mL of USP Quetiapine Fumarate RS prepared as follows. Transfer an appropriate amount of USP Quetiapine Fumarate RS into a suitable volumetric flask. Add 40% of the flask volume of methanol and sonicate to dissolve. Dilute with water to volume.

**Acid stage standard solution:** 0.03 mg/mL of USP Quetiapine Fumarate RS from Standard stock solution in Acid stage medium

**Buffer stage standard solution:** 0.03 mg/mL of USP Quetiapine Fumarate RS from Standard stock solution in Buffer stage medium

**Acid stage sample solution:** Pass a portion of the solution under test through a suitable filter, discarding the first portion of filtrate if needed. Dilute the filtrate further with Acid stage medium, if needed. Replace the portion of solution removed from the vessel with an equivalent volume of warmed Acid stage medium.

**Buffer stage sample solution:** Pass a portion of the solution under test through a suitable filter, discarding the first portion of filtrate if needed. Dilute the filtrate further with Buffer stage medium, if needed. Replace the portion of solution removed from the vessel with an equivalent volume of warmed Buffer stage medium.

**Instrumental conditions**

(See Ultraviolet-Visible Spectroscopy (857).)

**Mode:** UV

**Analytical wavelength:** 290 nm

**Blank:** Acid stage medium or Buffer stage medium

**System suitability**

**Samples:** Acid stage standard solution and Buffer stage standard solution

**Suitability requirements**

**Relative standard deviation:** NMT 2.0%, Acid stage standard solution and Buffer stage standard solution

**Analysis**
Samples: Acid stage standard solution and Acid stage sample solution or Buffer stage standard solution and Buffer stage sample solution

Calculate the concentration \( C_i \) of quetiapine \( (C_{21}H_{25}N_3O_8S) \) in the sample withdrawn from the vessel at each time point \( (i) \):

\[
\text{Result}_i = \left( \frac{A_U}{A_S} \right) \times C_S \times D \times \left( \frac{M_{f1}}{M_{f2}} \right) \times N
\]

\( A_U \) = absorbance of the Acid stage sample solution or Buffer stage sample solution
\( A_S \) = absorbance of the Acid stage standard solution or Buffer stage standard solution, corresponding to the related sample solution
\( C_S \) = concentration of quetiapine fumarate in Acid stage standard solution or Buffer stage standard solution (mg/mL)
\( D \) = dilution factor for the Acid stage sample solution or Buffer stage sample solution, if needed
\( M_{f1} \) = molecular weight of quetiapine free base, 383.51
\( M_{f2} \) = molecular weight of quetiapine fumarate, 883.09
\( N \) = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

Calculate the percentage of the labeled amount of quetiapine \( (C_{21}H_{25}N_3O_8S) \) dissolved at each time point \( (i) \):

\[
\text{Result}_1 = C_i \times V_A \times \left( \frac{1}{L} \right) \times 100
\]

\[
\text{Result}_2 = \left[ \left( C_2 \times V_A \right) + \left( C_1 \times V_S \right) \right] \times \left( \frac{1}{L} \right) \times 100
\]

\[
\text{Result}_3 = \left\{ \left( C_3 \times V_B \right) + \left[ \left( C_2 + C_1 \right) \times V_S \right] \right\} \times \left( \frac{1}{L} \right) \times 100
\]

\[
\text{Result}_4 = \left\{ \left( C_4 \times V_B \right) + \left[ \left( C_3 + C_2 + C_1 \right) \times V_S \right] \right\} \times \left( \frac{1}{L} \right) \times 100
\]

\[
\text{Result}_5 = \left\{ \left( C_5 \times V_B \right) + \left[ \left( C_4 + C_3 + C_2 + C_1 \right) \times V_S \right] \right\} \times \left( \frac{1}{L} \right) \times 100
\]

\( C_i \) = concentration of quetiapine in Acid stage medium or Buffer stage medium in the portion of sample withdrawn at each time point (mg/mL)
\( V_A \) = volume of Acid stage medium, 900 mL
\( L \) = label claim (mg/Tablet)
\( V_S \) = volume of the Acid stage sample solution or Buffer stage sample solution withdrawn from the vessel and replaced with Acid stage medium or Buffer stage medium, respectively (mL)
\( V_B \) = volume of Buffer stage medium, 1000 mL

Tolerances: See Table 7.

