Rivaroxaban Tablets

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<tr>
<th>Type of Posting</th>
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<td>Targeted Official Date</td>
<td>To Be Determined, Revision Bulletin</td>
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<td>Expert Committee</td>
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In accordance with the Rules and Procedures of the Council of Experts and the Pending Monograph Guideline, this is to provide notice that the Small Molecules 2 Expert Committee intends to revise the Rivaroxaban Tablets monograph.

Based on the supporting data received from a manufacturer awaiting FDA approval, the Expert Committee proposes to revise the Rivaroxaban Tablets monograph to add Dissolution Test 2. Labeling information has been incorporated to support the inclusion of Dissolution Test 2.

The proposed revision is contingent on FDA approval of a product that meets the proposed monograph specifications. The proposed revision will be published as a Revision Bulletin and an official date will be assigned to coincide as closely as possible with the FDA approval of the associated product.

See below for additional information about the proposed text.¹

Should you have any questions, please contact Yanyin Yang, Senior Scientist II (301-692-3623 or yanyin.yang@usp.org).

¹ This text is not the official version of a USP–NF monograph and may not reflect the full and accurate contents of the currently official monograph. Please refer to the current edition of the USP–NF for official text.

USP provides this text to indicate changes that we anticipate will be made official once the product subject to this proposed revision under the Pending Monograph Program receives FDA approval. Once FDA approval is granted for the associated revision request, a Revision Bulletin will be posted that will include the changes indicated herein, as well as any changes indicated in the product's final approval, combined with the text of the monograph as effective on the date of approval. Any revisions made to a monograph under the Pending Monograph Program that are posted without prior publication for comment in the Pharmacopeial Forum must also meet the requirements outlined in the USP Guideline on Use of Accelerated Processes for Revisions to the USP–NF.
Rivaroxaban Tablets

**DEFINITION**
Rivaroxaban Tablets contain NLT 90.0% and NMT 110.0% of the labeled amount of rivaroxaban (C₁₉H₁₈ClN₃O₅S).

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

**ASSAY**
- **PROCEDURE**
Protect solutions containing rivaroxaban from light.

- **Solution A**: 0.01 M phosphoric acid
- **Solution B**: Acetonitrile
- **Mobile phase**: See *Table 1*.

**Table 1**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Solution A (%)</th>
<th>Solution B (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>13.0</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>13.1</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>16.0</td>
<td>92</td>
<td>8</td>
</tr>
</tbody>
</table>

**Diluent**: *Solution A* and *Solution B* (40:60)

**Standard solution**: 0.2 mg/mL of USP Rivaroxaban RS in Diluent

**Sample solution**: Nominally 0.2 mg/mL of rivaroxaban prepared as follows. Transfer Tablets (NLT 4) into an appropriate volumetric flask. Add a suitable amount of Diluent and sonicate to disintegrate and dissolve. Dilute with Diluent to volume. Pass the solution through a suitable filter of 0.45-µm pore size.

**Chromatographic system**
(See Chromatography (621), System Suitability.)

- **Mode**: LC
- **Detector**: UV 250 nm. For Identification B, use a diode array detector in the range of 200–400 nm.
- **Column**: 4.0-mm × 5.5-cm; 3-µm packing L1
- **Column temperature**: 45°C
- **Flow rate**: 1 mL/min

C322875M7232-SM22020, rev. 00 20230929
Injection volume: 5 µL

System suitability
Sample: Standard solution

Suitability requirements
Tailing factor: NMT 1.5
Relative standard deviation: NMT 1.5%

Analysis
Samples: Standard solution and Sample solution

Calculate the percentage of the labeled amount of rivaroxaban (C₁₉H₁₈ClN₃O₅S) in the portion of Tablets taken:

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

- \( r_U \) = peak response of rivaroxaban from the Sample solution
- \( r_S \) = peak response of rivaroxaban from the Standard solution
- \( C_S \) = concentration of USP Rivaroxaban RS in the Standard solution (mg/mL)
- \( C_U \) = nominal concentration of rivaroxaban in the Sample solution (mg/mL)

Acceptance criteria: 90.0%–110.0%

PERFORMANCE TESTS

Change to read:

- **Dissolution** (711)

^Test 1_(TBD)

Buffer: 0.022 M sodium acetate; adjusted with sodium hydroxide or glacial acetic acid to a pH of 4.5

Medium

- For 2.5-mg Tablets: Buffer; 900 mL
- For 10-mg Tablets: 0.2% sodium dodecyl sulfate in Buffer; 900 mL
- For 15-mg and 20-mg Tablets: 0.4% sodium dodecyl sulfate in Buffer; 900 mL

