Australian Government
Department of Industry, Science and Resources

National Measurement Institute

NATA
WORLD RECOGNISED ACCREDITATION

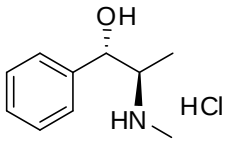
CERTIFIED REFERENCE MATERIAL CERTIFICATE OF ANALYSIS

NMIA D1089: (+)-Ephedrine hydrochloride

Report ID: D1089.2024.01

Chemical Formula: $C_{10}H_{15}NO.HCl$

Molecular Weight: 201.7 g/mol (hydrochloride), 165.2 (base)



Certified value

Batch No.	CAS No.	Purity (mass fraction of Ephedrine base)
23-D-05	24221-86-1 (HCl) 321-98-2 (free base)	99.4 ± 0.4%

The uncertainty has been calculated according to ISO Guide 35 and is stated at the 95% confidence limit (k = 2).

IUPAC name: (1S,2R)-2-(Methylamino)-1-phenyl-1-propanol hydrochloride.

Expiration of certification: The property values are valid till 19 January 2027, three years from the date of certification provided the **unopened** material is handled and stored in accordance with the recommendations below. The material as issued in the unopened container and stored as recommended below should be suitable for use beyond this date, subject to confirmation of batch stability from the issuing body. The expiry date/shelf life does not apply to sample bottles that have been opened. In such cases it is recommended that the end-user conduct their own in-house stability trials.

Description: White crystalline solid prepared by synthesis and certified for identity and purity by NMIA. Packaged in amber glass bottles with a septum and crimped aluminium cap or screw top cap.

Intended use: This certified reference material is suitable for use as a primary calibrator.

Instructions for use: Equilibrate the bottled material to room temperature before opening.

Recommended storage: When not in use this material should be stored at or below 4 ºC in a closed container in a dry, dark area.

Metrological traceability: The certified purity value is traceable to the SI unit for mass (kg) through Australian national standards via balance calibration. In the mass balance all impurities are quantified as a mass fraction and subtracted from 100%.

Stability: In the absence of long-term stability data the measurement uncertainty at the 95% coverage interval has been expanded to accommodate any potential change in the property value. The stability component has been estimated from stability trials conducted on similar materials by NMI Australia over the last ten years. The measurement uncertainty at the 95% confidence interval also includes a stability component determined from accelerated stability trials conducted at 40 ºC and 75% humidity for a 14 day period.

The long-term stability of the compound in solution has not been examined.

Homogeneity assessment: The homogeneity of the material was assessed using purity assay by GC-FID on ten randomly selected 1-2 mg sub samples of the material. The material was judged to be sufficiently homogeneous at this level of sampling as the variation in analysis results between samples was not significantly different at a 95% confidence level from that observed on repeat analysis of the same sample.

Safety: Treat as a hazardous substance. Use appropriate work practices when handling to avoid skin or eye contact, ingestion or inhalation of dust. Refer to the provided safety data sheet.

S. R. Davies

Dr Stephen R. Davies,
Team Leader,
Chemical Reference Materials, NMI.
27 February 2024
NATA Accreditation No. 198 / Corporate Site No. 14214.

Legal notice: Terms and Conditions associated with the provision of this reference material can be found on the NMIA website.

Characterisation Report:

The identity was confirmed by a range of spectroscopic techniques, NMR, IR and MS. The certified purity value was obtained by mass balance from a combination of traditional analytical techniques, including GC-FID, thermogravimetric analysis, Karl Fischer analysis, and ^{1}H NMR spectroscopy. The purity value is calculated as per Equation 1.

Purity = (100 % - I_{ORG}) x (100 % - I_{VOL} – I_{NVR}) Equation 1

I_{ORG} = Organic impurities of related structure, I_{VOL} = volatile impurities, I_{NVR} = non-volatile residue.

Supporting evidence is provided by elemental microanalysis.