<table>
<thead>
<tr>
<th>Time Point ((i))</th>
<th>Time ((h))</th>
<th>Amount Dissolved ((%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 15</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>28–48</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>40–60</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>62–82</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>NLT 80</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine \( (C_{21}H_{25}N_3O_8S) \) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.

Test 10: If the product complies with this test, the labeling indicates that it meets USP Dissolution Test 10.
Medium: 3.72 g/L potassium chloride in water. Adjust with hydrochloric acid to a pH of 1.2; 900 mL

Apparatus 1: 100 rpm

Times: 1, 4, and 12 h

Standard solution: 0.016 mg/mL of USP Quetiapine Fumarate RS in Medium

Sample solution: Pass a suitable portion of the solution under test through a suitable filter of 0.45-μm pore size. Discard the first few milliliters of filtrate. Replace the volume withdrawn with an equal volume of Medium. Dilute with Medium, if necessary.

Instrumental conditions
(See Ultraviolet-Visible Spectroscopy (857).)

Mode: UV

Analytical wavelength: 254 nm

Blank: Medium

Analysis

Samples: Standard solution and Sample solution

Calculate the concentration ($C_i$) of quetiapine ($C_{21}H_{25}N_3O_2S$) in the sample withdrawn from the vessel at each time point ($i$):

$$C_i = \frac{A_U}{A_S} \times C_S \times D \times \frac{M_{r1}}{M_{r2}} \times N$$

$A_U$ = absorbance of the Sample solution

$A_S$ = absorbance of the Standard solution

$C_S$ = concentration of USP Quetiapine Fumarate RS in the Standard solution (mg/mL)

$D$ = dilution factor for the Sample solution, if needed

$M_{r1}$ = molecular weight of quetiapine free base, 383.51

$M_{r2}$ = molecular weight of quetiapine fumarate, 883.09

$N$ = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

Calculate the percentage of the labeled amount of quetiapine ($C_{21}H_{25}N_3O_2S$) dissolved at each time point ($i$):

$$\text{Result}_1 = C_i \times V \times \frac{1}{L} \times 100$$

$$\text{Result}_2 = \left[ (C_2 \times V) + (C_1 \times V_S) \right] \times \frac{1}{L} \times 100$$

$$\text{Result}_3 = \left\{ (C_3 \times V) + [(C_2 + C_1) \times V_S] \right\} \times \frac{1}{L} \times 100$$

$C_i$ = concentration of quetiapine in the portion of sample withdrawn at time point ($i$) (mg/mL)

$V$ = volume of Medium, 900 mL

$L$ = label claim (mg/Tablet)

$V_S$ = volume of the Sample solution withdrawn from the vessel and replaced with Medium (mL)

Tolerances: See Table 8.

<table>
<thead>
<tr>
<th>Time Point ($i$)</th>
<th>Time (h)</th>
<th>Amount Dissolved (for 150- and 200-mg Tablets) (%)</th>
<th>Amount Dissolved (for 300- and 400-mg Tablets) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 40</td>
<td>NMT 40</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>55–75</td>
<td>50–70</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>NLT 85</td>
<td>NLT 85</td>
</tr>
</tbody>
</table>
The percentages of the labeled amount of quetiapine ($C_{21}H_{25}N_3O_2S$) dissolved at the times specified conform to *Dissolution* (711), *Acceptance Table 2*.

**Test 11:** If the product complies with this test, the labeling indicates that it meets USP *Dissolution Test 11*.

**Medium:** 0.1 N hydrochloric acid VS; 900 mL

**Apparatus 2:** 50 rpm

**Times:** 1, 4, 8, and 16 h

**Standard stock solution:** 1.5 mg/mL of USP Quetiapine Fumarate RS prepared as follows. Transfer a suitable amount of USP Quetiapine Fumarate RS into an appropriate volumetric flask and add 20% of the flask volume of methanol to dissolve. Dilute with *Medium* to volume.