Apparatus 2: 75 rpm

Times: 15 min for 10-mg, 15-mg, and 20-mg Tablets; 20 min for 2.5-mg Tablets

Mobile phase: Acetonitrile and water (40:60)

Standard stock solution: 0.55 mg/mL of USP Rivaroxaban RS in acetonitrile

Standard solution

- For 2.5-mg Tablets: 0.003 mg/mL of USP Rivaroxaban RS from the Standard stock solution in Medium
- For 10-mg Tablets: 0.01 mg/mL of USP Rivaroxaban RS from the Standard stock solution in Medium
- For 15-mg and 20-mg Tablets: 0.02 mg/mL of USP Rivaroxaban RS from the Standard stock solution in Medium

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

Chromatographic system

(See Chromatography (621), System Suitability.)

Mode: LC
Detector: UV 250 nm
Column: 4.0-mm × 6.0-cm; 3-µm packing L1
Column temperature: 40°
Flow rate: 1 mL/min
Injection volume: 10 µL for 10-mg, 15-mg, and 20-mg Tablets; 20 µL for 2.5-mg Tablets
Run time: NLT 3 times the retention time of rivaroxaban

System suitability
Sample: Standard solution
Suitability requirements
Relative standard deviation: NMT 1.5%

Analysis
Samples: Standard solution and Sample solution
Calculate the percentage of the labeled amount of rivaroxaban \((C_{19}H_{18}ClN_{3}O_{5}S)\) dissolved:

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

- \(r_U\) = peak response of rivaroxaban from the Sample solution
- \(r_S\) = peak response of rivaroxaban from the Standard solution
- \(C_S\) = concentration of USP Rivaroxaban RS in the Standard solution (mg/mL)
- \(V\) = volume of Medium, 900 mL
- \(L\) = label claim (mg/Tablet)

Tolerances: NLT 80% \((Q)\) of the labeled amount of rivaroxaban \((C_{19}H_{18}ClN_{3}O_{5}S)\) is dissolved.

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

For Tablets labeled to contain 2.5 mg of rivaroxaban

Buffer: 3 g/L of sodium acetate and 14 mL/L of 2 N acetic acid in water. Adjust with 2 N acetic acid or 2 N sodium hydroxide to a pH of 4.5, if necessary. Deaerate before use.

Medium: Buffer; 900 mL
Apparatus 2: 75 rpm
Time: 30 min
Solution A: Add 5.0 mL of triethylamine to 1000 mL of water and mix. Adjust with phosphoric acid to a pH of 2.2.
Mobile phase: Acetonitrile and Solution A (35:65)
Standard stock solution: 0.28 mg/mL of USP Rivaroxaban RS in acetonitrile. Sonicate to dissolve.
Standard solution: \((L/900)\) mg/mL of USP Rivaroxaban RS from the Standard stock solution in Medium, where \(L\) is the label claim of rivaroxaban in mg/Tablet.
Sample solution: Pass a portion of the solution under test immediately through a suitable filter.

Chromatographic system
(See Chromatography (621), System Suitability.)
Mode: LC
Detector: UV 250 nm
Column: 4.6-mm × 15-cm; 3.5-µm packing L1
Column temperature: 30°
Flow rate: 1 mL/min
Injection volume: 100 µL
Run time: NLT 1.6 times the retention time of rivaroxaban

System suitability
Sample: Standard solution

Suitability requirements
Tailing factor: 0.8–2.0
Relative standard deviation: NMT 2.0%

Analysis
Samples: Standard solution and Sample solution

Calculate the percentage of the labeled amount of rivaroxaban (C₁₉H₁₈ClN₃O₅S)
dissolved:

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

\(r_U\) = peak response of rivaroxaban from the Sample solution
\(r_S\) = peak response of rivaroxaban from the Standard solution
\(C_S\) = concentration of USP Rivaroxaban RS in the Standard solution (mg/mL)
\(V\) = volume of Medium, 900 mL
\(L\) = label claim (mg/Tablet)

Tolerances: NLT 80% (Q) of the labeled amount of rivaroxaban (C₁₉H₁₈ClN₃O₅S) is dissolved.

