Acceptance criteria: 95.0%–135.0%

OTHER COMPONENTS

- **ALCOHOL DETERMINATION,** *Method II* ⟨**611**⟩**:** 90.0%–110.0% of the labeled quantity of C_2H_5OH, using acetone as the internal standard

ADDITIONAL REQUIREMENTS

- **PACKAGING AND STORAGE:** Preserve in tight, light-resistant containers.
- **USP REFERENCE STANDARDS** ⟨**11**⟩
  USP Thiamine Hydrochloride RS

Thiamine Hydrochloride Tablets

DEFINITION

Thiamine Hydrochloride Tablets contain NLT 90.0% and NMT 110.0% of the labeled amount of thiamine hydrochloride ($C_{12}H_{17}ClN_4OS \cdot HCl$).

IDENTIFICATION

- **A.**
  Sample solution: Triturate a quantity of powdered Tablets, equivalent to 10 mg of thiamine hydrochloride, with 10 mL of 0.5 N sodium hydroxide, and filter.
  Analysis: To 5 mL of the *Sample solution* add 0.5 mL of potassium ferricyanide TS and 5 mL of isobutyl alcohol, shake the mixture vigorously for 2 min, and allow the liquid layers to separate. Illuminate from above by a vertical beam of UV light, and observe the air–liquid meniscus at a right angle to this beam.
  Acceptance criteria: The air–liquid meniscus shows a vivid blue fluorescence, which disappears when the mixture is slightly acidified, but reappears when it is again made alkaline.
- **B.**
  Sample solution: Triturate a quantity of powdered Tablets, equivalent to 10 mg of thiamine hydrochloride, with 10 mL of water, and filter.
  Analysis 1: To 2 mL of the *Sample solution* add iodine TS.
  Acceptance criteria 1: A red-brown precipitate is formed.
  Analysis 2: To 2 mL of the *Sample solution* add mercuric chloride TS.
  Acceptance criteria 2: A white precipitate is formed.
  Analysis 3: *Identification Tests—General* ⟨191⟩*, Chloride*
  Acceptance criteria 3: Meet the requirements
- **C.**
  Sample solution: Use the remainder of the *Sample solution* from *Identification* test *B*.
  Analysis: Add 1 mL of lead acetate TS and 1 mL of 2.5 N sodium hydroxide.
  Acceptance criteria: A yellow color is produced. Heat the mixture for several min on a steam bath: the color changes to brown, and, on standing, a precipitate of lead sulfide separates.

ASSAY

- **THIAMINE ASSAY** ⟨**531**⟩
  Assay preparation: Place NLT 20 Tablets in a flask of suitable size, half fill the flask with 0.2 N hydrochloric acid, and heat on a steam bath, with frequent agitation, until the Tablets have dissolved or have disintegrated so that a uniform dispersion is obtained. Cool, transfer the contents of the flask to a volumetric flask, and dilute with 0.2 N hydrochloric acid to volume. If the mixture is not clear, either centrifuge it or filter it through paper known not to adsorb thiamine. Dilute a portion of the clear solution with 0.2 N hydrochloric acid to obtain a 0.2 µg/mL solution of thiamine hydrochloride.
  Analysis: Proceed as directed in the chapter.
  Acceptance criteria: 90.0%–110.0%

PERFORMANCE TESTS

- **DISSOLUTION,** *Procedure for a Pooled Sample* ⟨**711**⟩
  Medium: Water; 900 mL
  Apparatus 2: 50 rpm
  Time: 45 min
  Standard solution: A known concentration of USP Thiamine Hydrochloride RS in *Medium*
  Sample solution: Filtered portion of the solution under test, suitably diluted with the *Medium* if necessary
  Mobile phase: A mixture of methanol, glacial acetic acid, and water (27:1:73) containing 1.40 mg/mL of sodium 1-hexanesulfonate
  Chromatographic system
  (See *Chromatography* ⟨621⟩*, System Suitability*.)
  Mode: LC
  Detector: UV 280 nm
  Column: 3.9-mm × 30-cm; packing L1
  Flow rate: 1 mL/min
  Injection size: 10 µL
  System suitability
  Sample: *Standard solution*
  Suitability requirements
  Relative standard deviation: NMT 3.0%
  Analysis
  Samples: *Standard solution* and *Sample solution*
  Calculate the percentage of the labeled amount of thiamine hydrochloride ($C_{12}H_{17}ClN_4OS \cdot HCl$) dissolved:

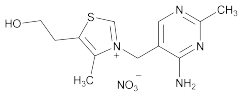
$$\text{Result} = (r_U/r_S) \times (C_S \times D \times V/L) \times 100$$

  r_U = peak area of thiamine from the *Sample solution*
  r_S = peak area of thiamine from the *Standard solution*
  C_S = concentration of USP Thiamine Hydrochloride RS in the *Standard solution* (mg/mL)
  D = dilution factor for the *Sample solution*
  V = volume of *Medium*, 900 mL
  L = labeled amount of thiamine hydrochloride (mg/Tablet)
  Tolerances: NLT 75% (Q) of the labeled amount of thiamine hydrochloride ($C_{12}H_{17}ClN_4OS \cdot HCl$) is dissolved.
- **UNIFORMITY OF DOSAGE UNITS** ⟨**905**⟩**:** Meet the requirements

ADDITIONAL REQUIREMENTS

- **PACKAGING AND STORAGE:** Preserve in tight, light-resistant containers.
- **USP REFERENCE STANDARDS** ⟨**11**⟩
  USP Thiamine Hydrochloride RS

Thiamine Mononitrate



$C_{12}H_{17}N_5O_4S$ 327.36
Thiazolium, 3-[(4-amino-2-methyl-5-pyrimidinyl)methyl]-5-(2-hydroxyethyl)-4-methyl-, nitrate (salt);
Thiamine nitrate (salt) [532-43-4].

DEFINITION

Thiamine Mononitrate contains NLT 98.0% and NMT 102.0% of thiamine mononitrate ($C_{12}H_{17}N_5O_4S$), calculated on the dried basis.

IDENTIFICATION

- **A.**
  Sample solution: 20 mg/mL of Thiamine Mononitrate
  Analysis: To 2 mL of the *Sample solution* add 2 mL of sulfuric acid. Cool, and superimpose 2 mL of ferrous sulfate TS.
  Acceptance criteria: A brown ring is produced at the junction of the two liquids.
- **B.**
  Sample: 5 mg
  Analysis: Dissolve the *Sample* in a mixture of 1 mL of lead acetate TS and 1 mL of 2.5 N sodium hydroxide. Heat for several min on a steam bath.
  Acceptance criteria: After dissolution of the *Sample*, a yellow color is produced. After heating the solution, the color changes to brown and on standing, a precipitate of lead sulfide separates.
- **C.** A solution of Thiamine Mononitrate yields a white precipitate with mercuric chloride TS, and a red-brown precipitate with iodine TS. It also yields a precipitate with mercuric–potassium iodide TS, and with trinitrophenol TS.
- **D.**
  Sample solution: Dissolve 5 mg in 5 mL of 0.5 N sodium hydroxide.
  Analysis: To the *Sample solution* add 0.5 mL of potassium ferricyanide TS and 5 mL of isobutyl alcohol. Shake the mixture vigorously for 2 min, and allow the liquid layers to separate.
  Acceptance criteria: When illuminated from above by a vertical beam of UV light and viewed at a right angle to this beam, the air–liquid meniscus shows a vivid blue fluorescence, which disappears when the mixture is slightly acidified, but reappears when it is again made alkaline.

ASSAY

- **PROCEDURE**
  Solution A: 0.005 M sodium 1-octanesulfonate in dilute glacial acetic acid (1 in 100)
  Solution B: Methanol and acetonitrile (3:2)
  Mobile phase: *Solution A* and *Solution B* (60:40)
  Internal standard solution: 2.0% (v/v) of methylbenzoate in methanol
  Standard solution: Prepare a 1-mg/mL solution of USP Thiamine Hydrochloride RS in *Mobile phase*. Transfer 20.0 mL of this solution and 5.0 mL of *Internal standard solution* to a 50-mL volumetric flask, and dilute with *Mobile phase* to volume. The *Standard solution* contains 400 µg/mL of thiamine hydrochloride.
  Sample solution: Prepare a 2-mg/mL solution of Thiamine Mononitrate in *Mobile phase*. Transfer 10.0 mL of this solution and 5.0 mL of *Internal standard solution* to a 50-mL volumetric flask, and dilute with *Mobile phase* to volume.
  Chromatographic system
  (See *Chromatography* ⟨621⟩*, System Suitability*.)
  Mode: LC
  Detector: UV 254 nm
  Column: 4-mm × 30-cm; packing L1
  Flow rate: 1 mL/min. [NOTE—The flow rate may be adjusted as needed to obtain a retention time of about 12 min for thiamine hydrochloride.]
  Injection size: 10 µL
  System suitability
  Sample: *Standard solution*
  Suitability requirements
  Resolution: NLT 4.0 between the thiamine and methylbenzoate peaks
  Tailing factor: NMT 2.0 for the thiamine peak
  Column efficiency: NLT 1500 theoretical plates for the thiamine peak
  Relative standard deviation: NMT 2.0% for the ratios of the thiamine peak area to the internal standard peak area
  Analysis
  Samples: *Standard solution* and *Sample solution*
  Calculate the percentage of thiamine mononitrate ($C_{12}H_{17}N_5O_4S$) in the portion of Thiamine Mononitrate taken:

$$\text{Result} = (R_U/R_S) \times (C_S/C_U) \times (M_{r1}/M_{r2}) \times 100$$

  R_U = internal standard ratio (peak area of thiamine/peak area of the internal standard) from the *Sample solution*
  R_S = internal standard ratio (peak area of thiamine/peak area of the internal standard) from the *Standard solution*
  C_S = concentration of USP Thiamine Hydrochloride RS in the *Standard solution* (mg/mL)
  C_U = concentration of Thiamine Mononitrate in the *Sample solution* (mg/mL)
  M_{r1} = molecular weight of thiamine mononitrate, 327.36
  M_{r2} = molecular weight of thiamine hydrochloride, 337.27
  Acceptance criteria: 98.0%–102.0% on the dried basis

IMPURITIES

- **RESIDUE ON IGNITION** ⟨**281**⟩**:** NMT 0.2%
- **CHLORIDE AND SULFATE,** *Chloride* ⟨**221**⟩
  Standard: 0.40 mL of 0.020 N hydrochloric acid
  Sample: 500 mg of Thiamine Mononitrate
  Acceptance criteria: NMT 0.06%
- **RELATED COMPOUNDS**
  Solution A, **Solution B**, and **Mobile phase:** Proceed as directed in the *Assay*.
  Sample solution: 1.0 mg/mL of Thiamine Mononitrate in *Mobile phase*
  Chromatographic system
  (See *Chromatography* ⟨621⟩*, System Suitability*.)
  Mode: LC
  Detector: UV 254 nm
  Column: 4.0-mm × 15-cm; packing L1
  Flow rate: 0.75 mL/min
  Injection size: 10 µL
  Analysis
  Sample: *Sample solution*
  Allow the *Sample solution* to elute for NLT three times the retention time of the main peak.
  Calculate the percentage of total secondary peaks in the portion of Thiamine Mononitrate taken:

$$\text{Result} = (r_U/r_T) \times 100$$

  r_U = sum of the areas of all the peaks, except that of the thiamine peak
  r_T = sum of the areas of all the peaks
  Acceptance criteria: NMT 1.0%

SPECIFIC TESTS

- **PH** ⟨**791**⟩
  Sample solution: 20-mg/mL solution
  Acceptance criteria: 6.0–7.5
- **LOSS ON DRYING** ⟨**731**⟩**:** Dry 500 mg at 105° for 2 h: it loses NMT 1.0% of its weight.

ADDITIONAL REQUIREMENTS

- **PACKAGING AND STORAGE:** Preserve in tight, light-resistant containers.

• **USP REFERENCE STANDARDS** ⟨**11**⟩
USP Thiamine Hydrochloride RS

Thiamine Mononitrate Oral Solution

DEFINITION
Thiamine Mononitrate Oral Solution contains NLT 95.0% and NMT 115.0% of the labeled amount of thiamine mononitrate ($C_{12}H_{17}N_5O_4S$).

IDENTIFICATION
• **A.**
Sample solution: Dilute a portion of Oral Solution with water to a concentration of 10 mg/mL of thiamine mononitrate.
Analysis: To 0.5 mL of the *Sample solution* add 5 mL of 0.5 N sodium hydroxide, then add 0.5 mL of potassium ferricyanide TS and 5 mL of isobutyl alcohol. Shake the mixture vigorously for 2 min, and allow the liquid layers to separate. Illuminate from above by a vertical beam of UV light and observe the air–liquid meniscus at a right angle to this beam.
Acceptance criteria: The air–liquid meniscus shows a vivid blue fluorescence, which disappears when the mixture is slightly acidified, but reappears when it is again made alkaline.
• **B.**
Sample: 5 mL of Oral Solution
Analysis: Add 2 mL of sulfuric acid to the *Sample*, cool, and superimpose 2 mL of ferrous sulfate TS.
Acceptance criteria: A brown ring is produced at the junction of the two liquids.

