



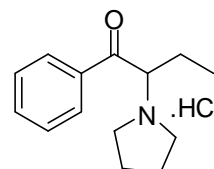
CERTIFIED REFERENCE MATERIAL CERTIFICATE OF ANALYSIS

NMIA D1012: 1-Phenyl-2-(1-pyrrolidinyl)-1-butanone hydrochloride

Report ID: D1012.2022.01

Chemical Formula: $C_{14}H_{19}NO \cdot HCl$

Molecular Weight: 253.8 g/mol (HCl), 217.3 g/mol (base)



Certified value

Batch No.	CAS No.	Purity (mass fraction)
14-D-04	13415-54-8 (HCl) 13415-82-2 (base)	99.5 ± 0.3%

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

IUPAC name: 1-Phenyl-2-(1-pyrrolidinyl)-1-butanone hydrochloride (1:1).

Expiration of certification: The property values are valid till 20 December 2027, i.e. five 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: Off-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 °C 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%.

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 HPLC with UV detection on seven 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.
23 December 2022

This report supersedes any issued prior to 23 December 2022.

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 HPLC with UV detection, thermogravimetric analysis, Karl Fischer analysis and ¹H NMR spectroscopy. The purity value is calculated as per Equation 1.

$$\text{Purity} = (100 \% - I_{\text{ORG}}) \times (100 \% - I_{\text{VOL}} - I_{\text{NVR}})$$

Equation 1

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

Supporting evidence is provided by qualitative headspace GC-MS analysis of occluded solvents and elemental microanalysis.

HPLC:	Instrument:	Shimadzu Binary pump LC-20AB, SIL-20A HT autosampler OR Waters Binary pump 1525, 717 autosampler OR Thermo Scientific Ultimate 3000 RS Pump, RS autosampler
	Column:	X-Bridge C-18, 5.0 μm (4.6 mm x 150 mm)
	Column oven:	Ambient
	Mobile Phase:	A: MilliQ water buffered at pH 10.8 using 20mM NH_4OAc and NH_4OH , B: Acetonitrile
	Gradient:	0-14 min, 50% B; 14-15 min, 50%-80% B; 15-19 min, 80% B; 19-20 min, 80%-50% B; 20-25 min, 50% B.
	Flow rate:	1.0 mL/min
	Detector:	Shimadzu SPD-M20A PDA OR Waters 2998 PDA OR RS Diode Array operating at 242 nm
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 99.7%, s = 0.02% (5 sub samples in duplicate, March 2016)
	Re-analysis:	Mean = 99.9%, s = 0.03% (5 sub samples in duplicate, April 2017)
	Re-analysis:	Mean = 99.9%, s = 0.00% (7 sub samples in duplicate, December 2022)
HPLC:	Instrument:	Shimadzu Binary pump LC-20AB, SIL-20A HT autosampler
	Column:	X-Bridge C-18, 5.0 μm (4.6 mm x 150 mm)
	Column oven:	40 $^{\circ}\text{C}$
	Mobile Phase:	Acetonitrile/MilliQ water (40:60), the aqueous phase was buffered at pH 10.8 using 20mM NH_4OAc and NH_4OH
	Flow rate:	1.5 mL/min
	Detector:	Shimadzu SPD-M20A PDA operating at 225 nm
	Relative mass fraction of the main component:	
	Initial analysis:	Mean = 99.9%, s = 0.004% (7 sub samples in duplicate, March 2014)
	Re-analysis:	Mean = 99.9%, s = 0.004% (5 sub samples in duplicate, March 2015)
Karl Fischer analysis:	Moisture content 0.2% mass fraction (February 2014 and March 2015) Moisture content 0.1% mass fraction (March 2016, April 2017 and December 2022)	
Thermogravimetric analysis:	Non-volatile residue < 0.2% mass fraction (March 2014). The volatile content (e.g. organic solvents and/or water) could not be determined because of the inherent volatility of the material and/or degradation at elevated temperatures.	

Spectroscopic and other characterisation data

GC-MS:	Free base:	
	Instrument:	Agilent 6890/5973
	Column:	TG-MS, 30 m x 0.25 mm I.D. x 0.25 µm
	Program:	100 °C (1 min), 5 °C/min to 120 °C (2 min), 20 °C/min to 300 °C (3 min)
	Injector:	200 °C
	Carrier:	Helium, 1.0 mL/min
		Transfer line temp: 300 °C
		Split ratio: 20/1
	The retention time of the free base is 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 (10.9 min): 215 (4), 188 (6), 112 (100), 105 (29), 77 (50), 55 (26), 41 (26) <i>m/z</i>	
ESI-MS:	Instrument:	Micromass Quatro LC Micro
	Operation:	Positive ion mode, direct infusion at 10 µL/min
	Ionisation:	ESI spray voltage at 3.5 kV positive ion
	EM voltage:	650 V
	Cone voltage:	20 V
	Peak:	218.2 (M+H ⁺) <i>m/z</i>
HS-GC-MS:	Instrument:	Agilent 6890/5973/G1888
	Column:	DB-624, 30 m x 0.25 mm I.D. x 1.4 µm
	Program:	50 °C (5 min), 7 °C/min to 120 °C, 15 °C/min to 220 °C (8.3 min)
	Injector:	150 °C
	Transfer line temp:	280 °C
	Carrier:	Helium, 1.2 mL/min
	Split ratio:	50/1
	Solvents detected:	Diethyl ether
TLC:	Conditions:	Kieselgel 60F ₂₅₄ . Methanol/ammonia (200:3)
		Single spot observed, R _f = 0.64
IR:	Instrument:	Biorad FTS3000MX FT-IR
	Range:	4000-400 cm ⁻¹ , KBr powder
	Peaks:	3480, 2932, 2803, 2619, 2462, 1685, 1598, 1450, 1390, 1353, 1229, 1139, 1078, 1031, 967, 776, 708, 588, 421 cm ⁻¹
¹ H NMR:	Instrument:	Bruker Avance III-600
	Field strength:	600 MHz
	Solvent:	DMSO- <i>d</i> ₆ (2.50 ppm)
	Spectral data:	δ 0.77 (3H, t, <i>J</i> = 7.6 Hz), 1.90-2.01 (4H, m), 1.97 (1H, m), 2.04 (1H, m), 3.08 (1H, m), 3.26 (1H, m), 3.52 (1H, m), 3.61 (1H, m), 5.64 (1H, m), 7.62 (2H, t, <i>J</i> = 7.9 Hz), 7.76 (1H, t, <i>J</i> = 7.4 Hz), 8.08 (2H, d, <i>J</i> = 7.2 Hz), 10.70 (1H, s) ppm
	Ethanol estimated at 0.2% mass fraction was observed in the ¹ H NMR	
¹³ C NMR:	Instrument:	Bruker Avance III-600
	Field strength:	150 MHz
	Solvent:	DMSO- <i>d</i> ₆ (39.5 ppm)
	Spectral data:	δ 8.5, 22.88, 22.93, 22.95, 51.8, 53.8, 68.6, 128.8, 129.2, 134.4, 134.9, 196.4 ppm
Melting point:	200-201 °C	
Microanalysis:	Found:	C = 65.6%; H = 7.9%; N = 5.4%; Cl% = 13.9% (March, 2014)
	Calculated:	C = 66.3%; H = 7.9%; N = 5.5%; Cl% = 14.0% (Calculated for C ₁₄ H ₁₉ NO.HCl)