GC-FID:	Instrument:	Varian CP-3800
	Column:	DB-17, 30 m × 0.32 mm I.D. × 0.25 µm
	Program:	160 °C (1 min), 5 °C/min to 190 °C (5 min), 30 °C/min to 280 °C (5 min)
	Injector:	180 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component as a combination of the *N*-acetyl and *O*,*N*-*bis*-acetyl derivatives:	
	Initial analysis:	Mean = 99.8%, s = 0.02% (10 sub samples in duplicate, January 2024)
GC-FID:	Instrument:	Varian CP-3800
	Column:	HP-5, 30 m × 0.32 mm I.D. × 0.25 µm
	Program:	160 °C (1 min), 5 °C/min to 190 °C (5 min), 30 °C/min to 280 °C (5 min)
	Injector:	180 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component as a combination of the *N*-acetyl and *O*,*N*-*bis*-acetyl derivatives:	
	Initial analysis:	Mean = 99.8%, s = 0.02% (10 sub samples in duplicate, January 2024)
Karl Fischer analysis:		Moisture content = 0.2% mass fraction (December 2023)
Thermogravimetric analysis:		Non-volatile residue < 0.2 % mass fraction (December 2023)

Spectroscopic and other characterisation data

GC-MS:	Instrument:	Agilent 8890/5977B
	Column:	HP-5MS, 30 m x 0.25 mm I.D. x 0.25 μm
	Program:	100 °C (1 min), 10 °C/min to 300 °C (10 min)
	Injector:	200 °C
	Split ratio:	20/1
	Transfer line temp:	280 °C
	Carrier:	Helium, 1.0 mL/min
	Scan range:	50-550 *m/z*

The retention time of free base, *mono*-TMS derivative and *bis*-TMS derivative are reported with the major peaks in the mass spectra. The latter are reported as mass/charge ratios and (in brackets) as a percentage relative to the base peak.

Free base (12.2 min): 147 (M^+-H_2O, 2), 146 (9), 117 (13), 105 (26), 91 (7), 77 (26), 58 (100) *m/z*

N-Acetyl (15.9 min): 189 (M^+-H_2O, 2), 146 (3), 117 (9), 105 (16), 100 (71), 91 (5), 77 (20), 58 (100) *m/z*

O,*N*-*Bis*-Acetyl (16.2 min): 207 (M-Ac+H^+, 2), 189 (3), 148 (7), 117 (16), 105 (7), 100 (100), 91 (8), 77 (9), 58 (96) *m/z*

IR:	Instrument:	Perkin-Elmer FT-IR
	Range:	4000-400 cm^{-1}, KBr
	Peaks:	3324, 2961, 2821, 2753, 2467, 1452, 1389, 1352, 1238, 1047, 991, 751, 698, 522, 448 cm^{-1}
^{1}H NMR:	Instrument:	Bruker Avance III-500
	Field strength:	500 MHz
	Solvent:	D_2O (4.79 ppm)
	Spectral data:	δ 1.18 (3H, d, *J* = 6.9 Hz), 2.82 (3H, s), 3.60 (1H, dd, *J* = 3.6, 6.9 Hz), 5.17 (1H, d, *J* = 3.6 Hz), 7.44-7.47 (3H, m), 7.50-7.53 (2H, m) ppm
		Methanol and isopropanol were each quantified at 0.1% mass fraction by ^{1}H NMR.
^{13}C NMR:	Instrument:	Bruker Avance III-400
	Field strength:	100 MHz
	Solvent:	D_2O
	Spectral data:	δ 9.7, 30.7, 59.9, 71.5, 126.1, 128.4, 128.8, 138.3 ppm
Melting point:		219-220 °C
Microanalysis:	Found:	C = 59.5%; H = 7.5%; N = 6.8% (February 2024)
	Calculated:	C = 59.6%; H = 8.0%; N = 6.9% (Calculated for $C_{10}H_{15}NO.HCl$)