**Standard solution:** Prepare a solution of USP Quetiapine Fumarate RS at a concentration equivalent to $(L/900)$ mg/mL of quetiapine, from *Standard stock solution* in *Medium*, where $L$ is the label claim in mg/Tablet.

**Sample solution:** At the times specified, withdraw a portion of the solution under test, centrifuge, and use the supernatant.

**Instrumental conditions**

*(See *Ultraviolet-Visible Spectroscopy* (857).)*

**Mode:** UV

**Analytical wavelength:** 290 nm

**Cell**

- 50-mg Tablets: 1 cm
- 150-, 200-, 300-, and 400-mg Tablets: 0.1 cm

**Blank:** *Medium*

**Analysis**

**Samples:** *Standard solution* and *Sample solution*

Calculate the concentration ($C_i$) of quetiapine ($C_{21}H_{25}N_3O_2S$) in the sample withdrawn from the vessel at each time point ($i$):

$$C_i = \frac{A_U}{A_S} \times C_S \times \left( \frac{M_{r1}}{M_{r2}} \right) \times N$$

- $A_U$ = absorbance of the *Sample solution*
- $A_S$ = absorbance of the *Standard solution*
- $C_S$ = concentration of USP Quetiapine Fumarate RS in the *Standard solution* (mg/mL)
- $M_{r1}$ = molecular weight of quetiapine free base, 383.51
- $M_{r2}$ = molecular weight of quetiapine fumarate, 883.09
- $N$ = number of moles of quetiapine free base per mole of quetiapine fumarate, 2

Calculate the percentage of the labeled amount of quetiapine ($C_{21}H_{25}N_3O_2S$) dissolved at each time point ($i$):

$$\text{Result}_1 = C_i \times \frac{V}{L} \times 100$$

$$\text{Result}_2 = \left\{ (C_2 \times (V - V_S)) + (C_1 \times V_S) \right\} \times \left( \frac{1}{L} \right) \times 100$$

$$\text{Result}_3 = \left\{ (C_3 \times [V - (2 \times V_S)]) + [(C_2 + C_1) \times V_S] \right\} \times \left( \frac{1}{L} \right) \times 100$$

$$\text{Result}_4 = \left\{ (C_4 \times [V - (3 \times V_S)]) + [(C_3 + C_2 + C_1) \times V_S] \right\} \times \left( \frac{1}{L} \right) \times 100$$

- $C_i$ = concentration of quetiapine in the portion of sample withdrawn at time point ($i$) (mg/mL)
- $V$ = volume of *Medium*, 900 mL
- $L$ = label claim (mg/Tablet)
- $V_S$ = volume of the *Sample solution* withdrawn from the vessel (mL)

**Tolerances:** See *Table 9*.

**Table 9**

<table>
<thead>
<tr>
<th>$i$</th>
<th>$\pm$</th>
<th>$\pm$</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C300460-M3003-SM42020, rev. 00 20211119
<table>
<thead>
<tr>
<th>Time Point (i)</th>
<th>Time (h)</th>
<th>Amount Dissolved (for 50-mg Tablets) (%)</th>
<th>Amount Dissolved (for 150-mg Tablets) (%)</th>
<th>Amount Dissolved (for 200-mg Tablets) (%)</th>
<th>Amount Dissolved (for 300-mg Tablets) (%)</th>
<th>Amount Dissolved (for 400-mg Tablets) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>NMT 25</td>
<td>NMT 25</td>
<td>NMT 25</td>
<td>NMT 25</td>
<td>NMT 25</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>42–60</td>
<td>40–60</td>
<td>35–55</td>
<td>35–55</td>
<td>30–50</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>70–90</td>
<td>65–85</td>
<td>62–82</td>
<td>60–80</td>
<td>55–75</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>NLT 80</td>
<td>NLT 80</td>
<td>NLT 80</td>
<td>NLT 80</td>
<td>NLT 80</td>
</tr>
</tbody>
</table>

