

**Water** Not more than 1.0% (3.0 g, volumetric titration, direct titration).

**Assay** Weigh accurately an amount of Piperacillin Sodium, equivalent to about 0.1 g (potency), and dissolve in water to make exactly 100 mL. To exactly 5 mL of this solution add exactly 5 mL of the internal standard solution, and use this solution as the sample solution. Separately, weigh accurately an amount of Piperacillin Reference Standard, equivalent to about 0.1 g (potency), and dissolve in the mobile phase to make exactly 100 mL. Pipet 5 mL of this solution, add exactly 5 mL of the internal standard solution, and use this solution as the standard solution. Perform the test with 5  $\mu$ L each of sample solution and the standard solution as directed under the Liquid Chromatography according to the following conditions, and calculate the ratios,  $Q_T$  and  $Q_S$ , of the peak height of piperacillin to that of the internal standard.

$$\begin{aligned} & \text{Amount } [\mu\text{g (potency)}] \text{ of } \text{C}_{23}\text{H}_{27}\text{N}_5\text{O}_7\text{S} \\ & = \text{amount } [\text{mg (potency)}] \text{ of Piperacillin} \\ & \text{Reference Standard} \times \frac{Q_T}{Q_S} \times 1000 \end{aligned}$$

**Internal standard solution**—A solution of acetanilide in the mobile phase (1 in 5000).

**Operating conditions**—

**Detector:** An ultraviolet absorption photometer (wavelength: 254 nm).

**Column:** A stainless steel column 4.6 mm in inside diameter and 15 cm in length, packed with octadecylsilanized silica gel for liquid chromatography (5  $\mu$ m in particle diameter).

**Column temperature:** A constant temperature of about 25°C.

**Mobile phase:** To 60.1 g of acetic acid (100) and 101.0 g of triethylamine add water to make exactly 1000 mL. To 25 mL of this solution add 25 mL of dilute acetic acid and 210 mL of acetonitrile, and add water to make exactly 1000 mL.

**Flow rate:** Adjust the flow rate so that the retention time of piperacillin is about 5 minutes.

**System suitability**—

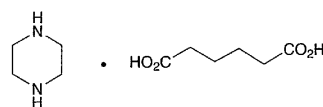
**System performance:** When the procedure is run with 5  $\mu$ L of the standard solution under the above operating conditions, the internal standard and piperacillin are eluted in this order with the resolution between these peaks being not less than 3.

**System repeatability:** When the test is repeated 6 times with 5  $\mu$ L of the standard solution under the above operating conditions, the relative standard deviation of the ratios of the peak height of piperacillin to that of the internal standard is not more than 1.0%.

**Containers and storage** Containers—Hermetic containers.

## Piperazine Adipate

アジピン酸ピペラジン



$\text{C}_4\text{H}_{10}\text{N}_2 \cdot \text{C}_6\text{H}_{10}\text{O}_4$ : 232.28

Piperazine hexanedioate [142-88-1]

Piperazine Adipate, when dried, contains not less than 98.5% of  $\text{C}_4\text{H}_{10}\text{N}_2 \cdot \text{C}_6\text{H}_{10}\text{O}_4$ .

**Description** Piperazine Adipate occurs as a white, crystalline powder. It is odorless, and has a slightly acid taste.

It is soluble in water and in acetic acid (100), and practically insoluble in ethanol (95), in acetone and in diethyl ether.

Melting point: about 250°C (with decomposition).

**Identification (1)** Dissolve 0.5 g of Piperazine Adipate in 10 mL of water, add 1 mL of hydrochloric acid, and extract with two 20-mL portions of diethyl ether. Combine the diethyl ether extracts, evaporate to dryness on a water bath, and dry the residue at 105°C for 1 hour: the melting point is between 152°C and 155°C.

(2) To 3 mL of a solution of Piperazine Adipate (1 in 100) add 3 drops of Reinecke salt TS: a light red precipitate is formed.

(3) Determine the infrared absorption spectrum of Piperazine Adipate, previously dried, as directed in the potassium bromide disk method under the Infrared Spectrophotometry, and compare the spectrum with the Reference Spectrum: both spectra exhibit similar intensities of absorption at the same wave numbers.

**pH** The pH of a solution of Piperazine Adipate (1 in 20) is between 5.0 and 6.0.

**Purity (1)** Clarity and color of solution—Dissolve 1.0 g of Piperazine Adipate in 30 mL of water: the solution is clear and colorless.

(2) Heavy metals—Proceed with 2.0 g of Piperazine Adipate according to Method 2, and perform the test. Prepare the control solution with 2.0 mL of Standard Lead Solution (not more than 10 ppm).

**Loss on drying** Not more than 0.5% (1 g, 105°C, 4 hours).

**Residue on ignition** Not more than 0.10% (1 g).

**Assay** Weigh accurately about 0.2 g of Piperazine Adipate, previously dried, dissolve in a mixture of 20 mL of acetic acid for nonaqueous titration and 40 mL of acetone for nonaqueous titration, and titrate with 0.1 mol/L perchloric acid VS until the red-purple color of the solution changes to blue-purple (indicator: 6 drops of bromocresol green-methylrosaniline chloride TS). Perform a blank determination, and make any necessary correction.

$$\begin{aligned} & \text{Each mL of 0.1 mol/L perchloric acid VS} \\ & = 11.614 \text{ mg of } \text{C}_4\text{H}_{10}\text{N}_2 \cdot \text{C}_6\text{H}_{10}\text{O}_4 \end{aligned}$$

**Containers and storage** Containers—Well-closed containers.