For Tablets labeled to contain 10, 15, and 20 mg of rivaroxaban
Buffer: 3 g/L of sodium acetate and 14 mL/L of 2 N acetic acid in water. Adjust with 2 N acetic acid
or 2 N sodium hydroxide to a pH of 4.5, if necessary. Deaerate before use.
Medium
For 10-mg Tablets: Dissolve 2 g of sodium dodecyl sulfate in 1000 mL of Buffer; 900 mL
For 15-mg and 20-mg Tablets: Dissolve 4 g of sodium dodecyl sulfate in 1000 mL of Buffer; 900 mL
Apparatus 2: 75 rpm
Time: 30 min
Standard stock solution: 0.28 mg/mL of USP Rivaroxaban RS in acetonitrile. Sonicate to dissolve.
Standard solution: \((L/900)\) mg/mL of USP Rivaroxaban RS from the Standard stock solution in
Medium, where \(L\) is the label claim of rivaroxaban in mg/Tablet.
Sample solution: Use a portion of the solution under test.
Instrumental conditions
(See Ultraviolet-Visible Spectroscopy (857).)
Mode: UV
Analytical wavelength: 248 nm with background correction at 490 nm
Cell
For 10-mg and 15-mg Tablets: 1.0 cm
For 20-mg Tablets: 0.5 cm
Blank: Medium
Analysis
Samples: Standard solution and Sample solution
Calculate the percentage of the labeled amount of rivaroxaban \((C_{19}H_{18}ClN_{3}O_{5}S)\) dissolved:

\[
\text{Result} = \left( \frac{A_U}{A_S} \right) \times C_S \times V \times \left( \frac{1}{L} \right) \times 100
\]

- \(A_U\) = absorbance from the \textit{Sample solution}
- \(A_S\) = absorbance from the \textit{Standard solution}
- \(C_S\) = concentration of USP Rivaroxaban RS in the \textit{Standard solution} (mg/mL)
- \(V\) = volume of Medium, 900 mL
- \(L\) = label claim (mg/Tablet)

**Tolerances**: NLT 80\% \((Q)\) of the labeled amount of rivaroxaban \((C_{19}H_{18}ClN_{3}O_{5}S)\) is dissolved. ▲

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

**IMPURITIES**

- **Organic Impurities**
  Protect solutions containing rivaroxaban from light.

  - **Mobile phase, Diluent, Standard solution, Sample solution, and Chromatographic system**: Proceed as directed in the Assay.
  - **System suitability solution**: 2 µg/mL each of USP Rivaroxaban RS and USP Rivaroxaban Related Compound H RS in Diluent
  - **Sensitivity solution**: 0.2 µg/mL of USP Rivaroxaban RS from the Standard solution in Diluent

**System suitability**

- **Samples**: Standard solution, System suitability solution, and Sensitivity solution
  [Note—See Table 2 for the relative retention times.]

**Suitability requirements**

- **Resolution**: NLT 2.0 between rivaroxaban and rivaroxaban related compound H, System suitability solution
- **Relative standard deviation**: NMT 1.5\%, Standard solution
- **Signal-to-noise ratio**: NLT 10 for rivaroxaban, Sensitivity solution

**Analysis**

- **Samples**: Standard solution and Sample solution
  Calculate the percentage of any unspecified degradation product in the portion of Tablets taken:

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

- \(r_U\) = peak response of each unspecified degradation product from the Sample solution
- \(r_S\) = peak response of rivaroxaban from the Standard solution
- \(C_S\) = concentration of USP Rivaroxaban RS in the Standard solution (mg/mL)
- \(C_U\) = nominal concentration of rivaroxaban in the Sample solution (mg/mL)

**Acceptance criteria**: See Table 2. The reporting threshold is 0.1\%.

**Table 2**
<table>
<thead>
<tr>
<th>Name</th>
<th>Relative Retention Time</th>
<th>Acceptance Criteria, NMT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivaroxaban</td>
<td>1.0</td>
<td>—</td>
</tr>
<tr>
<td>Rivaroxaban related compound H&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.2</td>
<td>—</td>
</tr>
<tr>
<td>Any unspecified degradation product</td>
<td>—</td>
<td>0.2</td>
</tr>
<tr>
<td>Total degradation products</td>
<td>—</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<sup>a</sup> This impurity is included for establishing the Resolution requirement in System suitability.

**ADDITIONAL REQUIREMENTS**

- **Packaging and Storage:** Preserve in well-closed containers. Store at controlled room temperature.

*Add the following:*

- **Labeling:** The labeling states the *Dissolution* test used only if Test 1 is not used. ▲ (TBD)

- **USP Reference Standards (11):**
  - USP Rivaroxaban RS
  - USP Rivaroxaban Related Compound H RS

(S)-4,5-Dichloro-N-{(2-oxo-3-[4-(3-oxomorpholino)phenyl]oxazolidin-5-yl}methyl)thiophene-2-carboxamide.

\[ C_{19}H_{17}Cl_{2}N_{3}O_{5}S \quad 470.32 \]