The percentages of the labeled amount of quetiapine (C$_{21}$H$_{25}$N$_{3}$O$_{5}$S) dissolved at the times specified conform to Dissolution (711), Acceptance Table 2.\(^{(RB 1-Dec-2021)}\)

**Uniformity of Dosage Units (905):** Meet the requirements

**Impurities**

*Change to read:*

**Organic Impurities**

*Buffer, Mobile phase, Diluent, System suitability solution, Sample solution, and Chromatographic system:* Proceed as directed in the Assay.

**System suitability**

*Sample: System suitability solution*

[Note—See Table 10\(^{(RB 1-Dec-2021)}\) for the relative retention times.]

**Suitability requirements**

*Resolution:* NLT 1.5 between quetiapine related compound G and quetiapine related compound H; NLT 2.0 between the quetiapine desethoxy and quetiapine peaks

**Analysis**

*Sample: Sample solution*

[Note—See Table 10\(^{(RB 1-Dec-2021)}\) for the relative retention times.]

Calculate the percentage of each degradation product in the portion of Tablets taken:

\[
\text{Result} = \left(\frac{r_U}{r_S}\right) \times \left(\frac{1}{F}\right) \times 100
\]

- $r_U$ = peak response of each degradation product from the Sample solution
- $r_S$ = peak response of quetiapine from the Sample solution
- $F$ = relative response factor for the corresponding degradation product from Table 10\(^{(RB 1-Dec-2021)}\)

**Acceptance criteria:** See Table 10\(^{(RB 1-Dec-2021)}\) Disregard peaks less than 0.05%.

\[\text{Table 10\(^{(RB 1-Dec-2021)}\)}\]

<table>
<thead>
<tr>
<th>Name</th>
<th>Relative Retention Time</th>
<th>Relative Response Factor</th>
<th>Acceptance Criteria, NMT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fumaric acid(^a)</td>
<td>0.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Quetiapine related compound G</td>
<td>0.48</td>
<td>1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Name</td>
<td>Relative Retention Time</td>
<td>Relative Response Factor</td>
<td>Acceptance Criteria, NMT (%)</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Quetiapine related compound H</td>
<td>0.57</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Quetiapine desethoxy&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.87</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Quetiapine</td>
<td>1.0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Quetiapine related compound B&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.9</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Any individual unspecified degradation product</td>
<td>—</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Total degradation products</td>
<td>—</td>
<td>—</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<sup>a</sup> Counter ion peak, not to be included in the total degradation products.

<sup>b</sup> Process impurity controlled in the drug substance. Included for identification purposes only. Not reported for the drug product and not included in the total degradation products.

**ADDITIONAL REQUIREMENTS**

- **Packaging and Storage:** Preserve in well-closed containers. Store at controlled room temperature.
- **Labeling:** When more than one **Dissolution** test is given, the labeling states the **Dissolution** test used only if Test 1 is not used.
- **USP Reference Standards** (11)
  - **USP Quetiapine Fumarate RS**
  - **USP Quetiapine Related Compound H RS**
    - 4-(Dibenzo[b,f][1,4]thiazepin-11-yl)-1-[2-(2-hydroxyethoxy)ethyl]piperazine 1-oxide.
    - \( C_{21}H_{25}N_3O_3S \) 399.51
  - **USP Quetiapine System Suitability RS**
    - It contains quetiapine fumarate and at least 0.1% of each of the following impurities:
      - Quetiapine related compound B: 11-(Piperazin-1-yl)dibenzo[b,f][1,4]thiazepine; Quetiapine related compound G: Dibenzo[b,f][1,4]thiazepin-11(10H)-one; and Quetiapine desethoxy: 2-[4-(Dibenzo[b,f][1,4]thiazepin-11-yl)piperazin-1-yl]ethanol.