ASSAY
• **PROCEDURE**
Mobile phase: Methanol and 0.04 M aqueous monobasic potassium phosphate (45:55)
Internal standard solution: 100 µg/mL of methylparaben in *Mobile phase*
Standard stock solution: 500 µg/mL of USP Thiamine Hydrochloride RS in *Mobile phase*
Standard solution: Dilute a mixture of equal volumes of the *Standard stock solution* and *Internal standard solution* with *Mobile phase* to obtain a concentration of USP Thiamine Hydrochloride RS of 50 µg/mL.
Sample stock solution: Equivalent to 500 µg/mL of thiamine mononitrate in *Mobile phase* from an accurately measured volume of Oral Solution
Sample solution: Dilute a mixture of equal volumes of the *Sample stock solution* and *Internal standard solution* with *Mobile phase* to obtain a concentration of thiamine mononitrate of 50 µg/mL.
Chromatographic system
(See *Chromatography* ⟨621⟩, *System Suitability*.)
Mode: LC
Detector: UV 254 nm
Column: 3.9-mm × 30-cm; packing L1
Flow rate: 1 mL/min
Injection size: 25 µL
System suitability
Sample: *Standard solution*
[NOTE—The relative retention times for thiamine and methylparaben are about 0.35 and 1.0, respectively.]
Suitability requirements
Resolution: NLT 6.0 between the thiamine and methylparaben
Relative standard deviation: NMT 2.0%
Analysis
Samples: *Standard solution* and *Sample solution*
Calculate the percentage of the labeled amount of thiamine mononitrate ($C_{12}H_{17}N_5O_4S$) in the portion of Oral Solution taken:

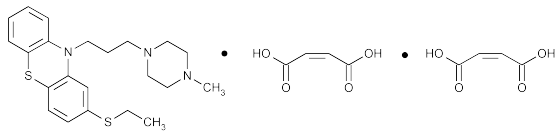
$$\text{Result} = (R_U/R_S) \times (C_S/C_U) \times (M_{r1}/M_{r2}) \times 100$$

R_U = peak area ratio of thiamine to methylparaben from the *Sample solution*
R_S = peak area ratio of thiamine to methylparaben from the *Standard solution*
C_S = concentration of USP Thiamine Hydrochloride RS in the *Standard stock solution* (µg/mL)
C_U = nominal concentration of thiamine mononitrate in the *Sample stock solution* (µg/mL)
M_{r1} = molecular weight of thiamine mononitrate, 327.36
M_{r2} = molecular weight of thiamine hydrochloride, 337.27
Acceptance criteria: 95.0%–115.0%

OTHER COMPONENTS
• **ALCOHOL DETERMINATION,** *Method II* ⟨**611**⟩**:** 90.0%–110.0% of the labeled quantity of C_2H_5OH, using acetone as the internal standard

ADDITIONAL REQUIREMENTS
• **PACKAGING AND STORAGE:** Preserve in tight, light-resistant containers.
• **USP REFERENCE STANDARDS** ⟨**11**⟩
USP Thiamine Hydrochloride RS

Thiethylperazine Maleate



$C_{22}H_{29}N_3S_2 \cdot 2C_4H_4O_4$ 631.76
10*H*-Phenothiazine, 2-(ethylthio)-10-[3-(4-methyl-1-piperazinyl)propyl]-, (*Z*)-2-butenedioate (1:2).
2-(Ethylthio)-10-[3-(4-methyl-1-piperazinyl)propyl]pheno thiazine maleate (1:2) [1179-69-7].

» Thiethylperazine Maleate contains not less than 98.0 percent and not more than 101.5 percent of $C_{22}H_{29}N_3S_2 \cdot 2C_4H_4O_4$, calculated on the dried basis.

Packaging and storage—Preserve in tight, light-resistant containers.

USP Reference standards ⟨11⟩**—**
USP Thiethylperazine Maleate RS
NOTE—Throughout the following procedures, protect test or assay specimens, the Reference Standard, and solutions containing them, by conducting the procedures without delay, under subdued light, or using low-actinic glassware.
Identification, *Infrared Absorption* ⟨197K⟩.
pH ⟨791⟩**—**Dissolve 100 mg in 100 mL of water, warming, if necessary, to effect solution: the pH of this solution is between 2.8 and 3.8.
Loss on drying ⟨731⟩**—**Dry it at 105° for 4 hours: it loses not more than 0.5% of its weight.