Australian Government
Department of Industry, Science and Resources

National Measurement Institute

NATA
WORLD RECOGNISED ACCREDITATION

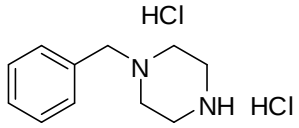
CERTIFIED REFERENCE MATERIAL CERTIFICATE OF ANALYSIS

NMIA D905: 1-Benzylpiperazine dihydrochloride

Report ID: D905.2021.02

Chemical Formula: $C_{11}H_{16}N_2.2HCl$

Molecular Weight: 249.2 g/mol (HCl), 176.3 g/mol (base)



Certified value

Batch No.	CAS No.	Purity (mass fraction)
06-D-02	5321-63-1 (HCl) 2759-28-6 (base)	95.9 ± 1.9%

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

IUPAC name: 1-Benzylpiperazine dihydrochloride

Expiration of certification: The property values are valid till 1 November 2031, i.e. ten years from the date of re-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 powder 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 25 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 approach all impurities are quantified as a mass fraction and subtracted from 100%. Quantitative NMR provides an independent direct measure of the mass fraction of the analyte of interest, calibrated with an internal standard certified for purity (mass fraction).

Stability: This material has demonstrated stability over a minimum period of five years. The measurement uncertainty at the 95% confidence interval includes a stability component which has been estimated from annual stability trials. 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.
19 September 2022

This report supersedes any issued prior to 19 September 2022.

NATA Accreditation No. 198 / Corporate Site No. 14214.

Characterisation Report:

The identity was confirmed by a range of spectroscopic techniques, NMR, IR and MS. The certified purity value was obtained from a combination of traditional analytical techniques and quantitative nuclear magnetic resonance (qNMR). The techniques used in the mass balance approach include 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

The certified purity value by qNMR was obtained using the one-proton singlet at 4.47ppm measured against a certified internal standard of dimethyl sulfone.

Supporting evidence is provided by elemental microanalysis.

GC-FID:	Instrument:	Agilent 6890N or 7890A
	Column:	HP-1ms, 30 m x 0.32 mm I.D. x 0.25 μm
	Program:	100 °C (1 min), 10 °C/min to 150 °C, 30 °C/min to 300 °C (5 min)
	Injector:	250 °C
	Detector Temp:	320 °C
	Carrier:	Helium
	Split ratio:	20/1
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 99.99%, s = 0.01% (10 sub samples in duplicate, June 2006)
	Re-analysis:	Mean = 99.65%, s = 0.093% (5 sub samples in duplicate, June 2007)
	Re-analysis:	Mean = 99.89%, s = 0.023% (5 sub samples in duplicate, February 2008)
	Re-analysis:	Mean = 99.77%, s = 0.011% (5 sub samples in duplicate, February 2009)
	Re-analysis:	Mean = 99.95%, s = 0.05% (5 sub samples in duplicate, February 2012)
	Re-analysis:	Mean = 100.0%, s = 0.003% (5 sub samples in duplicate, February 2017)
	Re-analysis:	Mean = 99.96%, s = 0.009% (5 sub samples in duplicate, November 2021)
Karl Fischer analysis:		Moisture content. 3.6% mass fraction (2006, 2008, 2009 and 2012) Moisture content 3.8% mass fraction (June 2013 & November 2016) Moisture content 3.9% mass fraction (October 2021)
Thermogravimetric analysis:		Volatile content 3.4% mass fraction (2006) Volatile content 3.3% mass fraction (June 2007) Volatile content 3.8% mass fraction (February 2009) Theoretical water content for the hemihydrate is 3.5% mass fraction Non volatile residue was not determined
QNMR:	Instrument:	Bruker Avance-III-500
	Field strength:	500 MHz
	Solvent:	D_2O (4.79 ppm)
	Internal standard:	Dimethyl sulfone (100.0% mass fraction)
	Initial analysis:	Mean (4.47 ppm) = 95.5%, s = 0.1% (4 sub samples, October 2006)

Spectroscopic and other characterisation data

GC-MS:	Instrument:	HP 6890/5973
	Column:	ZB-5, 28 m × 0.25 mm I.D. × 0.25 μm
	Program:	60 °C (1 min), 10 °C/min to 300 °C, (1 min)
	Injector:	250 °C
	Transfer line temp:	280 °C
	Carrier:	Helium, 1.0 mL/min
	Split ratio:	20/1
	The retention time of the free base is reported along with the major peaks in the mass spectrum. The latter are reported as mass /charge ratios and (in brackets) as a percentage relative to the base peak	
	Free base (10.8 min):	176 (M^+, 19), 134 (66), 91 (100), 65 (12), 56 (20) *m/z*
TLC:	Conditions:	Kieselgel 60F_{254}. Dichloromethane/methanol/conc. ammonia (90/10/0.6) Single spot observed, R_f = 0.3. Visualisation with potassium permanganate
IR:	Instrument:	Biorad FTS300MX FT-IR
	Range:	4000-400 cm^{-1}, KBr powder
	Peaks:	3449, 3128, 2905, 2764, 2519, 1631, 1556, 1421, 1301, 1072, 953, 877, 747, 701 cm^{-1}
^{1}H NMR:	Instrument:	Bruker DMX500
	Field strength:	500 MHz
	Solvent:	MeOH-d_4 (3.31 ppm)
	Spectral data:	δ 3.68 (8H, bs), 4.56 (2H, s), 7.54-7.56 (3H, m), 7.68-7.70 (2H, m) ppm
^{13}C NMR:	Instrument:	Bruker DMX500
	Field strength:	125 MHz
	Solvent:	MeOH-d_4 (49 ppm)
	Spectral data:	δ 41.9, 49.1, 61.6, 129.4, 130.5, 131.6, 132.7 ppm
Melting point:		Not determined due to decomposition
Microanalysis:	Found:	C = 51.3 %, H = 7.2 %; N = 10.9% (March 2006)
	Calculated:	C = 51.2 %, H = 7.4 %; N = 10.9% (Calculated for the hemihydrate)