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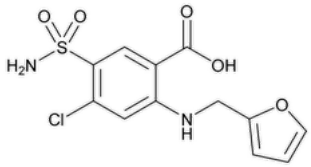
Furosemide



$C_{12}H_{11}ClN_2O_5S$ 330.74

Benzoic acid, 5-(aminosulfonyl)-4-chloro-2-[(2-furanylmethyl)amino]-;

4-Chloro-*N*-furfuryl-5-sulfamoylanthranilic acid CAS RN®: 54-31-9; UNII: 7LXU5N7ZO5.

DEFINITION

Furosemide contains NLT 98.0% and NMT 102.0 of furosemide ($C_{12}H_{11}ClN_2O_5S$), calculated on the dried basis.

IDENTIFICATION

Change to read:

• **A.** ▲**Spectroscopic Identification Tests** ⟨197⟩, *Infrared Spectroscopy*: **197K**▲ (CN 1-May-2020)

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

• **C.** The UV spectrum of the major peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the *Assay*.

ASSAY

• **Procedure**

Protect Furosemide solutions from exposure to light.

Mobile phase: Tetrahydrofuran, glacial acetic acid, and water (30:1:70)

Solution A: Acetonitrile and water (50:50)

Diluent: *Solution A* and glacial acetic acid (978:22)

System suitability solution: 20 µg/mL of USP Furosemide RS and 12 µg/mL of USP Furosemide Related Compound A RS in *Diluent*

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

Sample solution: 0.2 mg/mL of Furosemide in *Diluent*

Chromatographic system

(See *Chromatography* ⟨621⟩, *System Suitability*.)

Mode: LC

Detector: UV 272 nm. For *Identification* test *C*, use a diode-array detector in the range of 200–400 nm.

Column: 4.6-mm × 25.0-cm; 5-µm packing L1

Flow rate: 1 mL/min

Injection volume: 20 µL

System suitability

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

Suitability requirements

Resolution: NLT 1.5 between furosemide related compound A and furosemide, *System suitability solution*

Relative standard deviation: NMT 0.73%, *Standard solution*

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of furosemide ($C_{12}H_{11}ClN_2O_5S$) in the portion of Furosemide taken:

$$\text{Result} = (r_U/r_S) \times (C_S/C_U) \times 100$$

r_U = peak response from the *Sample solution*

r_S = peak response from the *Standard solution*

C_S = concentration of USP Furosemide RS in the *Standard solution* (mg/mL)

C_U = concentration of Furosemide in the *Sample solution* (mg/mL)

Acceptance criteria: 98.0%–102.0% on the dried basis

IMPURITIES

• **Residue on Ignition ⟨281⟩:** NMT 0.1%

• **Organic Impurities**

Protect Furosemide solutions from exposure to light.

Mobile phase, Solution A, Diluent, and **System suitability solution:** Proceed as directed in the *Assay*.

Standard solution: 5.0 µg/mL each of USP Furosemide Related Compound A RS and USP Furosemide Related Compound B RS in *Diluent*

Sample solution: 1.0 mg/mL of Furosemide in *Diluent*

Chromatographic system

(See *Chromatography ⟨621⟩, System Suitability*.)

Mode: LC

Detectors: 254 and 272 nm

[Note—The 2,4-dichloro-5-sulfamoylbenzoic acid impurity does not respond at 272 nm, and the 2,4-bis(furfurylamino)-5-sulfamoylbenzoic acid impurity has a very intense absorbance at 254 nm. The response for furosemide is at 254 nm.]

Column: 4.6-mm × 25-cm; packing L1

Flow rate: 1 mL/min

Injection volume: 20 µL

Run time: NLT 2.5 times the retention time of the furosemide peak

System suitability

Sample: *System suitability solution*

Suitability requirements

Resolution: NLT 2.5 between furosemide and furosemide related compound A

Relative standard deviation: NMT 2.0% for furosemide

Analysis

Samples: *Standard solution* and *Sample solution*

Acceptance criteria: The sum of the peak areas of peaks eluting before furosemide at 254 nm from the *Sample solution* is NMT the area of the furosemide related compound B peak at 254 nm from the *Standard solution* (0.5%). The sum of the peak areas of peaks eluting after furosemide at 272 nm from the *Sample solution* is NMT the area of the furosemide related compound A peak at 272 nm from the *Standard solution* (0.5%).

SPECIFIC TESTS

• **Loss on Drying ⟨731⟩**

Analysis: Dry at 105° for 3 h.

Acceptance criteria: NMT 1.0%

ADDITIONAL REQUIREMENTS

• **Packaging and Storage:** Preserve in well-closed, light-resistant containers. Store at 25°, excursions permitted between 15° and 30°.

• **USP Reference Standards ⟨11⟩**

USP Furosemide RS

USP Furosemide Related Compound A RS

2-Chloro-4-*N*-furfurylamino-5-sulfamoylbenzoic acid.

$C_{12}H_{11}ClN_2O_5S$ 330.74

USP Furosemide Related Compound B RS

4-Chloro-5-sulfamoylanthranilic acid.

$C_7H_7ClN_2O_4S$ 250.66

Auxiliary Information - Please check for your question in the FAQs before contacting USP.

Topic/Question	Contact	Expert Committee
FUROSEMIDE	Documentary Standards Support	SM22020 Small Molecules 2

Chromatographic Database Information: Chromatographic Database

Most Recently Appeared In:
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